BIOMEDICAL INNOVATIONS

SHAPING THE FUTURE OF THERAPY

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PREFACE

This volume brings together a collection of scholarly contributions that explore important developments in biomedical sciences, therapeutic research, and contemporary healthcare. As global health systems continue to face complex challenges, interdisciplinary approaches that combine pharmacology, nutrition science, and rehabilitation medicine are becoming increasingly essential.

The chapters in this book address key themes related to disease management, preventive health, and patient care. The discussion on antibiotic resistance examines one of the most urgent threats to modern medicine, highlighting molecular mechanisms and pharmacological strategies for intervention. The review of cantaloupe peel emphasizes the growing importance of nutritional resources and bioactive compounds in health promotion and therapeutic applications. In addition, the chapter on geriatric rehabilitation underlines the significance of functional recovery, quality of life, and specialized care for aging populations.

By adopting an interdisciplinary perspective, this volume integrates insights from biomedical sciences, clinical medicine, nutrition, and rehabilitation studies. It contributes to academic discourse while also offering practical implications for healthcare professionals, researchers, and policymakers seeking innovative approaches to human health and wellbeing.

It is hoped that this book will serve as a valuable resource for scholars, practitioners, and students interested in medical sciences and therapeutic innovation, while encouraging further research on sustainable and patient-centered healthcare solutions.

Editorial Team
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CHAPTER 1
ANTIBIOTIC RESISTANCE: MOLECULAR MECHANISMS, CLINICAL BURDEN, AND PHARMACOLOGICAL COUNTERSTRATEGIES

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INTRODUCTION

Antibiotics have revolutionized modern medicine since the discovery of penicillin in 1928. They have significantly decreased mortality from infectious diseases and made complicated medical procedures like organ transplantation and cancer chemotherapy possible. However, the growing problem of Antimicrobial resistance (AMR) around the world, which is primarily due to misuse and overuse of antibiotics, is threatening all these achievements. The median prevalence of methicillin-resistant Staphylococcus aureus (MRSA) and Escherichia coli resistant to third-generation cephalosporins have been reported at 35% and 42%, respectively, by World Health Organization's Global Antimicrobial Resistance and use Surveillance system (GLASS) reflecting the reduced effectiveness of even first line antibiotics. Currently, the WHO ranks AMR among the top concerns for public health in the twenty-first century (Ma et al., 2026).

Given that antibiotic resistance compromises the effectiveness of antibiotics, which have been responsible for the remarkable advances in treating infection in the past decades; it has become one of the major biological challenges confronting medicine today. It has become apparent that the advent of antibiotic-resistant infections has altered the course of practice in all areas, ranging from intensive care medicine to oncology, surgery, transplantation medicine, and neonatology. Resistance is recognized not only as an ecological and evolutionary phenomenon in community and healthcare associated infections globally but also as a separate microbiological challenge in the past periods, which primarily occurred in hospital settings. The global spread of transmission routes, rapid bacterial evolution, antibiotic selection pressures, and poor antimicrobial discovery are some of the causes behind the present concern (Murray et al., 2022).

The most complete assessment done on the global burden reveals that bacterial antimicrobial resistance was one of the key contributors to death through infections in the world in 2019 with the direct deaths standing at 1.27 million and the contribution of 4.95 million deaths globally. The above statistics are very important because they help convert the possibility of antibiotics being resistance as an important cause of death in the world into reality.

Local studies have also revealed that developing nations suffer much more since they lack infection control measures among others (Tomislavet al., 2023).

Adaptation in bacteria occurs through multiple parallel pathways at the molecular level rather than via a single pathway of resistance, and that is perhaps one of the major factors making antibiotic resistance difficult to manage. In the case of a single strain, the resistance mechanisms often converge, giving additive or synergic benefits to survival. Resistant clones, as discovered by genome monitoring, turn out to be very adaptable life forms having high levels of fitness, transmissibility, and ecologic stability as well as being simply carriers of genes for resistance. Resistance genes are now becoming more common in genomic platforms along with other features such as virulence and stress adaptation (Shepherd et al., 2024).

Discovery of antibiotics has greatly slowed as well. Few novel antibiotic classes have been employed in medicine since the end of the twentieth century. In fact, most approved drugs are derivatives of existing scaffolds, which are easily countered by resistance genes that can either already exist or are rapidly developed. Such disparity in research on pharmaceuticals and bacterial adaptation resulted in an increasing trend for researching alternative treatment methods such as immune modulation, bacteriophages, resistance enzyme inhibitors, virulence factor inhibitors, and genome editing (MacNair et al., 2023).

Overprescription of antibiotics has traditionally been considered one of the major selective pressures that drive resistance, particularly in clinical and agricultural contexts. However, with advances in research, the more elusive and complex “resistome,” namely, the natural environmentis increasingly recognized as a crucial element in understanding the full mechanism of antibiotic resistance genes (ARGs) evolution and transmission. Apart from serving as “sinks” of antibiotics, antibiotic resistant bacteria (ARB) and antibiotic resistant genes (ARGs) in agriculture and medicine, environmental matrices such as soils, aquatic environments, and sediments are vital for serving as sources of ARGs evolution via horizontal gene transfer (HGT) and ecological distribution.

This shift in perception reflects the fact that studies about antibiotic resistance have evolved from solely concentrating on their prevention and containment in a clinical context to an era of total "One Health" approach that necessitates consideration of environmental, animal, and human health (Chen et al., 2026).

Resistance to antimicrobials adds another challenge because there are numerous scientific, financial, and regulatory barriers when developing new medicines. Because of relatively lower profits and significant investments, the pharmaceutical industry has been increasingly withdrawing from the creation of new antibiotics. It is estimated that developing and selling a novel antibiotics takes around 10-15 years and costs roughly one billion dollars. Innovation in the pharmaceutical sector is greatly hampered by the complex regulations and safety requirements as well as the absence of incentives. Moreover, the emergence of antibiotic resistance mechanisms is quick, thus rendering any developed drug less efficient economically (Pierce et al., 2021). In scientific terms, discovering novel antimicrobial substances is not an easy task, owing to the complexity associated with the adaptability of bacteria and increasing complexity of their resistance systems. These calls for the need the need of more advanced technologies, such as the use of drug designing software, metagenimics, and multi-disciplinary approach involving microbiology, genetics, and computing technology (Elshobary et al., 2025).

1. MOLECULAR MECHANISMS OF ANTIBIOTIC RESISTANCE

It is not surprising that, after many years of evolution, bacteria have become highly efficient in the development of defense mechanisms against antimicrobials that could kill them. It is also interesting to note that one bacterial cell can employ multiple defense mechanisms to counteract an antimicrobial agent, and the ability to resist a specific class of antimicrobial drugs can be achieved through more than one biochemical pathway.

As an example, there are three possible mechanisms for resistance to fluoroquinolones that may occur simultaneously in the same bacterium (causing an additive effect and, most likely, causing increased resistance), including (i)mutation in the DNA gyrase and topoisomerase IV enzymes responsible for the drug action; (ii) overproduction of efflux pumps responsible for the drug removal from the cell; and (iii) protein binding to the fluoroquinolone target site (Almatroudi et al., 2025)

Knowledge of how bacteria develop resistance towards antibiotics has become imperative in addressing this problem, especially in the current era marked by increased AMR. For bacteria to thrive under the influence of the antibiotics, they have to inhibit the processes involved in the effectiveness of the antimicrobial drug. Bacteria develop resistance to antibiotics by six major mechanisms. These include the;

- Enzymatic antibiotic inactivation
- Alteration of antibiotics target
- Reduced permeability and outer membrane barrier adaptation
- Efflux pump systems
- Biofilm-mediated resistance
- Horizontal gene transfer (Wubetuet al., 2024)

1.1 Enzymatic Antibiotic Inactivation

Enzymatic degradation of the antimicrobial compound is the most efficient method of bacterial resistance because it neutralizes antibiotics directly before it can interact with its intracellular target site. This occurs when bacterial enzymes metabolizes the drug by either modifying chemical groups essential for the function of the antimicrobial or breaking down its molecular structure. Many of the genes coding for this resistance are located on plasmids and often coexist with other genes that cause the expression of resistance through other means. This makes enzymatic resistance clinically relevant because of its ease of transmission (Darby et al., 2022).

1.1.1 B-Lactamase Mediated Hydrolysis

The β-lactamases cleave the β-lactam ring of penecillins and cephalosporins by using two different approaches that includes either the serine molecule in the active site or activation of water molecules by Zn2+. The serine β-lactamases and metallo- β-lactamases can be distinguished according to their amino acid sequence, substrate specificity, and inhibitor sensitivity. There are different classification schemes for β-lactamases. There are basically four main groups of enzymes, all of which were obtained from analysis of more than 200 β-lactamases. Group 1, 2, and 4 are serine β-lactamases, while group 3 contains metallo- β-lactamases. Group 1 refers to cephalosporins which are resistant to inhibition by the β-lactamases inhibitor clavulanic acid; Group 2 refers to penicillinases which are susceptible to inhibition by clavulanic acid and also includes extended spectrum β-lactamases; while Group 4 refers to lactamases which are neither group 1 nor group 2 and also resistant to inhibition by clavulanic acid. Like serine proteinases and esterases, the serine- β-lactamases act through the mechanism of covalent catalysis through a ring opening nucleophilic attack by active site serine on the lactam ring. Covalent catalysis of this kind results in formation of an enzyme intermediate that is subsequently hydrolyzed. This is analogous to the mechanism of action of β-lactams on the extracellular bacterial peptidoglycan transpeptidases which are targets for the antibiotics, since it involves covalent modification of an active site.Metallo- β-lactamases are members of the larger group of Zn dependent hydrolases, and while they used to be regarded as clinically insignificant proteins, they now play an important role in the development of carbapenem resistance among Gram-negative pathogens (Muller et al., 2022).

1.1.2 Aminoglycoside Modifying Enzymes

Instead of direct breakdown, aminoglycoside resistance often occurs from enzymatic modification. The enzymatic modification of the antibiotic involves modification of either the hydroxyl group or the amino group of the aminoglycoside structure, making it less likely to bind with the ribosomes and hence not interfering with protein synthesis.

Three main groups of enzymes responsible for this reaction are the aminoglycoside nucleotidyltransferase (ANT), aminoglycoside acetyltransferase (AAC), and the aminoglycoside phosphotransferase (APH). A unique chemical group acetyl, phosphate, or adenyl moieties is transferred to particular locations on the aminoglycoside scaffold by each family (Thacharodi et al., 2022).

Since one bacterium can express more than one aminoglycoside modifying enzymes at the same time leading to extensive resistance to gentamcin, tobramycin, amikacin, and other such drugs, this modification is clinically relevant. The aminoglyciside 6–N-acetyltransferase type 1b (AAC6′-1b) and aminoglycoside 3′ phosphotransferase (APH3′) genes are very common among multidrug resistant Gram negative bacteria in accordance with several hospital studies carried out recently, where aminoglycosides are still extensively used. Combination therapy fails when a β-lactamase along with an aminoglycoside modifying enzyme exists simultaneously (Malik et al., 2024).

1.1.3 Chloramphenicol Acetyltransferases and Related Enzymes

Acetyltransferases that shuttleacetyl moieties to the hydroxyl groups in the drug and interfere with its binding to the ribosome are often the reason for choramphenicol resistance. Even though the use of chloramphenicol has diminished in many instances, the prevalence of acetyltransferase genes is still clinically relevant, since these genetics elements are commonly part of the mobile elements along with resistance markers for other antibiotics. Lincosamides and some streptogramins possess the same mechanism of action based on drug acetylation (Hasan et al., 2020).

1.1.4 Fosfomycin and Rifamycin Inactivation

Glutathione transferases such as fosfomycin A (FosA) that facilitate the nucleophilic attack needed to open the epoxide ring to block UDP-N-acetylglucosamineenolpyruvyl transferase (MurA) enzymes contributing to fosfomycin resistance, are also becoming increasingly relevant.

Plasmid mediated fosfomycin genes have gained increased attention owing to the re-emergence of fosfomycin as an important therapeutic alternative against multi drug resistant urogenital and systemic infections. Adenosine diphosphate (ADP) ribosyltransferases, enzymes capable of modifying rifampin by blocking its binding to RNA polymerase, could also be responsible for rifamycin resistance. However, target mutations on the chromosome continue to prevail for rifamycin resistance despite enzymatic modification gaining recognition (El-Khoury et al., 2022).

1.2 Alteration of Antibiotics Target

Through structural modification at the point of binding of the antimicrobial compound, bacteria can become resistant to antibiotics by modifying drug targets. The bacteria modify the target protein to reduce binding while ensuring that the physiological activity of the cell remains intact rather than completely removing the antibiotic molecule from the body. This strategy becomes especially problematic because small alteration in amino acids, methylation reactions, or even obtaining new target proteins could make the bacteria resistant against the antibiotic without any significant energy being used. Target modification interferes with the drug microorganism pharmacodynamic process and it is considered highly adaptive and efficient according to modern molecular findings.On the other hand, target modification alters the interface in suach a way that antibiotic loses the capacity to bind adequately and inhibit bacterial growth or kill the bacterium. Almost all known classes of antibiotics, from β-lactams, glycopepetides, macrolides, aminoglycosides, fluoroquinolones, rifamycins, tetracyclines, to new generations of synthetic antibiotics, exhibit resistance due to target modification, as per recent molecular studies (Wilson et al., 2020).

1.2.1 Target Alteration Molecular Basis

Macromolecules in bacteria that have high conservation within the functions of cell wall biosynthesis, protein synthesis, DNA replication, RNA transcription, and metabolism are the targets for antibiotics.

Resistance occurs if there are significant changes in these targets due to mutations, acquition of genes, and enzymes modifications without loss of biological activity and reduction in the binding capacity of drugs.

The main molecular mechanisms for the target alteration include:

- Mutations in the chromosomal genes coding the target protein of the antibiotic
- Horizontal gene transfer for acquiring different target proteins
- Modification of the target molecule, especially methylation of ribosomal RNA

Resistance development occurs through the continuous application of antibiotic pressure, which may accumulate slowly leading to low level-resistance, eventually resulting in high level resistance (Naveed at el., 2020).

1.3 Reduced Permeability and Outer Membrane Barrier Adaptation

Because most antibiotic molecules have to cross the outer membrane in order to access their intracellular targets, decreased permeability is one of the key strategies used by gram negative bacteria to combat such drugs either by innate or acquired means. The outer membrane of gram negative bacteria acts as an engineered permeability barrier that allows nutrient uptake while preventing noxious molecules from crossing the membrane. The rate of antibiotic entry is severely hindered, the intracellular concentration of the drug falls below the threshold for inhibition, and resistance emerges despite the lack of hydrolysis or alterations in the drug target because bacteria alter this membrane structure. Decreased permeability is a common cause of multidrug resistance observed in clinically relevant strains of bacteria such as Escherichia coli, Klebsiellapneumonia, Pseudomonas aeruginosa,and Acinetobacter baumannii (Maher et al., 2023).

1.3.1 Key Mechanism Behind Reduced Antibiotic Permeability: Porin Deficiency

Water filled pores in transmembrane proteins known as porinsfacilitatae the passive transport of various antibiotics and small hydrophilic molecules.

The efficiency of β-lactams, quinolones, tetracyclines, and certain amonoglycosides transport into the periplasmic space is regulated by these proteins. Resistance in bacteria is often developed by reducing the expression of porin proteins, deactivating porin genes, and modifying the structure to decrease pore size. When the pore size shrinks, the diffusion rate becomes very slow. For example, since carbapenems require porins for their uptake, the deletion of outer membrane porins (OmpK35 and ompK36) is highly correlated with carbapenem resistance in Klebsiella pneumonia. Porin deficiency alone can cause an enormous increase in minimum inhibitory concentration (MIC) values even when the carbapenemase enzyme level is not high. Porin deficiency often results in the transition from borderline sensitivity to significant resistance when combined with β-lactamase production, as observed in molecular studies (Prajapati et al., 2021).

1.4 Efflux Pump Systems

The most important mechanism of active resistance that reduces the concentration of antibiotics within the bacterial cell below the inhibitory concentration is the efflux pump system. Resistance caused by efflux involves specific membrane-bound transporters that pump out antimicrobial agents from the bacterial cell utilizing energy from metabolism, unlike other forms of resistance involving enzymatic degradation or modification of targets as represented in figure 1. Both Gram-positive and Gram-negative bacteria possess this machinery, and, due to the ability of efflux pumps to recognize compounds of diverse structures, these systems play an important role in multidrug resistance. Due to their potential to provide temporary survival and mutation, efflux pumps often act as key regulatory elements involved in adaptive response, pathogenicity, and development of resistance, according to recent molecular studies (Manoj et al., 2022).

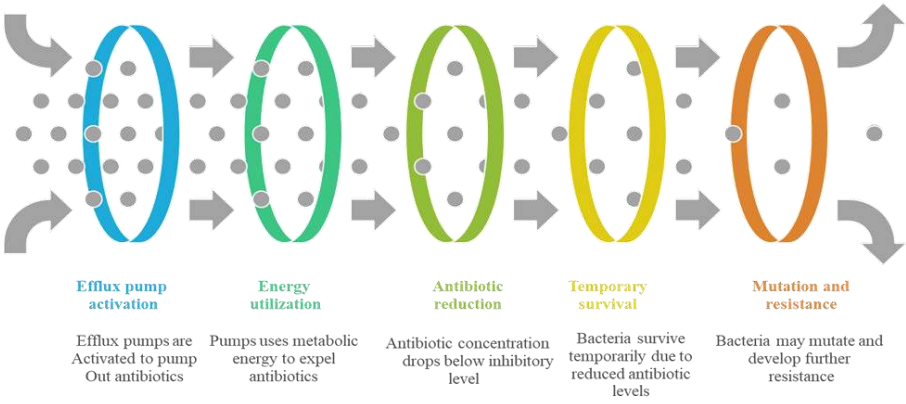

Figure 1. Efflux pump resistance mechanism

1.5 Biofilm Mediated Antibiotic Resistance

Among the complex mechanisms evolved by microorganisms for survival purposes, the biofilm based method of antimicrobial resistance involves genetic, physiological, and structural alterations that reduce antimicrobial sensitivity. Biofilm refers to an intricate group of microorganisms embedded within an extracellular polymeric substance (EPS) matrix attached to surfaces. The microorganisms within biofilms possess distinct properties compared to those within planktonic forms, which include lower replication rates, variations in gene expression, and elevated stress tolerance levels. Most importantly, the bacteria living within biofilms play a role in chronic and persistent infections by surviving antibiotic treatment at levels 10-1,000 times greater than those lethal to planktonic forms (Liu et al., 2024).

1.5.1 Structural Complexity of Biofilms

Using modern imaging techniques such as confocal laser scanning microscopy and cryo-electron tomography, it is now evident that biofilms are sophisticated structures which are highly organized and dynamic in nature, having:

- Water channels functioning as a primitive circulatory system
- Microcolonies within the EPS
- Distinct micro-environments with different metabolic areas.

The EPS matrix is often composed of 90% of the whole biofilm mass. In addition to being a structural and functional barrier, it plays a role of: exopolysaccharides (e.g., alginate produced by Pseudomonas aeruginosa); Extracellular DNA (eDNA); lipids; membrane vesicles; and various proteins (adhesions and amyloids). Recent studies suggest the role of eDNA as an architectural component, reinforcing structure, and reducing mobility of biofilms and antibiotic diffusion by its binding with cations (Dincer et al., 2020).

1.5.2 Physiological Heterogeneity and Metabolic Zonation

As a consequence of the nutrient and oxygen gradients, biofilms exhibit physiological heterogeneity as follows:

- Outer layer: rich in oxygen and active metabolically
- ntermediate layer: nutrient-poor
- Core region: metabolically inactive and hypoxic/anaerobic

Given that many antibiotics require an active metabolism which is critical for the effectiveness of some drugs as β-lactams rely on cell wall synthesis. The metabolism must be active for aminoglycosides to act, whereas fluoroquinolones affect DNA replication. Antibiotic resistance among deep layers of bacteria results from low metabolic activity rather than genetic changes. It has been shown in transcriptome analysis studies that biofilm bacteria are engaged in stress response mechanisms, like activation of stringent response and toxin-antitoxin systems which further increases tolerance (Obando & Serra, 2024).

1.6 Horizontal Gene Transfer

Among the key mechanisms responsible for the fast emergence and rapid dissemination of antibiotic resistance is the horizontal gene transfer (HGT). In distinction from vertical gene transfer, where genetic material is inherited from generation to generation via replication, HGT gives bacteria an opportunity to acquire genetic materials from other living things, usually those not belonging even to the same genus as the recipient, and it make adaptation significantly faster.

As HGT provides bacteria with the chance to acquire genes for complex resistance determinants quickly rather than wait while mutations accumulate gradually in their chromosomes, it transforms the process of bacterial evolution drastically. The use of mobile genetic elements which act as carriers of genetic material such as plasmids, transposons, integrons, and bacteriophages is an important component of horizontal gene transfer (HGT). Bacteria that take up the elements will become resistant to many different kinds of antibiotics all at once because mobile genetic elements often contain many antibiotic resistance genes (ARGs) located next to each other. Extensively drug resistant and multidrug resistant bacteria pose a serious threat to the global health system, and this is due to this process. Importantly, most of these mobile elements are capable of self transmission and multiplication, enabling them to propagate on their own both among bacterial communities and between ecological environments as described in figure 2 (Wang et al., 2023).

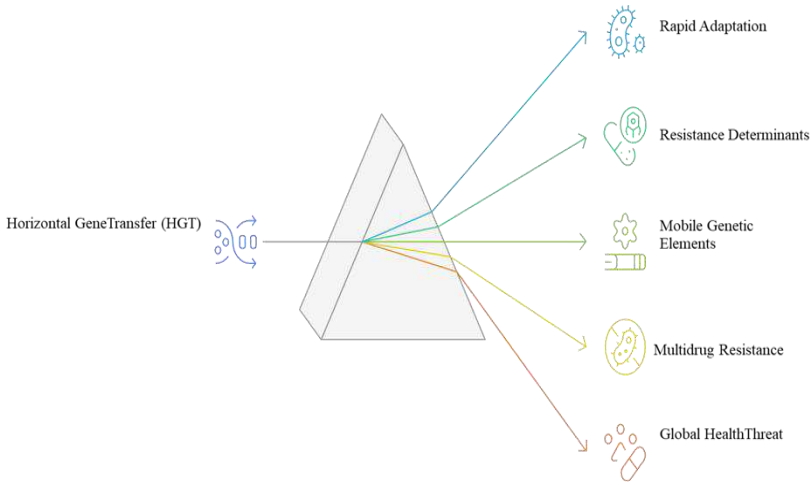

Figure 2. Unveiling the Multifaceted Impact of Horizontal gene transfer

HGT occurs in diverse and interconnected ecosystems, including soil, water systems, microbes found in animals, and even those that make up the human microbiome. The concept of the "global resistome," where environmental bacteria function as repositories of resistance genes that can be recruited by pathogenic organisms, has emerged from this broad dispersal of HGT across the environment.

Anthropogenic factors, such as excessive use of antibiotics, agricultural processes, water pollution, and non-antibiotic contaminants, contribute to the issue by creating conditions of selection for gene transfer and persistence. It is worth noting that it has been proven that sub-inhibitory concentrations of antibiotics actively facilitate horizontal gene transfer through increased conjugation and gene expression related to DNA uptake and recombination (Sun et al., 2023).

3. CLINICAL BURDEN

Resistance against antibiotics and the perceived massive implications for mankind constitute the latest fear gripping our world. Over the past decade, antibiotic resistance has become an issue of great concern not only within the scientific community but also in the media, giving rise to a series of alarmed reports regarding future failure to cure people, leading to additional annual deaths of up to 10 million by 2050.The question then arises as to whether all these alarming claims represent reality or whether there is an urgent need to discover new antibiotics to maintain their effectiveness in the treatment of infectious diseases. Resistance to antibiotics is another significant factor contributing to morbidity, aside from mortality. It is associated with prolonged sickness, a slow process of healing, and an increased risk of developing complications. Examples of vulnerable populations include newborns, older individuals, and individuals with a weak immune system (Dim et al., 2025).

3.1 Global Health Impact

The efficiency of current medical treatment is highly compromised by antibiotic resistance (AR), an issue that has become a major public health crisis at a global level. Resistance to antimicrobials is estimated to have caused almost 1.27 million deaths around the world in 2019, with close to 5 million associated deaths resulting from resistant infections, as indicated in a systematic review that appeared in the journal, The Lancet. However, the impact continues to grow, as shown in subsequent systematic reviews, particularly in lower and middle-income countries where antimicrobial stewardships programs and healthcare infrastructure are frequently lacking (Zhang et al., 2022).

Resistance to antibiotics can be found all around the globe. Because of the low standards of infection control measures, late diagnoses, and limited availability of medicines that are potent enough, certain parts of the globe, including South Asia and Sub-Saharan Africa, have shown higher mortality rates. Additionally, due to high fatality rates and lack of therapeutic options, the WHO has classified these bacteria klebsiella pneumonia, carbapenem resistant Acinetobacter baumannii along with others, as priority pathogens for antibiotic resistance. The list of priority antibiotic-resistant bacteria was developed by WHO members in 2016 due to global concerns about the development of new drugs. This list would be used to facilitate the development of new potent drugs. The United Nations report in 2016 on the high-level panel on the global health crises and their responses, highlighting the danger posed to humans by some under-researched antibiotic-resistant bacteria requiring urgent research, was also heeded.The aim of the WHO priority list is to provide funding and facilitate coordination between different nations in the research and development of strategies aimed at discovering new active components that can be used against bacteria resistant to antibiotics, which not only resist treatment but also lead to acute infections and multidrug-resistant tuberculosis. The priority list is meant to benefit universities and other public institutions involved in conducting research in the field of antibiotics and drug companies expected to develop new antibiotics. (Sati et al., 2025).

3.2 Impact on Healthcare System

Antibiotic resistance influences healthcare institutions in different ways such as clinical, operational, and financial impacts. The presence of antibiotic resistance leads to longer hospitalizations, greater need for intensive care unit (ICU) admission, and increased failures in treatment. As pointed out in a recent study, the presence of multidrug resistant organisms (MDRO) caused infections could lead to an increase in hospitalization period from several days to weeks, leading to increased resource utilization. The existence of antibiotic resistance complicates decision making on treatment from a clinical perspective. Second or third line medications, which are less efficacious, less tolerable, and more costly, are usually imposed on physicians.

For example, glycopeptides and linezolid, which both have substantial side effects, are typically administered for methicillin resistant staphylococcus aureus (MRSA) infection treatment (Rajput et al., 2024). Antibiotic resistance is exacerbated by the presence of hospital-acquired infections (HAIs) caused by resistant pathogens. Not only do they have negative health impacts on patients but they also require stricter infection prevention practices like personal protective equipment (PPE) usage, surveillance, and isolation. Consequently, hospitals will be faced with increased operational costs and logistical challenges. Antibiotic resistance also leads to increased economic implications. In accordance with an organization for economic cooperation and development (OECD) report, resistant infections can lead to annual losses for the global economy of up to $3.5 billion due to medical expenses and productivity loss. Without any effective intervention measures in place, these costs will significantly rise in the future (Ahmed et al., 2024).

3.3 Societal and Economic Consequences

Antibiotic resistance has important implications in society and economics beyond the scope of healthcare institutions. One of the most alarming impacts of antibiotic resistance is its influence on the ability to conduct safe medical procedures effectively. Infection prevention with the help of antibiotics is vital when conducting surgery, transplanting organs, and treating patients with chemotherapy. Such procedures might be made very dangerous owing to the increasing numbers of resistant bacteria, thereby rendering all the previous efforts of the medicine ineffective.Antibiotics are widely used in farming, thus causing the emergence of resistant bacteria. They can subsequently infect humans either directly or through the environment or contaminated products. This interconnectedness highlights the importance of the "One Health" approach combining aspects of environmental, animal, and human health (Ardal et al., 2019).

The cost of antibiotic resistance is not limited to the costs associated directly with treating the patient. Macro economic impacts will include a decline in labor productivity due to the increased period of illness and deaths.

Based on the prediction of the World Bank, the global gross domestic product (GDP) could fall by 3.8% until 2050 in case of high levels of resistance, pushing millions into abject poverty. In addition, the impact of antibiotic resistance has a greater impact on vulnerable groups. This creates a vicious cycle of poverty due to high mortality rates and poor health outcomes (Bassetti et al., 2020).

4. PHARMACOLOGICAL COUNTERSTRATEGIES OF ANTIBIOTIC RESISTANCE

The reason behind the rising problem of AMR across the world lies in the fact that bacteria are developing resistance against all the existing antibiotics. This is even a tougher challenge because the research and development industry involved in the production of the drugs has slowed down considerably in the development of new antibiotics. This has become apparent as the progress of resistance is now outpacing the development of new antibiotics. Hence, it has become crucial that a strategy is devised for tackling the growing problem of AMR. Many efforts have been made towards producing non conventional antibiotics.The development of such innovative technologies proceeds at the greatest speed even before a clinical trial is conducted. The described technologies will definitely have an impact on modern practices and contribute significantly to overcoming the problem of AMR, helping to change the current state of clinical practice and significantly improving contemporary medicine. Some of those innovations are highlighted in the table 2 below along with their benefits and drawbacks (Sun et al., 2024).

4.1 Alteration of Cell Membrane Permeability

Approaches aimed at altering membrane permeability have become extremely important as one of the ways to address antibiotic resistance. The use of agents designed to enhance or restore membrane permeability can be considered a possible way to help increase the uptake of antibiotics. For example, through the interaction with lipopolysaccharide, polymyxins such as colistin weaken the outer membrane, leading to increased permeability and eventually causing cell death. Such compounds are commonly used in combination with other antibiotics to improve their uptake into the cell.

Table 1. Proposed pharmacological strategies with their benefits and drawbacks (Sun et al., 2024)

strategies	Benefits	Drawbacks
Alteration of cell membrane permeability	1) A significant reduction in the levels of antibiotic resistance genes and antibiotic resistant bacteria. 2) Good specificity and selectivity. 3) Potential adjuvants to antibiotics. 4) Affordable.	1) Poor quality and efficiency. 2) Shortage of chemical availability. 3) Poor applicability.
Oxidative treatment	1) Capability for reliable sterilization. 2) Convenient and flexible process control. 3) Minimal operational costs. 4) High level of stability and reuse.	1) Target organisms and gene fragments influence advanced oxidation processes (AOPs) 2) Methods of preventing catalysts leaching. 3) Assessment of residual toxicity. 4) Limited commercial applicability.
Nanomaterials	1) Special anti-bacterial activity. 2) Increasing the effectiveness of antibiotics. 3) Minimizing the side effects caused by antibiotics. 4) Improving drug stability.	1) Cytotoxicity. 2) Aggregation of nanoparticles. 3) Lack of understanding of the mechanism.
Efflux pumps and enzyme inhibitors	1) Enhancing the efficiency of current antibiotics. 2) Reducing the expenditure of much time, energy, and money searching for new drugs. 3) Exploiting the pharmacological properties of existing antibiotics. 4) Regaining antibiotic resistance. 5) Developing resistant mutations rarely.	1) Having insufficient affinity for the target sites. 2) Possessing some dangerous properties. 3) Being costly for the inhibitor to be commercially viable. 4) Poor biological stability. 5) Working well with other antibiotics. 6) Lack of preclinical and clinical studies.

Membrane permeabilization through the use of agents that augment the efficacy of current antibiotics, although not having inherent antibacterial properties themselves, is yet another promising strategy. The use of antimicrobial peptides and synthetic cationic agents are some of the agents that can destabilize bacterial membranes and lead to enhanced diffusion of antibiotics into them. As far as antibiotic resistance in biofilms is concerned, the problem is largely one of low permeability, an area where the adjuvants have proven to be very successful (Sahu et al., 2026).

4.2 Oxidative Treatment

Environmental contaminants like ARGs and ARBs are often detected in various environmental matrices. Water systems, especially wastewater, have been identified as hotspots for ARGs and ARBs' emergence and dissemination. Various advanced oxidation processes (AOPs), such as the combination of ultraviolet and hydrogen peroxide (H2O2), ozonation, photolysis, and the Fenton process, have proven efficient in recent years for removing ARB and suppressing ARGs' spread.As a result of their ability to generate reactive oxygen species (ROSs) with very strong sterilization abilities, including hydroxyl and sulfate radicals, several studies have shown that AOPs can be an efficient treatment approach for eradicating ARB. As compared to hydroxyl radicals, sulfate radicals exhibit higher selectivity, efficacy, and longevity. DNA or enzyme damage, inactivation of proteins within the cells, lipid peroxidation, dysfunction in mitochondria, gradual breakdown of cell membranes, and ultimately cell death can occur due to the ROS generated through AOPs. One other combination approach of using oxidants and antibiotic therapy is the photodynamic therapy (PDT) approach. In PDT, the photosensitizers produce ROS that inflict irreparable damage to bacterial cells upon exposure to light. Studies have confirmed the effectiveness of this technique in combating genetically-resistant bacteria and those forming biofilms, like MRSA and E.coli that is capable of producing extended-spectrum β-lactamase (ESBL). Resistance-conferring genes or proteins could be dysfunctional due to the oxidative effects caused by PDT, thus limiting the probability of resistance propagation (Zhao et al., 2021)

4.3 Nanomaterials

Due to their unique physicochemical properties, including a high surface area to volume ratio, the capability for programmable surface chemistry, and multifunctionality, the use of nanomaterials has emerged as an extremely promising platform against antibiotic resistance. Nanomaterials possess wide ranging antibacterial properties through several mechanisms simultaneously, unlike conventional antibiotics, which normally act specifically on certain bacterial functions. Some examples of such mechanisms are the disruption of intracellular structures, generation of ROS, membrane disruption, and enhanced drug delivery. The multitarget effect makes nanomaterials particularly efficacious in targeting MDR bacteria.One of the most effective mechanisms that nanomaterials use against antibiotics is the physical contact with the membrane of bacteria. Metallic nanomaterials such as silver nanoparticles (AgNPs), gold nanoparticles (AuNPs), and zinc oxide nanoparticles (ZnO) may attach to bacteria and affect their membranes, making them more permeable and leading to leaking from the cell interior and eventually to cell death. Using such physical interactions helps bypass other more common modes of action of antibiotics against resistant bacteria, such as target modification and enzymatic breakdown. Silver nanoparticles are very potent against resistant bacteria like E. coli and S. aureus (Parvin et al., 2025)

Moreover, nanomaterials interfere with biofilms, which are organized bacterial communities characterized by high antibiotic resistance. Biofilms act as a barrier that prevents the transfer of resistance genes and limits the penetration of antibiotics. Nanoparticles are more efficient in breaking through biofilms than regular antibiotics since nanoparticles can be designed to deliver antimicrobial agents when needed. Moreover, certain types of nanomaterials possess anti-biofilm characteristics that make them capable of breaking down extracellular polymeric substances within biofilms. Another technological advancement in nanotechnology is the development of stimuli-responsive nanoparticles that are designed to release their antimicrobial properties only in response to certain physiological conditions such as changes in pH levels, temperature, or bacteria-associated enzymes. This technology reduces the level of systemic toxicity in patients while ensuring effective targeting of infected sites.

For example, by using pH-sensitive nanoparticles, the release of antibiotics can be targeted at specific acid environments (Makabenta et al., 2021).

4.4 Efflux Pumps and Enzymes Inhibitors

One of the most important mechanisms for the development of drug resistance in bacteria includes efflux pumps and enzymatic destruction of antibiotics. Efflux pumps are transmembrane protein complexes involved in the active exportation of antibiotics from bacteria, thus reducing their concentration within the cell to levels lower than the therapeutic threshold. This type of mechanism is more prominent in Gram negative bacteria, where a diverse range of structurally dissimilar antibiotics can be exported using families such as the resistance nodulation division (RND) transporter family in E. coli, which provides multidrug resistance. Additionally, antibiotics can be inactivated by chemical modification through the action of enzymes such as aminoglycoside modifying enzymes, beta-lactamases, and chloramphenicol acetyltransferases.Together, these approaches substantially diminish the efficacy of conventional antimicrobials (Zheng et al., 2023).

Reversing antibiotic resistance using pharmacological inhibition of efflux pumps has now become a promising strategy. Efflux Pump Inhibitors (EPIs) work by blocking efflux pumps thereby resulting in increased levels of antibiotic within the cell. Studies have revealed that certain compounds such as phenylalanine arginine β-naphthylamide (PAβN) have the potential of inhibiting RND efflux pumps. This leads to enhanced activity of β-lactam and fluoroquinolone antibiotics among others. Despite the fact that many of these EPIs are currently in the preclinical stages, efforts are now ongoing to make them selective and less toxic while circumventing pharmacokinetic barriers. Importantly, because EPIs target one of the major causes of resistance, they are extremely effective as adjuvants to antibiotics.The combination of enzyme inhibitors and efflux pump inhibitors together serves as a synergistic approach in tackling antibiotic resistance. This may greatly boost the efficiency of antibiotics since they simultaneously inhibit drug efflux and enzymatic degradation.

For instance, MIC levels for bacteria resistant to many drugs can significantly be reduced when an efflux pump inhibitor is added alongside β-lactam/β-lactamase inhibitors. Such strategies are particularly useful in cases where infections are caused by bacteria that display varying forms of resistance (Gaurav et al., 2023).

CONCLUSION

The issue of antibiotic resistance is still considered to be among the most serious problems that face modern medicine today, due to the high adaptability of bacteria and their improper use. This includes the development of various resistance mechanisms, which include the inhibition of enzymes, efflux pumps, changes in target sites, and decreased membrane permeability.Resistance to antibiotics has many implications for the patient, including increased morbidity and mortality, longer hospital stays, and increased costs. Also, the effectiveness of some medical treatments such as organ transplants, chemotherapy, and surgery is increasingly at risk because of the emergence of multidrug-resistant organisms. This shows how important it is to have more creative and sustainable solutions.Some promising ways of overcoming the problem are presented by the recent advances made in pharmacology. Antibiotic effectiveness has been recovered with the use of mechanisms such as enzyme inhibition or efflux pump inhibition, often in combination with other therapies. Moreover, novel techniques such as the delivery system of the drug helped with nanotechnology or oxidative stress treatment give very complicated methods of action that might be used to overcome known routes of resistance.

Despite all these improvements, however, several issues need to be addressed, including those regarding toxicity, translation into clinical practice, and regulation. Collaboration among scientists and clinicians from different disciplines is required to address the problem of antibiotic resistance.To conclude, ongoing innovation, proper use of antibiotics, and international cooperation are required to battle the resistance to antibiotics. Ensuring that present day antibiotics remain effective and the population remains healthy in the future requires further research and development of advanced treatments.

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CHAPTER 2
NUTRITIONAL COMPOSITION AND PHARMACOLOGICAL POTENTIAL OF CANTALOUPE PEEL: A REVIEW

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INTRODUCTION

Since sustainable policy rules have increased in recent decades due to growing environmental consciousness regarding the disposal of organic residues, the value-adding of organic waste has received a lot of attention. Valorizing waste food is a useful method of turning all leftover materials such as steams, leaves, blossoms, seeds, and peels into new, valuable goods. Reducing food waste by recycling by-products is one of the decisions that have recently drawn attention to European policies (Vella et al., 2023).

The cantaloupe (Cucumis melo L.), which is mostly grown and eaten in Europe, is one of the several economically significant species in the Cucurbitaceae family. Muskmelon encompasses a wide range of varieties, including those with smooth skins like Honeydew, Crenshaw, and Casaba (C. melo var. inodorous), those with rough skins like Cantaloupe, Persian melon, and Santa Claus or Christmas melon (C. melo var. reticulatus), and those that are used as vegetables when they are still immature, like Barattiere, Carosello, and Armenian Cucumber (C. melo var. flexuosus). The gray-to-green or light brown skin of the cantaloupe melon is recognizable by its net-like, somewhat ribbed appearance. Its sweetness, juicy flavor, and nutritional value make it one of the most popular melons in the world (Fundo et al., 2018). Cantaloupe is linked to both nutritional advantages and bioactive qualities (Vishwakarma &Upadhyay, 2017).Consumed worldwide, cantaloupe (Cucumis melo L.) is a significant commercial crop. Consumers love cantaloupe because of its phytochemical content, nutrition, refreshing flavor, and attractive aroma (Spadafora et al., 2019).

Faostat (2018), estimates that 40 million tonnes of melon are produced annually worldwide, with China being the leading producer at 12.7 million tonnes. Between 8 and 20 million tonnes of trash are produced annually worldwide from the huge buildup of non-edible portions (peels and seeds) caused by commercial melon processing sources (Rolim & de Macedo, 2019).Around 1.9 million tons of melon were harvested in the Mediterranean region in 2016; the top three European producers Spain, Italy, and Franceaccounted for 35%, 34%, and 13% of the total yield, respectively (FAO, 2019).

According to FAOSTAT (2023-24), in Pakistan, melons are an important summer fruit crop, grown mainly in arid and semi-arid region and the country's production has remained relatively stable in recent years. FAO production statistics, reported through secondary industry databases, show that Pakistan produced about 0.40million tones of melons including cantaloupe in 2023-24. The significant level of cantaloupe production at both global and national levels highlights the importance of exploring sustainable utilization strategies for melon by-products, especially cantaloupe peels, as value-added ingredients in food and nutraceutical applications.

According to (Gómez &Campos, 2021) (Aguilar & Pintado, 2020), these waste by-products could be valued because of their abundance in bioactive compounds, particularly polyphenols (flavonoids and phenolic acids), carotenoids (α-, β-carotene, and β-cryptoxanthin), and fatty acids (oleic, linoleic, and palmitoleic acids).Citrulline, glutamine, and γ-aminobutyric acid (GABA) are among the amino acids that cantaloupe is a good dietary supply of. However, different cantaloupe types cultivated in different locales have varying amounts of these amino acids. (Singh et al., 2020)

Cantaloupe peels were separated into three fractions: a pellet fraction with a greater protein content (34.90%); a liquid fraction with a higher ash content (11.5%); and a solid fraction with a higher quantity of carbs (84.81%). A composition of cellulose (27.68%), hemicellulose (8.2%), and lignin (26.46%) was found in the solid portion of the structural carbohydrates investigation. The DPPH, ABTS, and ORAC assay results show that the liquid fraction has the strongest antioxidant activity. In all fractions, the primary phenolic classes that are present are flavones, hydroxybenzoic and hydroxycinnamic acids. Furthermore, quantities of lutein, violaxanthin, β-carotene, and β-cryptoxanthin have been measured.

Due to the increasing market need for safe and nutritious food items, melons can be used to create new functional goods because they are rich in nutrients and bioactive chemicals (Gómez et al., 2021).As a food additive, gelling agent, thickening, texturizer, emulsifier, stabilizing agent, and fat substitute, pectin is mostly utilized either by itself or in conjunction with other biopolymers in a variety of food formulations, including meat, dairy, jams and jellies, and baked goods and confections.

Pectin's use in pharmaceutical goods has increased recently due to its anti-inflammatory properties, heart disease prevention, and health advantages as a soluble dietary fiber that lowers blood glucose and cholesterol levels. The yields of cantaloupe rind pectin extraction varied from 56.0 to 150.0 g kg−1. (Kazemi & colleagues,2021).

It is widely grown in temperate, subtropical, and tropical regions of the world. China, the United States, Spain, Turkey, and Iran are the leading producers of melon (FAO, 2019). Melon has a great deal of variation in its physical, biochemical, and morphological traits depending on the climate zones and local preferences. Cantaloupe's wild relatives can be found in Australia, Africa, and Asia (Kaushik & Kesh, 2021).

1. NUTRITIONAL COMPOSITION OF CANTALOUPE PEEL

The nutritional composition of cantaloupe (cucumis melo.) peel encompasses both macronutrients and micronutrients including proximate components as well as essential mineral and vitamins which collectively determine its nutritional quality and potential functional applications.

1.1 Proximate Composition

Table 1. Proximate Composition of the Sample (Mallek-Ayadi et al., 2017) (Zhivkova, 2021)

Components	Amount
Moisture	16.95%
Protein	34.90%
Fat	1.10 ± 0.05mg/kg
Carbohydrates	5.8%
Dietary fiber	8.83 ± 0.09mg/kg
Ash	11.5%

1.2 Minerals and Vitamins

Table 2. Mineral Composition of the Sample (Mallek et al., 2022)) (Zhivkova, 2021).

Components	Amount
Potassium	2113.75 ± 0.45mg/kg
Calcium	855.25 ± 0.19mg/kg
Magnesium	328.75 ± 0.11mg/kg
Sodium	137.58 ± 0.72mg/kg
Iron	1.82 ± 0.07mg/kg
Zinc	0.7 ± 0.64mg/kg
Manganese	0.48 ± 0.03mg/kg
Copper	0.2 ± 0.02mg/kg

Cantaloupe is one of the best sources of vitamin A and is rich in beta carotene, which is converted into vitamin A in the body. In addition, it contains other useful nutrients such as vitamin C ,vitamin B5, B3, B6 and B1. (Kaab et al., 2021).

2. PHARMACOLOGICAL PROPERTIES

Melon residues, peels, and seeds were examined for their positive qualities in light of possible industrial uses by determining their composition and functional activity. Total polyphenols, ortho-diphenols, flavonoids, tannins, and antioxidants were assessed using photometric tests and HPLC profiling to produce a biochemical characterisation in this contribution. (Vella et al., 2019).

Because of their many biological properties, including as their anti-inflammatory, anti-cancer, antibacterial, hepatoprotective, and immunomodulatory actions, cantaloupe peel has demonstrated therapeutic potential in the treatment of oedema, diabetes, and cardiovascular disease.(RSS , 2024). According to a pharmacological investigation, C. melo has great promise for treating liver disease, cardiovascular problems, cough, cancer, inflammation, and discomfort. Cucumis is used extensively as a skin conditioner in traditional medicine and the cosmetics industry. Phytochemicals, bioactives, vitamins, and other substances found in this plant help treat and prevent a number of illnesses. (Naaz et al., 2022).

According to the FRAP and DPPH antioxidant assays, the highest amounts of total polyphenols that can be detected are 3.75 mg of gallic acid equivalents (GAE)/g of dry weight (dw), 25.77 µmol of ascorbic acid equivalents (AAE)/g dw, and 34.44 µmol of AAE/g dw. Gallic acid, neochlorogenic acid, epicatechin, catechin, chlorogenic acid, and kaempferol were the polyphenols that were found. Through the development of value-added goods and waste reduction, the research will support sustainable waste management by ensuring the maximal isolation of bioactive content and antioxidant activity (Dimtsas et al., 2024).

Table 3. Phenolic Composition of Cantaloupe Peel (Extractable and Non-Extractable Fractions)

Components	**Phenolic components**	**Amount of extractable phenolic components**	**Amount of Non-extractable phenolic components**	**Total phenolic component amount**	**Loss percentage**	**Reference**
Cantaloupe peel	Polyphenol	25,480 ± 1440 mgGAE/kg;	Nd	Nd	25%	Fundo et al, 2018
	ortho-diphenol,	17,860 ± 1430 mg CAE/ kg;				
	flavonoid,	15,190 ± 1880 mgCE/kg;				
	tannin	11,830 ±1440 mg GAE/kg				

Table abbreviation: GAE: Gallic acid equivalent, CE, catechin equivalents; CAE:Carbonic Acid Esters(Fundo et al, 2018)

2.1 Antioxidant Properties

The billions of cells that make up our body are always at danger of being damaged by radicals, which can result in the emergence of illnesses. Illnesses do not appear suddenly. The "oxidative stress" caused by free radicals is one of the primary causes of disease. The most studied stressor that interferes with cells' regular function is oxidative stress. Numerous degenerative diseases, such as cancer, cardiovascular disease, blindness, dermatological disorders, and neurological disorders like Parkinson's and Alzheimer's disease, are brought on by the multitude of cell damage it causes. In order to maintain a healthy cellular balance, our body responds to any stress as a typical defense mechanism (Bibi et al., 2020).

Due to which antioxidants had a growing interest owing to their protective roles in food and pharmaceutical products against oxidative deterioration and in the body and against oxidative stress-mediated pathological processes. Screening of antioxidant properties of plants and plant-derived compounds requires appropriate methods, which address the mechanism of antioxidant activity and focus on the kinetics of the reactions including the antioxidants. Many studies evaluating the antioxidant activity of various samples of research interest using different methods in food and human health have been conducted(Gulcin ,2020).

Antioxidant enzymes, however, are occasionally insufficient to counteract free radicals. Therefore, it is essential to either eat foods high in antioxidants or, on the other hand, use medications to prevent and treat degenerative diseases. Even though free radicals are responsible for a wide range of illnesses, it's vital to keep in mind that they can also have intriguing therapeutic benefits, particularly in antimicrobial applications. For instance, a new tactic to counteract antibiotic resistance and biofilm formation involves the release of free radicals(Fasiku et al., 2020).The two main carotenoids found in cantaloupe peel were β-carotene (56.43 ± 0.11 µg βCE/g dw) and lutein (63.24 ± 0.73 µg βCE/g dw). Both are potent antioxidants. Using the DPPH assay, the extract demonstrated antioxidant activity (IC50 = 7.33 µg/mL) (Benmeziane et al., 2018).

In the analysis and comparison of antioxidant extracts from pulp, seeds and peels (Morais et al.,2015) discovered that peels exhibited greater levels of free radical inhibition by ferric reduction of antioxidant activity (FRAP) and DPPH than other fruit sections. In contrast to pulp (28.57 µmol FeSO4/100 g DM) and seed (6.50 µmol FeSO4/100 g DM), cantaloupe raw peels exhibited 49.49 µmol FeSO4/100 g DM. The significant concentration of polyphenols in the cantaloupe peels found in each fraction may be partially responsible for these antioxidant activity results. It is commonly known that these bioactive chemicals are efficient at scavenging free radicals and reducing substances. They also contributed to high level content of polyphenols in the melon peels in each subset might be the reason for these antioxidant activity findings. Besides being more effective than vitamins and carotenoids in plants, these bioactive molecules are widely known for their ability to reduce chemicals and scavenge free radical.

However, there is little information regarding phenolic compounds found in cantaloupe and their interaction to one another in terms of antioxidant action. Moreover, this data highlights the value of researching cantaloupe by-products as a cheap and abundant source of natural antioxidant extracts (Gómez-García et al., 2021).

2.2 Anti-Cancer Properties

Cucumis melo extract was shown to have promising anti-cancer effects in both in vivo and in vitro studies that were carried out on eight distinct cancer types—cervical, colon, prostate, leukemia, multiple myeloma, breast, hepatoma and ovarian cancer. A careful examination reveals that several of the IC50 values were noticeably low, particularly in prostate and colon cancer cases, suggesting a strong anti-cancer activity. Cucumis melo fruit extracts have significant anti-cancer properties, which suggests that further research is needed to determine whether they may be used as cancer therapy for all types of cancer (Soh et al., 2024).

Because of its strong antioxidant content, cantaloupe helps scavenge free radicals before they do any harm. It has been demonstrated that an extract from the peel and seeds of cantaloupe inhibits the growth of tumor cells in the renal, colorectal, and cervical regions.

The C.melo and peel's antioxidant qualities prevented the tumors from spreading by 20% to 85%. This study is tentative rather than definitive, though. It is encouraging for future endeavors, but further research is required (RSS et al., 2024). Cucumis melo's anti-cancer qualities and the evaluated studies' half maximum inhibitory concentration (IC50) (n = 14).

Table 4. Anticancer Activity of Cucumis melo Extracts Against Human Cancer Cell Lines

Fruit	**Fruit part**	**Pure compound/crude extract**	**A human tumor xenograft or cancer cell line**	**IC50**	**Concentration used**	**References**
Cucumis melo L.	**Seed**	Phenolic compounds	SiHa HeLa HT-29 786-0	1.2 mg/mL 0.5mg/mL 4.0 mg/mL 0.4mg/m	0.1, 0.25, 0.5 1.0mg/mL	Rolim et al., 2018
	Peel		SiHa HeLa HT-29 786-0	0.4mg/mL 0.3 mg/mL 2.8 mg/mL 1.0 mg/mL		

2.3 Anti-Cardiovascular Properties

High-fat diets hasten the development of cardiovascular disease through the processes of oxidative stress and inflammation. Increases in lipoprotein levels have been shown to alter the arterial system, increasing the risk of atherosclerosis and cardiovascular disease in adults. Cardiovascular risk factors include low concentrations of HDL-c, which are present in dyslipidemia and elevated levels of triglycerides (TG), total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-c (Zhu et al, 2018).

Cucumis melo is a great source of both soluble and insoluble fiber. It has been proposed that the large amount of dietary fiber in this fruit can help to improve simple digestion and prevent constipation. In essence, Cucumis melo work as flushing agent to cleanse impurities including harmful LDL-c, which lowers the risk of cardiovascular illnesses (Adebayo et al., 2022).

2.3.1. The Mechanism of Action

High fiber content, antioxidant substances and phytochemicals are present in Cucumis melo that encourage lipid metabolism and decreases the intestinal absorption of cholesterol, are responsible for its anti-hyperlipidemia qualities. Research has demonstrated that in animal models fed (a high-fat diet), melon peels and seeds extract can significantly reduce the LDL-c levels (Adebayo-Gege et al.,2022).

Although other fruits such as apples and citrus fruits may not have the same range of antioxidant activity as C.melo, but can also lower LDL-c through their soluble fiber content (like pectin) and phytosterols, which also prevent the absorption of cholesterol.

2.3.2. Clinical Evidence

Studies show that the peels extracts of the Cucumis melo fruit significantly lower the level of LDL-c which has the same effects of common drugs like atorvastatin in test conditions (Adebayo-Gege et al., 2022). This implies that melon can be a useful natural substitute for managing the cholesterol levels. Other fruits such as avocados and berries have also been proven to be beneficial in lipid profiles. For instance, avocados contain a lot of monounsaturated fats which have the ability to raise HDL-c and decrease LDL-c. However, under specific dietary conditions, avocados may have different LDL-c-reducing effects.

2.3.3 Nutritional Composition

The antioxidant qualities of C. melo are due to its high water content and the presence of vitamins like vitamin A and C.

Flavonoids and phenolic compounds present in it improves its ability to scavenge free radicals and decreases the oxidative stress responsible for elevated cholesterol level (Wahid et al., 2024). Although they are rich source of antioxidants but other fruits like berries (strawberries, blueberries, etc.) might not have the same specific anti-hyperlipidemia benefits as C.melo. Studies, for instance, indicate that consuming berries can improve the lipid profiles but they usually focus more on heart health in general than on the direct reduction of LDL-c.

2.3.4 Comparative Efficacy

Cucumis melo exhibit strong anti-hyperlipidemic action in trials comparing the lipid-lowering effects of different fruit extracts, especially when using concentrated extracts such as those from the seeds or peels of the fruits. (Srivastava et al., 2020).

The unique ways by which Cucumis melo works, both in its fiber content and its bioactive compounds for the desired results, may be an advantage in targeted LDL-c reduction over the fruits like apples and pears which are also beneficial because of their fiber content. All things considered, Cucumis melo is unique among the fruits which offers dietary fiber in addition to a broad range of antioxidants that may increase its ability to decrease the LDL-c levels. Although other fruits are also effective in terms of heart-health but C.melo have special qualities which make it a useful addition to diets that effectively control the cholesterol levels. More research is needed to completely investigate its mechanisms and its uses in the treatment of cardiovascular health.

2.4 Inflammation Inhibitory Properties

Inflammation is the body's reaction to different environmental stimuli such as germs or other materials which helps the body to eliminate these dangerous elements and recover itself. There are two stages of inflammation that are possible. First, is the acute inflammation and the second is chronic inflammation. Acute inflammation is caused by immune system cells and it lasts for a brief period of time. Chronic inflammation occurs over a long period of time. It disrupts the body's signaling pathways including nuclear factor Kappa-B and causes chronic illnesses (Aggarwal et al., 2021).

Inflammation is the reaction of immune system to an injury which is usually characterized by swelling, heat, pain and redness. Cantaloupe peel (which comes from cantaloupe fruit) has been recognized for its anti-inflammatory properties, mostly due to high content of carotenoid and polyphenols. Recent research has revealed that carotenoids like lutein and β-carotene have strong anti-inflammatory properties which alters inflammatory cytokines and intracellular signaling pathways. In a study, nanoparticles having carotenoids show more tissue integrity and less toxicity suggests that these partials can reduce the inflammation. (Medeiros et al., 2020).

Furthermore, the polyphenolic content present in cantaloupe peels have been associated with the antioxidant activity that enhances its anti-inflammatory effects and may reduce the inflammatory responses (Bouaziz et al., 2020; Farida et al., 2022). This shows that cantaloupe peel has potential to be a natural anti-inflammatory drug so further research is needed to understand its clinical benefits.

2.5 Advancing Ocular Health

High concentration of carotenoid including lutein, zeaxanthin and β-carotene present in cantaloupe peel has significant role in eye health. Age related diseases like cataracts and macular degradation can be prevented by these essential nutrients. β-carotene is transformed into vit.A which is essential for good vision and also prevents night blindness (Johra et al., 2020).

Oxidative stress in eyes, which is responsible for cellular damage can be minimize by lutein and zeaxanthin. Studies show that these components can slowdown the process of age-related macular degradation (AMD) by increasing macular pigment density. Thus enhancing optical function and provides protection against light induced damage (Flood et al., 2017). Moreover, cantaloupe peel is a good addition to the diet which is taken to preserve eye health. The antioxidant properties present in cantaloupe peel helps in the fight against oxidative stress which is the main reason for many eyes related diseases.

2.6 Pharmacological and Health Benefits of Cantaloupe

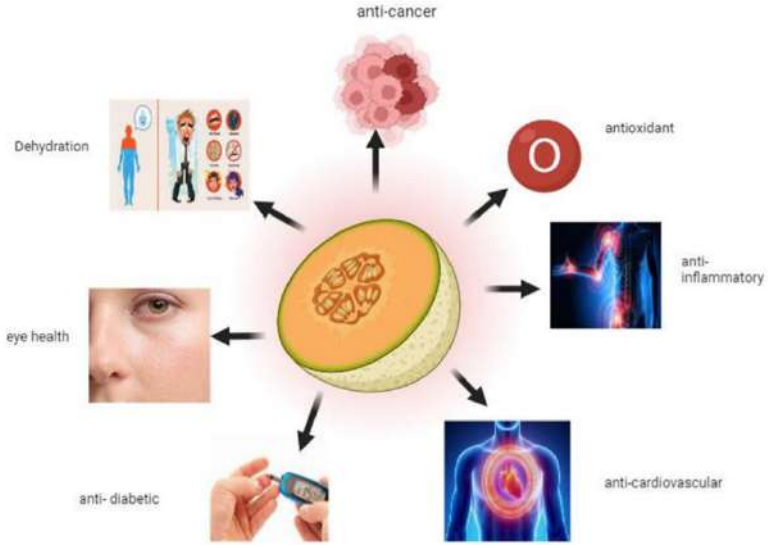

Figure 1. Overview of the Pharmacological and Health Benefits of Cantaloupe

3. APPLICATIONS IN FOOD ITEMS

Cantaloupe peels are usually thrown away as a waste but it is a rich source of nutrients and bioactive compounds which makes it a suitable source for food sector. Following are some advantages and applications of C.melo peel in culinary applications:

3.1 Ingredients in Functional Foods

Cantaloupe peel contains healthy compounds like carotenoids, flavonoids and phenolic substances that adds nutritional value to food products. It also contains high content of dietary fibers about 41.69% (Da Cunha et al., 2020). According to researches, addition of cantaloupe peel powder in chicken patties will increases the protein content and antioxidant activity of these patties which make them shelf stable and also improves their quality (Ali et al., 2022).

3.2 Source of Natural Antioxidants

Antioxidants included in the peel can help reduce oxidative stress in meals. According to research, goods can be fortified against oxidation with cantaloupe peel extracts, increasing their shelf life and safety (Vella et al.,2023).

3.3 Innovative Food Items

3.3.1 Fortification and Paste

Cantaloupe peel paste can be added to many food products such as yogurt, nutritional bars and smoothies. Peel, which is usually discarded as waste can contribute to increase the nutritional value of food products as well as in the reduction of organic waste (Miller et al.,2023).

3.3.2 Supplements for Diet

C.melo peel extract used in fortification of seawater has dominating antioxidant properties which make it fit for use in food fortification. This peel extract can also be used as dietary supplement (Vella et al., 2023). In the field of food science, cantaloupe peel can be used to enhance the nutritional value, shelf life (by using natural preservatives) and produce different food items. Due to its bioactive components, it is a useful ingredient in functional foods for the people who are health conscious. The use of cantaloupe peel can significantly reduce the food waste along with many health benefits.

CONCLUSION

Around 25% of fruit's weight is its peel which is mostly discarded as waste but it is a rich source of bioactive substances such as dietary fibers and antioxidants which makes it useful in many foods and therapeutic uses. Recent researches have analyzed many techniques such as freeze-drying and microwave assisted extraction to turn these peels into essential components like pectin and functional powders. We can also make useful things from it that can improve health and prevent illnesses like cardiovascular diseases, inflammation and cancer. By reducing this type of organic waste, will not only promotes sustainability but also focuses on the benefits that this waste can provide us. The therapeutic effects of C.melo peel has increased its value, decreases the waste and help in the development of new preventions for health.

Future developments in waste valorization might concentrate on creating environmentally friendly extraction methods, adding powdered cantaloupe peel to food products to improve their sensory appeal and advancing the ideas of the circular economy by making efficient use of agricultural by-products.

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CHAPTER 3
GERIATRIC REHABILITATION

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INTRODUCTION

In industrialized countries in recent years, there has been an increase in the geriatric population, as a result of many factors: the improvement of hygienic-sanitary conditions, the prevention of diseases and the increase of therapeutic qualities. But the more the life expectancy of the population increases, the more the probability of chronic diseases increases, such as: arterial hypertension, type 2 diabetes, sclerotic cardiopathy, chronic bronchitis, osteoarthrosis, immunological diseases, etc. Aging is characterized by physiological changes related to genetic and environmental factors with a noticeable decrease in the functional capacities of all organs and apparatuses of the human body. We must not forget that more than one disease is present in the elderly. Based on all the factors mentioned above, the elderly are defined as 'fragile'. Frailty is a clinical syndrome, typical of the elderly over 80 years old and not only that. It is manifested by a decrease and weakening of muscle mass, postural instability, decrease in physical strength, balance disturbances, reduced vision, weakness, malnutrition, habit of not walking, immobility, osteopenia (weakening of bones), depression, degenerative pathologies (arthrosis , diabetes, arteriosclerosis) that complicate different characteristics. So the elderly risk a dependency for everything: falls, acute pathologies with slow healing, accompanied by hospitalization and then until death.

1. DEMENTIA

It is the loss of cognitive and emotional abilities to the point of interfering not only with the normal functions of daily life but also with the quality of life. The increase in the number of patients in the European Community is 2.5 subjects per 1000 people / year. There are many pathologies that lead a patient to dementia: Alzheimer's disease, Vascular Dementia, Lewy body disease. Very important for the diagnosis is the HISTORY which requires a great commitment regarding the elderly who is not able to cooperate, so the relationship with his family members who are the ideal observers of the history, life, emotions and concerns of the patient remains fundamental.

1.1 The Brain of the Patient Affected by Dementia

The symptoms are characterized by an initial memory deficit with the subsequent degradation of executive functions, with a language deficit (speech), orientation, and connection in time and space, mobility disorders and difficulty in maintaining balance. These cognitive symptoms are accompanied by psychological symptoms such as: anxiety, depression, delirium, hallucinations; behavioral symptoms such as: psychomotor agitation, aggressiveness, sleep disturbances, eating disorders, etc. There are different tests to determine the different degrees of dementia. There is no specific therapy. Medicines are used which somehow alleviate the symptoms.

1.2 Immobilization Syndrome

Immobilization syndrome is a condition characterized by a reduction or lack of motivation to move. A progressive disease that makes it possible not only to immobilize, to permanently block the patient, but also to remain in bed forever. For the elderly, this is a bitter event as it limits them, makes them unable to perform activities of daily life such as climbing and descending stairs, walking autonomously (independently) and changing the position in bed.

Immobilization is determined by:

- Biological factors
- Psychological factors
- Social-Environmental factors

Biological Factors

Pathologies related to the musculoskeletal system such as arthritis, arthrosis, osteoporosis, fractures, tendinitis, bursitis cause pain, muscle weakness, i.e. reduced mobility.

Neurological Factors

The effects of stroke, Parkinson's, peripheral neuropathies, Dementia cause motor impairments, loss of muscle mass and deficits (decrease) in sensitivity.

Other Causes

Pulmonary syndromes that cause dyspnea and decrease in aerobic capacity, decreased vision, disabling diseases.

Psychological Factors

Depression, loss of movement reflexes due to long stay in bed, fear of falling. Specifically:

- **Emotional Impact**

Stress and Anxiety

Immobilization often leads to uncertainty regarding recovery, ability to return to normal activities, or concerns about dependence on others. This uncertainty can cause heightened levels of stress and anxiety.

Depression

Reduced mobility may result in feelings of hopelessness or helplessness, particularly if the immobility is long-term. A loss of independence or inability to participate in previously enjoyed activities can contribute to depressive symptoms.

Frustration and Anger

Being restricted from movement can lead to frustration, irritability, or even anger directed toward the situation, caregivers, or oneself.

- **Cognitive Effects**

Mental Fatigue

Lack of physical activity and stimulation can lead to cognitive sluggishness or difficulty concentrating.

Catastrophic Thinking

Immobilized individuals may overestimate the severity of their condition, leading to fear of permanent disability or the belief that recovery is unattainable.

Memory and Attention Impairment

Prolonged inactivity, especially in older adults, may result in declines in cognitive functions like memory and attention.

Social and Interpersonal Challenges

Isolation and Loneliness

Reduced mobility can limit social interactions, leaving individuals feeling isolated or excluded from their social circles.

Changes in Relationships

Dependency on caregivers may shift dynamics in personal relationships, causing strain or feelings of being a burden.

Reduced Communication Opportunities

Immobilization often limits participation in communal activities, leading to decreased opportunities for conversation and social engagement.

- **Self-Perception and Identity**

Body Image Concerns

Physical changes, such as muscle atrophy or weight fluctuations, can negatively affect body image and self-esteem.

Loss of Independence

Being dependent on others for basic tasks can challenge an individual's sense of autonomy and self-worth.

Role Disruption

Immobilization can prevent individuals from fulfilling roles they value, such as being a caregiver, worker, or athlete, causing identity conflicts.

- **Behavioral Responses**

Avoidance Behaviors

Immobilized individuals may avoid activities or people out of embarrassment, fear of injury, or low motivation.

Aggression or Defensiveness

Some individuals may respond to their immobility with hostility toward those around them, particularly caregivers.

Unhealthy Coping Mechanisms

Immobilization may lead to maladaptive behaviors such as overeating, substance abuse, or withdrawal from loved ones.

- **Long-Term Psychological Effects**

Post-Traumatic Stress

Immobilization caused by a traumatic injury can lead to persistent feelings of fear, nightmares, or flashbacks related to the incident.

Learned Helplessness

Prolonged dependence on others may lead individuals to believe they are incapable of taking control over their lives, perpetuating feelings of powerlessness.

Chronic Anxiety

Fear of reinjury or recurrent immobilization can result in long-lasting anxiety, even after recovery.

- **Positive Psychological Growth (in some cases)**

While immobilization primarily causes challenges, some individuals develop resilience and experience personal growth through their recovery journey:

Increased Gratitude: Appreciation for simple movements or independence may grow.

Strengthened Relationships: Dependency may lead to deeper connections with supportive caregivers and loved ones.

New Perspectives: Time for reflection may shift priorities or encourage personal development.

Social-Environmental Factors

They include the homeless, poor economic conditions (poverty), malnutrition and the inadequacy of socio-assistance structures, the presence of architectural barriers (portable stairs, mobility aids, wheelchairs, etc.)

Damage to Various Organs

The gastro-enteric apparatus: it is restricted by the mobility of the package and by the presence of fecalomas, which lead to anorexia.

Urinary system: urinary incontinence due to altered sensitivity, lack of privacy and insufficient physical strength to cope with these needs.

Integumentary apparatus: ulcers and decubitus wounds.

Musculoskeletal apparatus: decrease in muscle mass accompanied by decrease in muscle strength, osteoporosis, fibrosis of ligaments and tendons.

Cardio-vascular apparatus: changes in cardiac rhythms, heart pumping due to regular dysfunction of blood circulation in the extremities, deep venous thrombosis and growth of sclerotic arteries (arteriosclerosis).

Neurological apparatus: staying in bed for a long time causes cognitive (dementia) and psychological (depression) disturbances in the patient.

Rehabilitation from Immobilization

Rehabilitative therapy aimed at reactivating functions, preventing and worsening disability with an accurate assessment of the patient's functional capacity is important in order to continue with real objectives through physiotherapy, instrumental therapy (magnetotherapy, ultrasound, muscle strengthening, TENS- (transcutaneous nerve stimulation), occupational therapy until increasing the patient's capacity to independently achieve life activities than everyday.

Osteoporosis

It is the most frequent, most widespread bone disease, it appears with a decrease in bone mass, with an erosion of bone microstructures, with a decrease in bone density, making it possible to weaken it and expose it to various fractures as a result of the decrease of resistance. It is a situation that is often repeated in women during menopause. The secondary causes of osteoporosis are: myeloma, rheumatoid arthritis, the use of various drugs such as: cortisone, heparin, anticonvulsants.

The most important laboratory tests are: calcemia, phosphoremia, liver and renal functionality test, protein electrophoresis and hemochromia. X-ray of the vertebral column is also important, and the most sensitive are TAC, MRI.

Medical treatment suggests absorption of calcium, vitamin D, biophosphonate, estrogen and physical activity.

Balance Concerns

Balance concerns are very common among the elderly, exposing them like this and making them weaker to take control of the situation during a fall, which in most cases is accompanied by trauma. 20-30% of the elderly over 65 are exposed to acne every year. Over the age of 75, 80% of the elderly suffer significant trauma. The percentages are even higher for hospitalized patients. Let's not forget that 5% of elderly patients consciously limit their mobility for fear of getting injured. It should be emphasized that with the reduction of movements, the quality of life also decreases.

Balance in upright posture depends on high-quality sensory information relative to the position of the body's center in relation to the surrounding environment, the supporting surface and gravitational forces. Postural control, which means balance, depends on the visual system, the vestibular system and the proprioceptive receptors of the joints and neuromuscular groups. Alteration of two of the three systems compromises balance, makes it difficult to stand upright. While dementia and neurodegenerative diseases favor loss of balance, radiation, trauma, fractures. For all these pathologies, the treatment is physiotherapy and psychological support. The inner ear often referred to as the middle ear has an important role in maintaining balance.

Care for the 'Fragile' Elderly

'Taking care of someone' is a very beautiful expression which indicates the act towards someone who really needs care. But an individual who does not have this care as part of his profession, no matter how hard he tries, cannot "take care" of the frail elderly (fragility) who have many problems. To solve these problems, we must adhere to a practical-professional manual which does not allow us to make mistakes and enables us to behave like a professional. It is easier to always act according to the needs of the elderly: communication, feeding, hygiene and dressing, moving in bed, postural steps, walking, sleeping and resting.

Caring for the fragile elderly involves addressing the unique challenges of older adults who are vulnerable due to frailty, chronic illnesses, or age-related decline. Frailty, marked by reduced strength, endurance, and mobility, increases susceptibility to adverse health outcomes and requires comprehensive, individualized care.

Key Aspects of Care

Physical Health Management: Regular medical check-ups, proper medication management, and a balanced diet are essential. Physical activity, such as gentle exercises, can improve mobility, strength, and balance, reducing fall risks.

Fall Prevention: Home modifications, like grab bars and non-slip mats, and assistive devices (e.g., canes or walkers) help ensure safety. Vision and hearing care are also crucial in minimizing accidents.

Cognitive and Mental Health Support: Cognitive stimulation, such as puzzles and memory games, preserves mental sharpness. Addressing emotional well-being through counseling or social support combats depression, anxiety, and loneliness.

Social Engagement: Encouraging participation in community activities or maintaining contact through technology reduces isolation and enhances well-being.

End-of-Life Planning: Advance directives and palliative care focus on honoring the individual's wishes and ensuring comfort in terminal stages.

Caregiver and Integrated Support: Caregivers need education, emotional support, and respite care to manage stress and provide effective assistance. A multidisciplinary approach, involving healthcare professionals and social workers, ensures holistic care, while telemedicine offers convenience for monitoring health.

Comunication

Communication is very important but at the same time difficult with some types of patients. You must always find the right communication strategy, starting and developing the conversation. The patient's trust in the physiotherapist must be achieved for the development of further rehabilitative treatments. Communication means the union of ideas, the exchange of thoughts, the collection of information, the expression of emotions that are an expression of our identity. Some diseases can limit the possibility of communication, therefore it remains important to underline which goals and which behaviors help us to cooperate with the elderly.

How can we make communication easier for the patient?

- to listen calmly and attentively to the elderly, giving them enough time to think, process the message and express themselves.
- never pretend that we have understood

- simple conversations such as: slow articulation, with short sentences, related to the context without changing the discussion suddenly, limiting misunderstandings
- it is important to stand in front of or close to the patient, most of the communication is based on facial expressions, facial expressions, the closer we are to the patient, the slower we should speak and we should understand the articulation of words from the movement of his lips ; that way we tire him as little as possible.
- if we use precise, concrete questions, we are in control of the conversation; if we ask him to tell us something, the old man must be committed to organizing his ideas and telling the story.
- we must dedicate the right space to communication without asking the patient to perform other activities at the same time, such as walking.
- if the elderly find it difficult to express themselves, to articulate long sentences, then we will try to create the possibility to answer yes or no based on the sentences created by us which have enough of these answers; or for the patient to choose between two alternatives as an answer.
- images, objects, gestures enrich communication with the patient.
- we must check not to keep the same attitude with the elderly that we have instinctively during a physiotherapy session with the children.

Why does the elderly have problems with speaking?

Speaking can be divided into two moments so close that it is difficult to separate them:

Planning: our thoughts are arranged through the choice of words and the presentation of sentences.

Verbal act (speech): movements of the voice, tongue, lips are activated that make the words audible and articulate.

Cerebral injuries received:

Aphasia: the linguistic system becomes unknown, it is the same as if our language resembles a language that we do not speak, we do not know how to recognize, understand, the words do not come to form a sentence, no matter

how simple, it becomes difficult to explain something , almost incomprehensible news, newspapers.

Dysarthria: the movements are not precise, the speech becomes even more incomprehensible, it is the same as having a potato in your mouth and not noticing it, not understanding it because in your mind you have clearly what you want to say.

Diseases involving cerebral activity appear with reduced concentration, reduced memory to remember information and lived events, lack of orientation in time and space, lack of initiative to do even the smallest things. The physiotherapist must not only support and help the patient but also take on the function of the speech therapist in such cases as the elderly and in general each patient is closely related to the therapist.

The Movement

Mobility, i.e. free movement in a familiar environment, is essential for normal daily life. Motor function is very important during every stage of life from childhood to the moment when it becomes an important condition for maintaining autonomy.

The importance of movement for the 'fragile' elderly:

To maintain, improve and preserve the remaining functional and cognitive capacity; to prevent complications from immobilization; for the prevention of decubitus wounds; to reduce pain symptoms; to improve the stability of the balance and to reduce the assistance of family members.

How much and how should the patient be mobilized during the day:

It is important to orient the elderly person for every action during the day, to know how to separate day from night, to avoid feeding in bed, to sit and leave him in the wheelchair as long as possible, whether at home or in the hospital. It is important for the elderly to practice walking,and to take a few steps enough to be repeated during the day; they are of great importance because this way you don't forget the walking pattern, the repetition of getting up and down from the bed. They are essential for home placements (bed, kitchen, toilet). When possible, give the elderly the task of going up and down the stairs of the house as a simple exercise.

Positioning The Elderly In Bed and In A Wheelchair

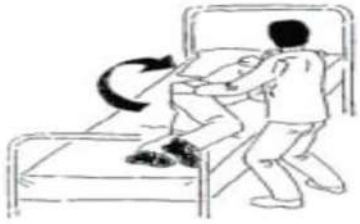
Shoulder positioning: in this position, it is important that the elderly's head and limbs are properly directed.

Positioning from one side: a position that supports the shoulder, is facilitated by flexion of the lower limbs. The physiotherapist positions himself on the interested arm from where the patient's rotation will take place and places his hands on the scapula and back, giving the patient not only security but also enables an efficient, easy and pain-free rotation. A posterior cushion helps maintain the position and realizes the correct inclination of the trunk. Another pillow is placed under the patient's knee.

Postural Steps

Supin - Sitting On The Bed

It should be taken into account from the initial position, i.e. the shoulder, the patient is turned on one side from where it will be possible to sit down, and he is asked to take his legs out of the bed and sit down.



The muscles that are activated first are the head and neck flexors, while the abdominals and pelvic flexors are activated when the therapist's hands are removed from the trunk of the elderly person. If the head and neck muscles of the elderly do not have the proper strength to perform this exercise, then we suggest the patient use his upper limbs as help. If the patient is able to perform this postural step on his own without the help of the physiotherapist, we only need to stay close and not allow him to perform incorrect movements. The patient should never be hindered or helped when there is no need, as he adapts to laziness and does not perform the exercises himself.

The exercise can also be achieved by bringing the patient's legs closer to the final line of the bed accompanied by grabbing the trunk and legs and rotating them at the same time, so that the legs come out of the bed as in the figure.

If the patient has undergone intervention in the coxo-femoral joint, we should place him sitting on the side of the fracture. During the posting, the legs should stay apart. It is important to stop the rotation of the operated limb. If it is difficult for the therapist, an assistant is called to hold the patient.

From The Bed - To The Carriage And Vice Versa

We have to arrange the cart at a 30º angle adapted to the bed. We position the patient sitting. The individual manages to keep the balance guided by the therapist who indicates the forward movement of the trunk and if it is important, fixes the patient's knees with his legs. The elderly person takes small steps in order to have space to turn his body and sit down.

When the patient has pelvic fractures, the cart is placed on the healthy side, on which the patient can lie down and rotate. To avoid the patient slipping, the therapist blocks the healthy leg in front. From the fracture side, the therapist's support is important, so the exercise may also require help; thus the patient avoids the weight of the body on the operated limb.

In The Wheelchair - When The Patient Slides Forward With The Pelvis

If a therapist fails to support the patient's weight, he calls the helper and they position themselves on both sides of the patient, cross their arms with his and with the other hands placed below the thighs, lift and move the sitting patient in the right way. It is important that the spine is straight and supported evenly throughout the pelvis; that is to avoid lateral inclination. Let's not forget to block the wheelchair of the elderly before the move is made.

From The Stroller To The Bed

The carriage-bed transfer is possible by bringing the carriage as close as possible to the bed. If the patient has fractures, then the wheelchair is positioned from the healthy limb, which will bear the weight of the body during the transfer. The patient rotates, using the healthy leg, and we make him sit on the bed.

Positioning In Bed

When the patient is not able to follow the above steps, then the exercise also requires help. To facilitate the movement of the patient (for example, to go a little higher in bed), a carcaf is placed below to help the therapist to protect his back. If the carcass is missing, then in addition to the trunk, the patient's lower limbs also need support.

The elderly are always at risk of falling. For the prevention of radiation, it may be necessary to adapt the helpers that are evaluated by the physiotherapist before use by the elderly: walker, cane, crutches, etc. Small adaptations at home can also help, such as: small portable stairs that are placed under the bed, elimination of carpets, grab handles in the toilet and curbs on the stairs of the house if there are any.

Special Recommendations For Patients With Coxo-Femoral Prostheses

Patients with coxo-femoral prostheses should avoid 3 movements, especially combined exercises to avoid luxation of the prosthesis.

Pelvic flexion of more than 90º should be avoided; adduction and internal rotation of the pelvis. The elderly should avoid sitting with the operated leg above the other. Sitting on low chairs, sofas, toilets, bidets should also be avoided.

In order to avoid the luxation of the prosthesis, you should use the water lift (wc), hold a pillow between the two legs. Let's not forget that the healthy leg supports the weight of the body when the patient is positioned on one side. This position is comfortable and for the hygiene of patients who do not move from the height.

The positions mentioned above are the main indications for the continuation of a quality recovery, but we must not forget that the genuine mobilization of the elderly is a minimum of about one hour on all days of the week; and then the family members are left with the task of implementing the rehabilitation protocol created by themselves for each individual patient. Various studies have shown that high-intensity rehabilitation exercises are able to provide good results against functional limitations and in elderly patients. The more intensive and time- focused the rehabilitation after the traumatic moment, the more the expected result will improve. Only a high-level rehabilitative treatment gives the desired results. Different polypathologies are the main factors that cause frailty "weakness" in the elderly. The elderly need different rehabilitation treatments. In this framework, the support and rehabilitative methodology should be adapted not only based on the existing pathologies of the patient, but also depending on his age.

2. TREATMENT OF THE HEMIPLEGIC PATIENT ACCORDING TO THE FNP METHOD - PROGRESSIVE NEUROKINETIC FACILITATION (PROGRESSIVE NEUROKINETIC FACILITATION)

Acute Phase

Functional postures for the hemiplegic patient

The treatment starts from the functional (correct) posture. To position the limbs with the knee in flexion and the pelvis in flexion means to organize the movement in synergy.

If it is important that in the acute phase the synergies are broken and a division of movement is inserted, then the hip should be in extension and the knee in flexion. This positioning can be achieved in 3 positions of space:

Anterior Chain Extension

Hips in extension and knees in flexion inhibit extensor synergy. The extension of the quadriceps muscle should be at 90º, an initial extension (pumping) of the muscle can avoid possible contractions.

As the days pass, we must prepare the muscles of the elderly for a greater extension of the muscular chain. In this way, not only the elasticity of the muscles is achieved, but the reflexes acquired during pumping (extension) decrease and the whole limb reacts faster. Hypertonia decreases, the leg is "softer", controllable and ready for subsequent exercises;

- physiological leg support is allowed
- an extrarotation of the pelvis is avoided.

Subsequent exercises:

- the biarticularity of the ischiocrural muscles is favored
- it is allowed to detach the leg from the floor with the pelvis in extension.
- prepares the correct positioning of the knee

It should not be forgotten that the patient who does not present stability in the knees cannot maintain balance. If you do not distribute it, balance the weight on both knees, the same situation would present in the state of balance. If the trunk is not symmetrical, the therapist has the answer, without trying to keep the patient on his feet.

Posterior Chain Extension

Immediate advantages

- The pelvis in flexion and the knee in extension inhibit flexor synergy.
- Maintains the elasticity of the ischio-crural muscles
- The flow of hemato-lymphatic circulation is improved

Subsequent exercises:

- Enables a full step with heel support
- A contraction in the biarticularity of the quadriceps muscle is favored

- contributing to the extension of the posterior chain (trunk, pelvis, thighs, legs)

The extension of the posterior musculature is very important because it disrupts the flexor synergy, the contracted ischiocrural muscles do not allow a full step to be taken.

With functional postures, we should be satisfied with keeping in tension (extending) an interested muscle group. For the lower limb, we are particularly interested in the biarticular muscles, and for the upper limb, we are interested in the scapulohumeral muscles, which are responsible for the onset of shoulder pain. So in the treatment we should be interested in extending those muscular chains which we cannot put under tension with the functional postures. In particular, we need to stretch the piriformis, medial and minor gluteal muscles, the intervertebral trunk muscles, the lumbar quadrate to achieve the extension of the entire postero- lateral chain, which is essential for the organization of the step (walking).

Progressive Treatment İn The Post-Acute Phase

Treatment starts with exercises in the lateral position of the patient. In this position, gravity is neutral (does not affect); thus, every response of the patient, even the smallest, can be manifested without effort, thus avoiding the activation of pathological responses. The patient manages to feel the limb with plegic neglect (hemiplegia of one limb) from which he manages to lose control and collapse. This position gives him the opportunity to control the plegic limb himself; it is very important in the presence of negl. Also, when the patient presents visual disturbances (hemianopsia) in this position he can see both his limbs and in relation to the objects that finalize the action. Stimulation at different levels of the first responses of the trunk and hemiparetic limbs of the patient without allowing him to be helped with the healthy hemisome is a fruitful therapy in the recovery of the patient with hemiplegia.

The anterior elevation of the pelvis stimulates blood flow in the hemiplegic limb, and also stimulates the sensibility of the elderly towards this limb. This is how we manage to build a therapeutic complex including the patient's hemiplegic limbs.

The first step of ambulation is the selective stimulation of the abdominal muscles. It helps the patient to exercise for the support of the foot on the ladder and will also allow the advancement of the exercise by reaching the support of the heel.

Preparing the gluteal musculature by achieving a lengthening of that muscle chain helps ensure the patient achieves balance.

The last but not least important exercise for this type of treatment is the balancing of the upper limbs. It ensures the patient to sit straight without possible inclinations. It also serves for walking symmetry.

An early therapeutic treatment is very necessary to lay the foundations of walking in patients with hemiplegia, thus describing the acute phase until the achievement of maximum performance. Maximum attention should be paid to maintaining muscle elasticity during positioning and specific maneuvers to achieve qualitative, not quantitative, movement at the time of recovery. By keeping the muscles of the trunk and limbs elastic, the responses (feedback) of deficit functions are improved; awareness about the plegic limb increases. Therapy with progressive exercises strengthens the verticalization of the patient's vertebral column, enabling him to balance naturally and without strain (the basic condition for stopping the growth of spasticity).

Immobilization Syndrome

Immobilization syndrome refers to the complex of signs and symptoms of different body systems; it manifests itself when an elderly person is forced not to move (in bed or another type of forced decubitus) for a long time.

Elderly predisposed:

- physiological limitation of functional reserves and adaptive mechanisms
- the existence of chronic-degenerative pathologies
- visual and auditory deficits
- orthostatic hypotension
- social isolation

Complications From İmmobilization İn The Physiotherapeutic Aspect

Musculoskeletal apparatus:

Muscle atrophy and loss of strength Osteoporosis and osteoarthritis Muscle contracture

Consumption of bones that are under tension and support the weight of the body After 3-4 weeks we encounter cartilage erosion and necrosis

From the studies done and from the existing reports, one month of immobilization reduces 45% of mobility. A month and a half of immobilization affects the permanent loss of mobility. Muscle strength decreases by 5% per day. There is a decrease in glycogen storage. Double reduction of the musculature of the lower limbs compared to the upper limbs. The length of muscle fibers decreases, muscle mass decreases. After 6 months of immobilization, the weight of the muscle decreases to 50%. After a prolonged immobility, in addition to having muscular atrophy, it also presents a decrease in resistance and the desire to perform physical activities. These lead the patient to osteoporosis from disuse of bones. Immobilization in bed is also a cause of malnutrition.

Decubitus ulcers

The consequences of immobilization and those of decubitus are often related and are always confused with each other. Prolonged immobilization increases the possibility for the elderly to fall asleep, thus scaring them not to move from the bed and causing even more complex problems than we have mentioned above. From staying in bed for a long time, decubitus wounds are formed, which are areas with lesions (openings) of the skin caused by the lack of blood circulation in those areas (feeding with oxygen and nutritional substances). They are formed at the ends of important bones as a result of pressure exerted all the time in the same body areas. The factors that lead to the formation of decubitus wounds are: hydration and nutrition, anemia, hypotonia, diabetes, incontinence (prolonged wetness).

First signs:

- Ischemia
- Redness
- Abrasion

- Necrosis

The most risky areas are different. They depend on the positioning of the elderly in bed (shoulder, lateral decubitus or sitting). Staying for a long time in lateral decubitus (on one arm) risks injuries in the areas:

Trochanter
Malleolar areas
Auricular lobe
loop
Shoulders

Correct positions

A long or inappropriate stay of the elderly sitting in a wheelchair or chair can cause damage to the areas where more pressure is exerted: scapulae, ischial tuberosities, popliteal cavity, heels. They can be prevented by placing anti-decubitus pillows or wheelchairs with an anti-decubitus posture system.

Positioning

The semi-pronation position is preferred by the elderly. The pronation position is adapted for the elderly with vertebral fractures or surgical intervention in the vertebral column.

In the supine position, a pillow under the legs and a pillow under the knees is necessary so that the heels stay in the air and do not burn the bed.

Mobilization in Bed

Mobilization must be done every two hours by two operators in different postures and positioning.

Lateral Decubitus

Lateral decubitus from the left side of the elderly is performed with the left leg in extension, the right leg in flexion and supported on a pillow, the right arm extended on the bed and away from the patient's trunk, the right arm is placed in half flexion and with my hand resting on a pillow.

In the case of trauma or stroke, the patient should be placed in lateral decubitus on his healthy side. Limbs that do not sleep in bed should be positioned with pillows as above.

Mobilization of the Patient

Body positioning and active-passive mobilization

Physical exercise in a straight position prevents the reduction of aerobic capacity, prevents osteoporosis.

Keeping the elderly in a functional condition teaches the elderly the correct positioning and gives us the possibility of mobilizing the whole body.

Physical and sports exercises in the elderly

Rehabilitation serves for:

- A stay in bed as short as possible
- global movement recovery and to achieve functional autonomy
- a better, healthier return home
- improving the quality of daily life, work and social life
- in addition to the rehabilitation of the operated limb, the physiotherapeutic training also mobilizes the healthy limbs, the respiratory and cardiovascular apparatus and the posture.

Reeducation in Bed

- positions and movements with risk of injury for the elderly are avoided
- active assisted mobilization
- isometric contractions
- pelvic movements
- rotations

After A Few Days of Mobilization in Bed

- exercises with increased difficulty for all the patient's limbs and trunk (ROM, tone, strength)
- physiotherapeutic exercises, facilitating forces for lengthening the anterior-posterior kinetic chains
- walking to the parallels after evaluating the rehabilitation of the patient

Isometric Exercises (No Joint Movement):

1.Wall Push

- How to Perform: Stand facing a wall, place your palms flat against it at shoulder height, and press into the wall with steady pressure for 10-15 seconds. Relax and repeat 5-10 times.
- Benefits: Strengthens chest and shoulder muscles without joint movement.

2.Seated Knee Press

- How to Perform: Sit in a sturdy chair with feet flat on the ground. Place both hands on one knee and press gently while resisting with your leg. Hold for 10-15 seconds. Alternate legs.
- Benefits: Strengthens thigh muscles and improves stability.

3.Hand Clench

- How to Perform: Sit comfortably and hold a small, soft ball in one hand. Squeeze it firmly for 5-10 seconds, then release. Repeat 10-15 times per hand.
- Benefits: Improves grip strength.

Isotonic Exercises (With Joint Movement):

1.Chair Squats

- How to Perform: Stand in front of a chair with feet shoulder-width apart. Slowly lower yourself as if sitting, then stand back up without using your hands. Perform 8-12 repetitions.
- Benefits: Strengthens thighs, hips, and improves balance.

2.Bicep Curls

- How to Perform: Sit or stand with a light dumbbell in each hand. Slowly curl the weights up to shoulder level, then lower them back down. Repeat for 10-15 repetitions.
- Benefits: Improves arm strength and functional movement.

3.Heel-Toe Raises

- How to Perform: Stand behind a chair for support. Lift your heels off the ground, then lower them. Follow by lifting your toes and lowering them. Perform 10-15 repetitions.
- Benefits: Enhances calf and foot strength for better walking stability.

Safety Tips:

- Perform exercises near a sturdy support, such as a chair or wall.
- Start with light resistance or body weight, progressing gradually.
- Avoid holding your breath during exercises.
- Stop if you experience pain or discomfort.

Postural Exercises

These exercises help improve alignment, reduce rounded shoulders, and strengthen postural muscles.

1.Wall Angels

How to Perform:

- Stand with your back against a wall, feet a few inches away from it.
- Flatten your lower back against the wall.
- Raise your arms to shoulder height, bending your elbows at 90°.
- Slowly slide your arms up and down the wall like making a snow angel.
- Perform 8-12 repetitions.
- Benefits: Improves shoulder mobility and strengthens upper back muscles.

2.Seated Shoulder Blade Squeeze

How to Perform:

- Sit on a sturdy chair with feet flat on the floor.
- Gently squeeze your shoulder blades together, as if holding a pencil between them.
- Hold for 5-10 seconds, then release. Repeat 10 times.
- Benefits: Strengthens upper back and corrects rounded shoulders.

3.Chin Tucks

How to Perform:

- Sit or stand upright.
- Slowly tuck your chin in toward your neck, creating a "double chin."
- Hold for 5 seconds, then release. Perform 8-10 repetitions.
- Benefits: Improves neck posture and alignment.

4.Pelvic Tilt

How to Perform:

- Lie on your back with knees bent and feet flat on the floor.
- Tighten your abdominal muscles to flatten your lower back against the floor.
- Hold for 5-10 seconds, then relax. Repeat 8-12 times.
- Benefits: Strengthens core and aligns the lower back.

Muscle Stretching Exercises

Stretching improves flexibility, prevents stiffness, and enhances mobility.

1.Chest Stretch

How to Perform:

- Stand near a wall or doorway.
- Place your arm at shoulder height with your elbow bent at 90°.
- Gently press forward until you feel a stretch across your chest.
- Hold for 15-30 seconds per side.
- Benefits: Opens up the chest and counteracts forward posture.

2.Hamstring Stretch (Seated)

How to Perform:

- Sit on the edge of a chair, one leg extended forward with the heel on the floor.
- Keep your back straight and lean slightly forward from your hips until you feel a stretch in the back of your thigh.

- Hold for 15-30 seconds per leg.
- Benefits: Improves hamstring flexibility and reduces tightness in the lower back.

3.Neck Side Stretch

How to Perform:

- Sit upright, shoulders relaxed.
- Tilt your head to one side, bringing your ear toward your shoulder.
- Hold for 15-20 seconds, then switch sides.
- Benefits: Relieves tension in the neck and shoulders.

4.Seated Spinal Twist

How to Perform:

- Sit on a chair with feet flat on the ground.
- Place your right hand on the outside of your left knee and your left hand on the backrest.
- Gently twist your upper body toward the left, holding for 15-20 seconds. Switch sides.
- Benefits: Enhances spinal mobility and posture.

5.Calf Stretch

How to Perform:

- Stand facing a wall, place your hands on it for support.
- Step one leg back, keeping it straight, while bending the front knee.
- Keep your back heel on the ground until you feel a stretch in your calf.
- Hold for 15-30 seconds per side.
- Benefits: Increases calf flexibility and reduces stiffness in the ankles.

Tips for Safety and Effectiveness

- Perform stretches slowly and avoid bouncing.
- Stretch to the point of mild tension, not pain.
- Focus on deep, steady breathing during exercises.
- Hold each stretch for at least 15-30 seconds and repeat 2-3 times.

- Rehabilitation exercises after 3 weeks
- diversity of exercises and increase in their repetition
- therapeutic exercises for balance and stretching the trunk, strengthening the baricenter sitting and then standing
- exercises in orthostatism to change the center of gravity
- proprioceptive exercises
- the exercise of walking with unilateral support (with the healthy leg), the use of a crutch Forcimi i bariqendres dhe ndryshimet e postures

Orthostatism - Proprioception - Balance

In the following days, the same exercises are repeated. The therapist makes sure that the elderly person memorizes and indicates to him the exercises that can be repeated without the presence of the therapist. The elderly exercise by walking and climbing stairs.

The Sixth Week

We must take care of the completion of all phases of rehabilitation, avoiding possible complications and ensuring that the elderly maintain balance and walk without the help of crutches or crutches.

3. FRACTURES IN THE ELDERLY

The most frequent falls and fractures

Falling is classified as an involuntary transfer of the body towards the floor or towards an inferior level compared to the previous one; including that caused by a violent blow; by loss of consciousness; from a sudden stroke; from an epileptic crisis.

Risk factors for falling in the elderly are:

- Internal factors
- External factors
- Environmental factors

The decrease in strength and resistance after 30 years (10% less in each decade) and the decrease in muscle strength (30% less in each decade) lead to a decrease in physical functionality and in the activities of daily life, which become difficult to performed. Aging, in addition to being demonstrated by a decrease in strength, is also associated with other changes that hinder well-being, among which is postural instability, reduced walking speed, slower and shorter steps, prolonged reaction time, decreased hearing and sight. The well-being problems of the elderly can also be caused by a malfunction of the nervous, musculoskeletal system, decreased blood circulation, decreased respiratory function, etc. Any type of debilitating concern regarding the lower limbs increases the probability of falling.

Radiation is classified as:

- Accidental (14%): when the individual falls involuntarily (slipping on the wet floor
- Unpredictable physiological (8%): when they are favored by unpredictable physical conditions until the moment of the fall (eg pathological fracture of the femur).
- Predictable physiological (78%): when they come from exposed subjects with unidentifiable risk factors.

When the patient is accidentally exposed to radiation, he is not considered as an individual at risk of relapse.Reniet dhe frakturat

The main reasons for staying in the hospital among people aged 65 and above are falls. In the majority of patients, these declines are mainly accompanied by fractures of the lower limb such as: coxo-femoral fractures, femur, etc.; fractures of the radius, ulna and other bones of the upper limb; neck and spine invoices.

Fractures in the Elderly

In the elderly, fractures can be divided into: traumatic and pathological. They are the subjects most predisposed to fractures, whether due to light or moderate trauma, because they have an increased probability of radiation; also their bones are more fragile due to osteoporosis or other factors characteristic of this age.

The average age predisposed to an osteoporotic fracture is 76 years. Fractures of the femur, vertebrae, leg, humerus, wrist, wrist, clavicle, pelvis, pelvis are closely related to the reduction of bone mass. Fractures that are verified as 'spontaneous' or the most frequent, caused by almost insignificant trauma are called pathological fractures. These fractures occur in bones in which their strength and density have weakened due to various pathologies that have acted on them. The most common factors for these fractures are osteoporosis and malignant tumor. In the elderly, according to studies, the most important factor for a fracture is exposure to sunlight. The most frequent fractures in the elderly are those of the proximal part of the femur and ankle.

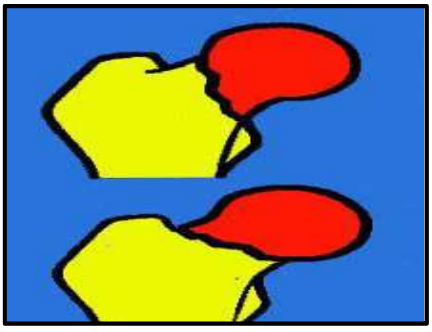
Fracture of the Femur

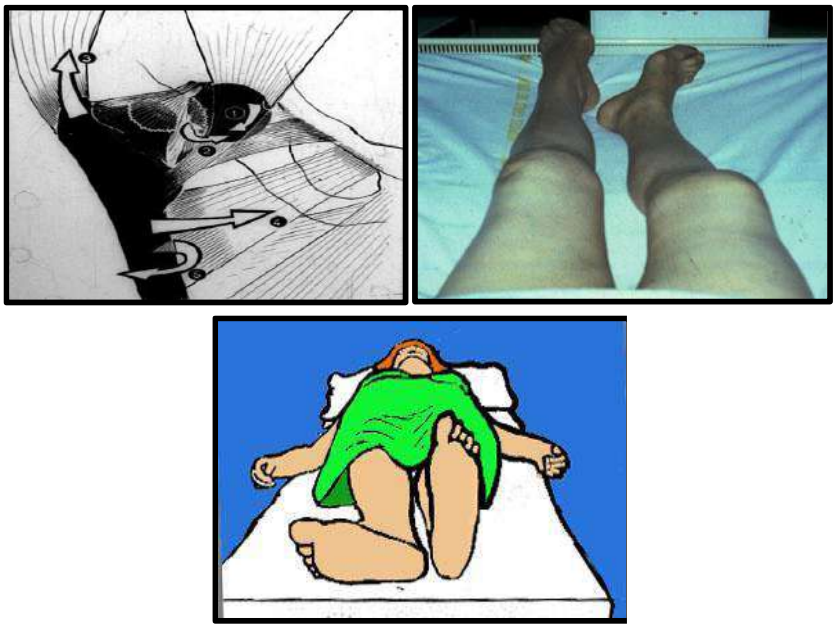
In all patients with femur fractures, the permanent ambulatory disability is 20% of the cases and only 30%-40% of the patients achieve the autonomy and activity of the previous life. In addition to the decline in the elderly, smoking or immobility also affects the weakening of the bone and thus the cause of a fracture of the femur. This fracture in the elderly is often a combined action between decline and osteoporosis. It can also be called 'fragility fracture'.

Femoral Neck Fractures

oblique fractures → they are less stable

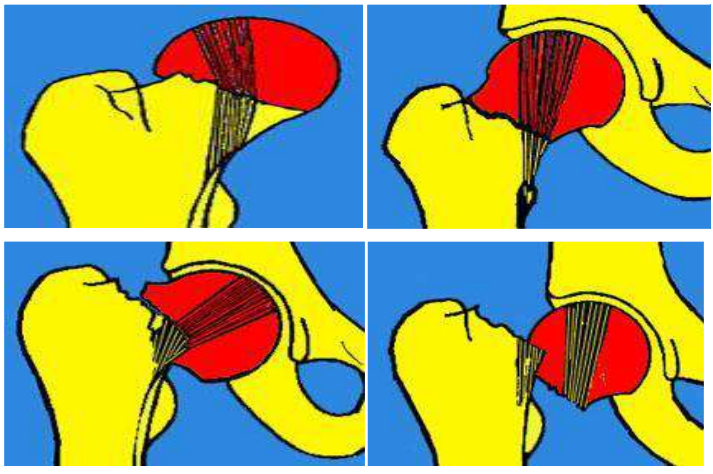
Horizontal fractures → they are more stable





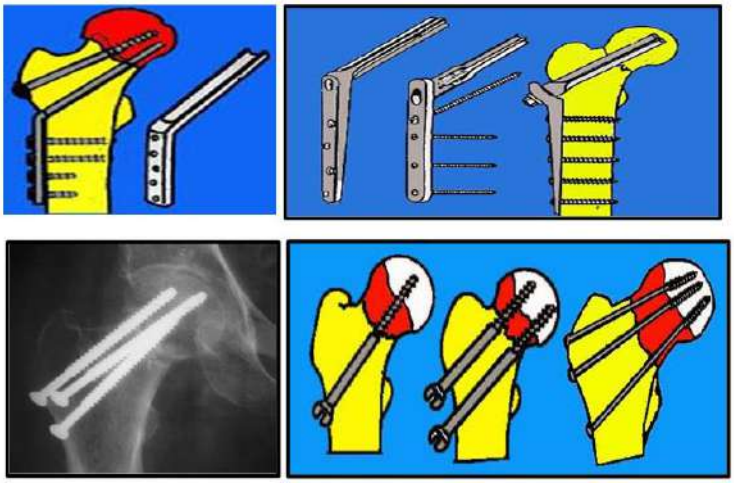
Femoral neck fractures are often associated with femoral neck prosthesis since bone grafting, whether by the method of synthesis tools such as screws and plates, does not provide security to the patient due to age, which makes bone consolidation almost impossible, pathologies, and wear and tear of the bone itself.

Types of Femoral Neck Injury



Appearance of the damage on the relevant X-ray:

Osteosynthesis of the femoral neck fixed with plates and screws is a therapy that is applied to the elderly only when the femoral fracture is able to withstand the patient's body weight and provide him with stability while sitting and then achieving balance.



Femoral prosthesis is the most commonly used intervention in elderly patients, both for stability and longevity. In the elderly, the prosthesis, in almost all cases when placed after the age of 65, does not reach the maximum wear and tear to be replaced; therefore, it is the best and most recommended choice by orthopedic surgeons.

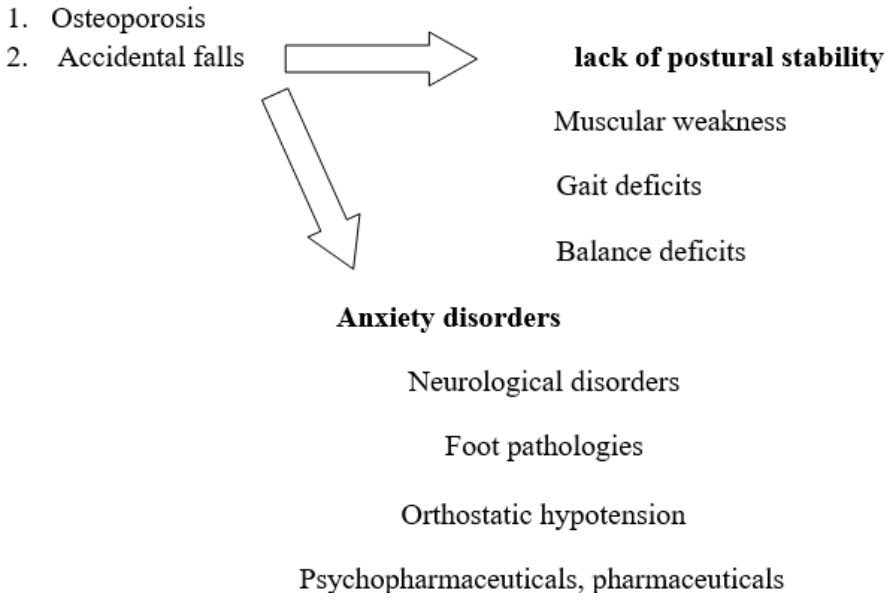
Thompson prosthesis

Moore prosthesis

4. REHABILITATION OF FEMUR FRACTURE

Rehabilitation includes all therapeutic maneuvers that prevent and reduce the prevalence of disabling diseases with the main objective of 'improving the quality of life' in relation to the environment of the elderly. For successful rehabilitation, it is necessary to:

- an accurate diagnosis
- disability assessment
- timely and appropriate treatment related to the medications the elderly person is taking As mentioned above, the main causes of femur fracture are:



5. OSTEOPOROSIS AND PHYSICAL EXERCISE

Physical exercise is able to stop 1% of bone mass loss and should achieve moderate and long- term bone stimulation.

Types of exercises

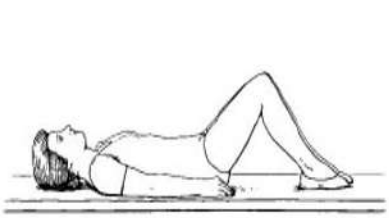
- osteoporosis-specific exercises indicated by Dr. Sinaki
- aerobic activity with natural load (walking in nature with the normal step of the elderly, jumping, climbing and descending stairs)
- resistance exercises with weights and elastic bandages

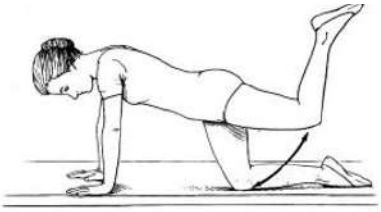
Exercises that cause exaggerated flexion and rotation of the spine; sudden and thoughtless movements should be avoided.

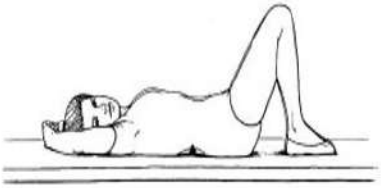
Rehabilitation of Lack of Postural Stability

Balance is maintained through repeated displacements of bone segments originating from continuous uncontrolled movements of muscular contractions and relaxations which must be corrected frequently by controlling the center of gravity so that the latter does not move away from the base of support.

Dr. Sinaki's Exercises







Balance is regulated by:

- Proprioceptive sensitivity
- Visual system
- Vestibular system
- Cerebellar system
- Muscular system

Exercises to create postural stability:

- Proprioceptive exercises
- Muscle power exercises
- Passive and active joint mobility exercises
- Exercises to correct posture in hyperkyphosis

- Achieving strength of the trunk extensor muscles
- Stretching of the posterior muscular chains
- Respiratory exercises with education of the diaphragm and ribs
  Proprioceptive gymnastics
- enables the reprogramming of the normal motor scheme of movement; the reeducation of proprioceptive reflexes with the aim of optimal joint control through a perfect muscular play.
- Proprioception, understood as the perception of joint position and joint movement, can be stimulated with various exercises such as:
  tracking and stretching Freeman's proprioceptive tables
  Stabilometric pedal

The Freeman table with a crescent base with a single axis of movement allows for flexion- extension, pronation-supination, inversion-eversion exercises; then it moves on to the table with a spherical base which allows for combined circumduction movements.

The Stabilometric Pedal, through software, provides visual feedback that allows you to adjust your weight distribution by drawing traces; forcing the nervous system to follow the correct steps through a continuous corrective work to keep the body in balance; verifying in real time the precision or errors made.

Characteristics of Physical Exercise in the Elderly

Personalized in relation to:

- Age
- Physical structure
- General clinical condition
- Lifestyle
- Degree of osteoporosis
- Daily physical exercise
- The patient must constantly and regularly follow the physical exercises at home indicated by the therapist.
- The exercises must be repeated to achieve safety, speed and accuracy in gestures.

Assistive Devices

In special cases, the indication is important:

- assistive devices for deambulation (crutches, canes, walkers)
- toilet supports for transferring the elderly
- special socks with anti-slip bases and predisposed to plantars
- dorso-lumbar corset to force maintaining correct posture, avoiding incorrect movements, relieving pain, improving proprioception, reducing or preventing dorso-lumbar hyperkyphosis

6. REHABILITATION PROTOCOL FORPATIENTS WITH OSTEOSYNTHESIS AND ENDOPROSTHESIS OF THE COXOFEMORAL JOINT

Starting from the 1st day with a rehabilitation appropriate to the patient's current conditions, rehabilitation is proceeded with in bed, with sitting and in a wheelchair. A series of exercises should be prepared that the patient should follow with the cooperation of the family. Each exercise should be explained and demonstrated by the therapist.

On the 2nd day, the patient's independence should be gradually increased, achieving greater mobility (it is better for the patient to receive commands verbally than to be helped by the therapist). Walking with a walker is started, gradually increasing the load (body weight) and the length of the steps, avoiding pain.

From the 4th-5th day, if the patient is able to bear weight on the operated limb, then he can begin performing proprioceptive exercises with alternating the center of gravity and exercises with stretching of the pelvic flexor

- Pacienti duhet te behet sa me i pavarur ne ekzekutimin e ushtrimeve
- Continue walking at least 2 times a day with the assistance of the therapist
- When the patient has achieved good balance with the use of two crutches, he/she is trained to climb by putting the healthy leg in front; and to descend by supporting the operated limb first
- The patient will hold both crutches until he/she gains stability and no longer feels pain; without the latter, only one crutch held by the healthy limb is suggested.

  Rehabilitation of patients with total joint replacement
- Start with postural steps in a wheelchair on days 3-4
- Verticalization (achievement of balance) with a walker on days 4-5
- Walking with a walker or 2 crutches for one month
- Remove the crutch from the healthy leg after one month (always verifying the patient's condition, balance, presence of pain, walking without pelvic compensation)

Proprioceptive Exercises for Geriatrics with Total Joint Replacement

1.Weight Shifting

How to Perform:

- Stand upright with feet shoulder-width apart.
- Hold onto a sturdy surface (e.g., a chair or countertop) for support.
- Slowly shift your weight from one leg to the other, feeling the pressure change under each foot.
- Hold each side for 5-10 seconds and repeat 8-12 times.
- Benefits: Improves balance and body awareness, especially for knee or hip replacements.

2.Single-Leg Stance (Supported)

How to Perform:

- Stand beside a chair or countertop, holding on lightly for support.
- Lift one leg slightly off the ground, balancing on the other.
- Hold for 5-10 seconds, then switch legs.
- Perform 8-10 repetitions per leg.
- Benefits: Enhances balance and stability around the replaced joint.

3.Tandem Stance

How to Perform:

- Stand with one foot directly in front of the other, forming a straight line.
- Hold onto a support for balance initially.
- Gradually reduce support as balance improves. Hold for 10-20 seconds and repeat 5-8 times.
- Benefits: Improves postural control and coordination.

4.Heel-to-Toe Walk

How to Perform:

- Walk in a straight line, placing the heel of one foot directly in front of the toes of the other.
- Use a wall or rail for support if needed.

- Perform 10-15 steps, turn around, and repeat.
- Benefits: Enhances balance, coordination, and gait stability.

5.Foam Pad Balance

How to Perform:

- Stand on a soft foam pad or folded towel.
- Hold onto a sturdy surface for support.
- Practice standing still for 10-15 seconds, progressing to gentle weight shifts or single-leg stances.
- Benefits: Challenges balance by reducing stability underfoot.

6.Step-Ups

How to Perform:

- Use a low step or platform (4-6 inches high).
- Step up with one leg, followed by the other, then step back down.
- Hold onto a rail for support. Perform 10-15 repetitions.
- Benefits: Strengthens the leg muscles and improves proprioception in the replaced joint.

7.Seated Ball Squeeze

How to Perform:

- Sit on a chair with feet flat on the ground.
- Place a small ball or cushion between your knees.
- Gently squeeze the ball, hold for 5-10 seconds, and release. Repeat 10-15 times.
- Benefits: Engages hip stabilizers and improves proprioceptive feedback.

8.Side Stepping

How to Perform:

- Stand upright with feet hip-width apart.
- Step sideways with one foot, followed by the other, maintaining balance.
- Perform 10 steps in each direction.

- Benefits: Improves lateral stability and hip joint control.

9.Chair Marching

How to Perform:

- Sit in a sturdy chair with feet flat on the ground.
- Slowly lift one knee, hold for 3-5 seconds, then lower it. Repeat with the other leg.
- Perform 10-15 repetitions per leg.
- Benefits: Enhances coordination and strengthens the lower limbs.

10.Standing Mini-Squats

How to Perform:

- Stand with feet shoulder-width apart, holding onto a chair or countertop for support.
- Slowly bend your knees slightly (as if starting to sit) and return to standing.
- Perform 8-10 repetitions.
- Benefits: Builds strength and proprioception in the knee or hip joint while being low impact.

Safety Tips

- Progress Gradually: Start with supported exercises, reducing reliance on support as balance improves.
- Avoid Pain: Stop any exercise if pain or discomfort occurs in the replaced joint.
- Use Proper Footwear: Wear non-slip, supportive shoes for better stability.
- Follow Post-Surgical Guidelines: Ensure exercises align with the recommendations of a physical therapist or healthcare provider.
- Create a Safe Environment: Perform exercises in a clutter-free area with sturdy furniture for support.

The Criteria That Must Be Met By The Patient To Go Home

- to have the autonomy to complete postural steps in bed
- to be able to walk with assistive devices (crutches, canes, walkers, etc.) for at least 15 meters.
- to be able to perform his personal needs with assistive devices.
- if such criteria are not met or the patient lives alone and in his home there are architectural barriers that limit his autonomy, it is necessary that the rehabilitation continue to be followed in the hospital with a long stay of the patient in those facilities.

Exercises And Tips For At Home

It is very important to do physiotherapy for the patient after discharge from the hospital according to the above scheme. Muscle strengthening exercises should be repeated many times during the day. Each exercise should be performed by holding the position for 5 seconds.

It should not be forgotten that the patient is contraindicated in dangerous positions as shown in the figure. Hyperflexion of the spine leads to dislocation of the femoral head prosthesis. The same danger is posed by sitting in a chair with one leg over the other, or by the patient leaning forward. The smaller the angle of the pelvis with the femur, the higher the probability of the prosthesis coming out.

Rules to follow after endoprosthesis and total arthroprosthesis

- use a pillow to maintain pelvic abduction, avoiding adduction, flexion of more than 90° and intrarotation.
- it is advisable to use a cyclette after the 20th day of the intervention
- avoid intrarotation of the operated limb for at least 2 months
- use the Watter lift for two months, trying to fix it well
- the patient is not allowed to sit cross-legged for the first 2 months
- placing a pillow in the chair for at least one month avoids the risk of prosthesis dislocation
- when sitting and raising the patient, a certain distance between the knees should always be maintained. When getting in and out of bed, care should

be taken as it is advisable that the postural steps be achieved from the side of the operated limb.

- climb the stairs with the scheme: crutches - healthy leg - operated leg
- descend the stairs with the scheme: crutches - operated leg - healthy leg
- after leaving the hospital, the patient should be provided with a chair with armrests where he can lean in order to balance his body weight, to avoid the weight on the operated limb.
- avoid increasing body weight

Assistive Devices and Orthoses

The use of assistive devices (braces) and orthoses helps in the recovery of ambulation and in greater autonomy in activities of daily living even when the level of ability or type of intervention does not allow it.

- Assistive devices for therapy and exercise: parallel bars
- Assistive devices for personal mobility (mobility): walker, quadripod, tripod, crutches with support, cane, cane.
- Personal assistance and protection devices: toilet lifts, handles, shower chair, tongs to reach objects.
- Orthoses for ambulation: hip-thigh brace, thigh-foot brace, anatomical insoles, etc.

7. FUNCTIONAL IMPAIRMENT OF THE RESPIRATORY SYSTEM, RESPIRATORY PROPHYLAXIS AND PHYSIOTHERAPEUTIC TECHNIQUES

The geriatric patient in most cases suffers from a decrease in respiratory function often accompanied by cough and secretions. Despite the fact that this patient may be hospitalized, the therapist immediately presents contraindications that may further complicate the patient's current condition:

- The patient is taught the correct breathing and coughing techniques. Deep breathing favors the expansion of the lungs and coughing in this case provokes the expulsion of secretions present in the lungs.
- The patient is moved to favorable positions for easier breathing every 2 hours. It must be checked that the position indicated by us improves breathing.
- The patient is prepared for early deambulation. The pace of respiratory exercises is gradually increased to cope with deambulation later. Encourage the patient to get out of bed if possible and go to the bathroom on their own, to move around the hospital or at home every 4 hours. If the patient is unsure, the family member (in the absence of the therapist) is given the task of accompanying the individual at all times.
- The correct position is achieved that favors deeper and easier breathing. The functional position and upright posture of the patient while walking are important to favor adapted breathing.
- The patient is advised to eat little but more meals. Excessive food has difficulty in digestion and hinders the patient's breathing in a sitting position.

7.1 Deep Breathing

For a valid prevention of lung problems, the patient needs to take deep breaths every 1-2 hours during the day. By indicating this exercise, the lungs are given the opportunity to expand the volume of the lobes, oxygenation is improved and breathing (ateletiasis) is prevented. Deep breathing also relaxes the patient. For a deep breath, the patient must use not only the thoracic muscles but also the diaphragm with the abdominal muscles.

Technique:

The patient is positioned supine. We position one hand on his chest and the other at the bottom of the rib cage; with the help of a pillow, we suggest that he keep his knees slightly flexed and stimulate his relaxation. (a very effective technique for patients with cardiological problems). The patient is told to breathe normally but by inhaling oxygen through the nose and exhaling carbon dioxide through the mouth. The patient is told that if during breathing his hand placed under the chest rises, then the breathing technique has been correct. Once this technique is learned, it is not necessary to position the hands for each deep breath. The exercise is followed up to 5 times in a row. The patient is told that the exhalation of carbon dioxide will take twice as long as the absorption of oxygen. After learning this exercise, the patient is told that he can use the technique during the day in a sitting position and in balance.

The patient is taught effective coughing, which helps cleanse the lungs by expelling secretions. This exercise is repeated every 2 hours. The patient is positioned sitting in his bed with an upright posture and a cough is provoked with vibration and percussion techniques. If the feet do not touch the floor, then a stool is taken to support them. The patient is told to be supplied with oxygen, an exercise that immediately provokes a cough if the lungs are full of secretions. These exercises are always accompanied by relaxation after each cough.

8. GERIATRIC FOOT; PROPHYLAXIS OF FOOT DISORDERS AND TREATMENT OF GERIATRIC FOOT

Antithrombotic prophylaxis

The elderly patient is at risk of thrombus formation, which can be prevented or treated. It is important to know about elastic stockings, their necessity and function.

Analysis of vascular changes The elderly are characterized by:

- decreased vascular elasticity, decreased muscle tone and valve efficiency
- vascular damage as a result of hypertension
- decreased blood flow to the heart, kidneys and stomach due to the above-mentioned changes and possible arteriosclerotic problems with reduced cardiac supply.

These changes cause the patient to have reduced venous return. The various problems that the patient encounters in this situation are: edema, phlebothrombosis (venous coagulation without vein inflammation), thrombophlebitis (venous coagulation with vein inflammation). It should not be forgotten that the thrombus can break off, provoking pulmonary embolism.

Patient Assessment For Thrombus Development

Patients who are inactive (do not perform physical activities), patients who are immobilized in bed (for example: after surgery); when they present trauma to one leg or pelvis; cardiovascular problems such as heart failure, atherosclerosis, hypertension, varicose veins (varicose veins), blood clotting disorders, dehydration, obesity. Patients who do not have such problems may also present thrombi.

Thrombus forms more easily in the pelvic area or in the patient's legs. Signs and symptoms vary according to the area of thrombus formation: in superficial veins, in small deep veins, or in large veins.

Superficial veins: cephalic, basilic, saphenous.

Signs and symptoms: focused on a certain territory, firm, red area, a cord along the vein is clearly visible and palpable.

Small deep veins: anterior tibial, posterior tibial.

Signs and symptoms: muscular edema over a flaccid surface in correspondence with venous infection, deep muscle weakness, temperature in the affected area, pain on dorsiflexion of the leg (Homans sign); body temperature is also possible, which rarely exceeds 38.3°C.

Large veins: subclavian vein, superior or inferior vena cava, axillary, iliac, femoral.

Signs and symptoms: skin discoloration (dark), edema, not accompanied by local signs of inflammation.

The doctor should be informed of any of the above signs. He may prescribe a conservative treatment to keep the patient in bed with the legs elevated, applying warm, moist compresses. It is not the therapist's job but the procedure should be followed. The main danger for the thrombus is that it cannot remain immobile in the vein.

A part of it can break off and be transported in the venous system as an embolus; if this is possible, then there is a risk of blocking a branch of the pulmonary artery, provoking pulmonary embolism. The patient may not express any signs or symptoms, or may have some combinations such as: dyspnea, retrosternal pulmonary pain, tachycardia, electrocardiographic alterations, fever due to increased leukocytes, convulsions, shock,. The doctor should be notified immediately if the patient presents one of these complications. If the patient does not present the above-mentioned signs but has a family predisposition or is at risk of forming a thrombus, then elastic stockings therapy or anticoagulants can be practiced as a preventive measure. For the geriatric patient, a series of measures should always be taken into account.

Information on thrombus prevention

- If the geriatric patient uses elastic stockings or other solutions such as anticoagulants, this patient should be observed with preventive measures.
- Crossing of the legs and wearing tight clothes should be avoided, special care should be taken with non-therapeutic stockings.
- Prevent compression of the popliteal cavity in the sitting position, in bed, or sitting with the legs out of bed with the knees flexed.
- Change the position every 1-2 hours.
- Elevate the leg for 5-10 minutes after the elderly person has walked or sat in a chair for a long time.
- Apply flexion-extension of the legs and their rotation from left to right - from right to left every 2 hours.
- Frequent walking is advisable if the patient can.
- Drinking fluids and eating whole grains is recommended.

What Should I Know About Elastic Stockings (Anti-Embolism)?

Elastic stockings help prevent thrombus formation by keeping the capillaries and small veins in the patient's leg under tension. This 'therapy' strengthens the blood in the large veins and provokes an increase in blood flow. For optimal advantage, elastic stockings must be placed correctly. If they are too tight, they can reduce blood circulation by stimulating the formation of a clot instead of preventing it.

If they are too light as stockings, they have no effect on the elderly. The exact size of a stocking depending on the individual who applies it should be answered by the doctor and the placement is the responsibility of the nurse. The stockings should be removed every 8 hours. The patient should be checked for skin color at those moments, for any visible symptoms and care should be taken in following the rehabilitation. Mobilization of the limb with the presence of the stocking is usually applied. This way, the foot learns how to cope with blood flow even during limb movement.

9. PHYSIOTHERAPY IN NERVOUS DISEASES

9.1 Alzheımer's

The aging process is accompanied by the inevitable decline of cognitive capacity, disrupting the physiology of all functions of the human organism. When such degeneration appears very early or develops progressively, we are dealing with the clinical syndrome called Dementıa.

The term “dementia” comes from the Latin language and means “to be deprived of one’s mind”. Today, the exact definition of this syndrome is: the global destruction of superior cortical functions (memory, ability to solve everyday problems, visual-motor impairment, control of emotional reactions) accompanied by the complete loss of consciousness. This syndrome can appear in different versions, the most common of which is Alzheimer’s.

This disease does not have very clear causes, but cranial trauma, genetic factors, birth accompanied by the mother's advanced age, race, occupational pathologies, malnutrition, surgical interventions, etc. cannot be ruled out.

Clinical Signs

Defining the clinical picture of a patient with Alzheimer's is difficult. Often the symptoms are incomprehensible in the early stages, not clear enough for an unmistakable definition of this disease. The following are observed:

- Cognitive changes
- Psychiatric symptoms Behavioral disorders

Cognitive modifications – it is difficult even for family members to understand, but the first symptoms of the disease are memory disorders.

The patient is inattentive, forgets the names of people he has met before, forgets fixed meetings, forgets where he left objects, forgets the completion of an action (e.g. preparing a meal). The deficit appears both in short-term memory, in the lack of capacity to receive new information, and in the long-term, the loss of past information, being related either to personal experience or to that of the family circumstances in which he lives. Not only is global memory involved, but also visual and spatial memory, accompanied by the inability to recognize the surrounding space. The patient has difficulty with orientation in time and refuses to stay in places that do not seem familiar to him. Language is so impoverished that short messages filled with grammatical errors remain. And the writing becomes distorted to the point of being unintelligible.

Motor activity is also significantly modified, as is the capacity to use finished objects such as: opening a lock with a key, brushing teeth with a brush, etc. It is very painful for the patients when the phase when the patient loses the capacity to recognize them, to recognize objects and parts of his body.

Psychic symptoms - cognitive deficits are joined by delusional ideas, auditory hallucinations, etc. Anxiety, depression, concentration problems, confusional state are the most frequent signs in Alzheimer's patients. But no less important is the patient's loss of sensitivity. He does not understand when and where he has pain. He only complains.

Behavioral disorders - agitation, violent episodes towards things and individuals, catastrophic reactions, insomnia and disruption of the sleep-wake rhythm, tendency to run away from home, eating disorders, incontinence, numerous falls.

Progression of the Disease

It is important to emphasize that the sooner the disease is identified, the better the patient's adaptation to the current situation is achieved, the easier the rehabilitation is. The relationship with family members is very important, who if they quickly understand the type of disease, can easily adapt and cope with Alzheimer's with less pain.

Alzheimer's is a disease that progresses significantly in 4 phases:

- reactive phase - coincides with the onset of the disease and is characterized by psychological symptoms, especially depression and anxiety, sleep disturbances, gradual detachment from the environment that surrounds it
- neuropsychological phase - is the main and longest phase of the disease in which cognitive deficits appear, accompanied by psychological symptoms and behavioral disturbances. In this phase, the typology of the disease is clearly understood, the diagnosis is made and family members are made aware of the ongoing situation.
- neurological phase – characterized by the advancement of the disease where the mental symptoms worsen, making the patient's current condition more difficult. The presence of generalized seizures is accompanied by walking and balance problems and a spontaneous decrease in motor activity.
- internal (physical) phase – deterioration of the health condition often occurs, often associated with significant weakness, even though the patient consumes more food than normal. In this phase, urinary tract infections, respiratory infections, etc. are present

The Framework of the Evolution of the Disease

Phase I – characterized by the loss of segmental memory. There are parts of the events that the patient cannot connect with the moment in which he is. Responsible limbic system.

Phase II – language deficits become present. The patient is unable to communicate clearly and be understood. Characterized by uncontrolled movements. Responsible left temporo-parietal area.

Phase III – perception deficits appear a little later, spatial orientation is lost, significant decrease in cognition. Responsible right temporo-parietal area.

Phase IV – characterized by the patient's loss of control, aggressiveness, etc. Responsible is the pre-frontal area.

Cognitive and Non-Cognitive Symptoms of Alzheimer's Disease

When talking about cognitive symptoms, we mean changes in memory, modifications of speech (language), changes in the organization of movement, thought and judgment; while non- cognitive symptoms mean changes in mood, sleep-wake rhythm, psychomotor activity, etc.

Cognitive Symptoms

Aphasia – change or loss of the capacity to express oneself, to understand written language, deformation of vowels in speech, articulation of sounds. Aphasia is divided into sensorial (fluent): the patient does not understand what is said to him but manages to express himself; expressive (non-fluent): the patient understands what is said to him but cannot express himself.

Amnesia - lack of capacity to receive, recover information from memory.

Aprasia – inability to carry out a specific, finalized and coordinated motor activity (without any paralysis being present) of the body that should normally fulfill the required activity.

Agnosia – the patient's inability to understand visual, auditory, or tactile information, even though the capacity to perceive and register sensory stimuli has remained intact.

Memory

Memory concerns represent one of the most frequent reasons that lead the elderly to a specific doctor. The difficult situation arises because the elderly are not aware of their disability and it is precisely the family members who seek the help of an expert. These memory deficits when they are still being diagnosed often do not receive the appropriate weight since they resemble the loss or characteristic reduction of past events in the elderly's life. Memory is often given the same value as intelligence since it is one of the most complex functions of human activity and can be defined as the capacity to reproduce in the mind a past experience; in other words, it summarizes a set of functions localized in the brain that are prepared to record messages or information thanks to the cooperation of the sensitive organs (hearing, sight, touch) and to bring them back to us when we need them.

Good memory functioning depends, in addition to the level of integrity, on the degree of concentration that the subject has devoted to a certain event. Memory is also influenced by the presence of various diseases (endocrine, infectious, tumors), the cure of which consists in a total recovery of the capacity to remember. Depression and anxiety are the most frequent causes of memory imbalance.

The terms for describing memory are numerous. The most common and must be known are the terms of short-term and long-term memory:

Short-term memory - refers to the capacity to recall actions, numbers, behaviors after a few seconds or minutes from the time of perception.

Long-term or past memory - the capacity to recall events after several hours or days; corresponds to facts that occurred some time ago and is more resistant in the case of cerebral diseases.

During normal aging, some aspects of memory function decline in the elderly compared to the young: the capacity to remember a 10-digit number after a 'busy' signal decreases, information heard on the radio while driving is almost lost after a short time. There are methods and exercises that can help improve memory. Exercises can be constructive in mental summaries or aloud readings or television programs at least once a day. An alternative is repetition that reminds you of school time (fables, poems, stories). Creating connections between numbers, objects, facts or transforming them into images, colors, numbers require processing of the content and increase the ability to remember. If the elderly person's memory is not very reliable, then they can be helped with tools such as: calendars, notepads, agendas where appointments are noted, programs during the day, alarm clocks to remember events and the right time to perform a process, but this is not always favored since it does not determine what process should be performed, so the same function can be performed by voice recorders that clearly determine the next event. A frequent problem for the elderly is the loss of small objects (keys, pencils, eyeglasses, glasses).

To deal with this problem, the therapist, knowing his most necessary tools as well as those that the elderly person most often requires, places a distinctive sign for each object, such as: pink adhesive tape on the eyeglasses, placing the latter in a visible place; a specific rope for the glasses so that they are secured around the elderly person's neck. It is important to end the actions so as not to risk later leaving the gas on or the lights on.

Behavioral disorders

The presence of behavioral disorders also worsens the level of autonomy in daily life due to cognitive deficits. By paying special attention to this dementia, the therapist helps to meet the unspoken needs of patients suffering from the disease. According to statistics, in Alzheimer's dementia, anxiety is present in 10-60% of cases, aggression in 21-25%, vagrancy in 26-34% of cases, delirium in 20-70% of cases, sleep disorders in 45-70% of cases, depression in 40-60% of cases.

Non-cognitive symptoms: include not only the clinical signs mentioned above but also personality modification, psychomotor hyperactivity, eating disorders, hallucinations, worsening of the confusional state (during each afternoon - otherwise called 'sundown syndrome') and exaggerated or catastrophic reactions.

Behavioral concerns:

- Delirium - the elderly person believes things that are not true.
- Hallucinations - the elderly person sees and hears things that do not exist.
- Apathy, Indifference - the elderly person does not show interest in the world around them.
- Irritability - the elderly person is impatient, gets irritated, gets upset about little things.
- Aggression - towards objects, towards people, towards themselves.
- Agitation - psychic, motor; The elderly person is difficult to manage, does not allow anyone to help them, refuses to cooperate, is arrogant, violent both physically and verbally.
- Depression, Dysphoria – the elderly person is sad (obvious decrease in mood).

- Anxiety – the elderly person is very nervous, alarmed, afraid for no real reason.
- Vagabondism – the elderly person continues to walk without stopping and because he is in an unknown territory.
- Exaltation, Euphoria – the elderly person is very happy or excited for no reason.
- Behavior (anorexia, bulimia) – the elderly person has problems with nutrition, swallowing (chewing); often refuses food, or on the contrary eats a lot.
- Sexual disorder – the elderly person reacts impulsively, without thinking, performs rude and shameful movements.
- Sleep disturbances – the elderly person presents an irregular sleep-wake rhythm (premature awakenings, sleep interruptions, problems sleeping).

Behavioral disturbances in the Alzheimer's patient, when they reach an advanced level, can disrupt the family balance. These are behavioral manifestations that make daily control of the patient impossible. They also provoke worsening reactions in their family members. Elderly people with Alzheimer's present a feeling of temporal-spatial disorientation, a feeling of fear, of facing themselves because they find themselves as a different person from the one they were before.

Alzheimer's Disease Rehabilitation

Throughout the course of the disease's evolution, it is always possible to set specific therapeutic objectives that are able to slow down and improve the most troubling symptoms. The treatment of dementia includes a series of pharmacological or non-pharmacological interventions; focused not only on the control of cognitive deficits but also on the care of associated diseases, on non-cognitive symptoms, on the improvement of the functional state of the elderly, of the patient's caregivers and relatives throughout the life span of the disease.

There are a series of rehabilitation interventions as mentioned above, or rather strategies that limit and slow down the evolution of the disease. Such interventions allow the patient to maintain a high level of autonomy and quality of life, compared to clinical conditions.

Reality Orientation Therapy (ROT)

ROT is a psychogeriatric rehabilitation technique that stimulates cognitive functions, to orient the confused patient with the environment that surrounds him, with time and with his personal history. In patients involved by cognitive symptoms, this therapy is very effective as it significantly improves the patient's responses regarding orientation.

There are two main modalities of ROT: informal and formal.

Informal ROT - provides for the process of continuous stimulation that includes socio-sanitary operators and family members; who during contact with the patient in daily therapy continuously provide information to the elderly. Information is important to be given from the moment the elderly wake up regarding the environment that surrounds him, the season in which he lives, the time, the names and roles of other family members; information that the elderly will retain throughout the day. All those individuals who approach the patient during the day, whether professional educators, doctors, therapists, nurses, other family members, should take advantage of every moment of the day to implement this therapy. Every activity of daily life creates the opportunity for conversation.

Formal rote – applied by one or more expert therapists in the appropriate room, organized in small groups or in individual therapy depending on the situation presented by the patient: confusion, disorientation, etc. The therapy room should be furnished as a place of residence with a clock with large numbers, placed on the most visible wall for all the elderly, with a calendar with pages that can be torn off in order to show the elderly the update, it is also important to have a blackboard in the room. It is important to always start therapy at the same time. These therapies are widely used in nursing homes and nursing homes.

Appraisal therapy – is based on an empathetic relationship (putting oneself in the individual's position) with the patient; communication with the patient involves the elderly person's acceptance of reality, the conditions in which they live, their feelings; and why these are closely linked to the past. It attempts to control and understand the immediate changes in the patient's behavior.

This therapy was tested by Naomi Feil (occupational therapist), who after many years of working with the elderly gave up on attempts to bring them back to reality; after this she learned that by returning to the past, disoriented patients gained a sense of survival.

Appreciation therapy is a method that proposes:

- restoring self-esteem
- reducing tension
- giving meaning to life
- helping to clarify unresolved past conflicts, expressing emotions
- improving verbal and non-verbal communication
- improving physical well-being

It is scientifically proven that when short-term memory is impaired, very elderly individuals try to achieve balance by recalling past memories. These well-preserved memories survive in elderly people with disorientation and are associated with uncontrolled behaviors of the moment. This method helps the disoriented elderly person to understand and express his inner reality.

To put this method into practice, you must:

- know the patient you are working with (family relationships, personality, life history, importance of religious belief, the way the individual copes with the crisis, etc.)
- observe verbal and non-verbal expression, emotional and spontaneous behavior find the stage of disorientation and the most appropriate technique to use.

Recollection therapy – is closely linked to the most important moments of the patient's life. By enabling the elderly to remember beautiful moments, it creates personal satisfaction, improves their spiritual state, and calms them down. The objective of this therapy is to enable the patient to become aware and free them from any feelings of guilt or unrealistic ideas. In the demented patient, if this therapy cannot be applied through memories, then photo albums, films, important objects such as: watches, rings, pendants, clothing, etc. come to the rescue. Recollection therapy awakens feelings, emotions, personal satisfaction.

Remotivation - therapy that consists of giving meaning to things, to external life, to experiences that can be experienced. The conviction that life is beautiful and must be lived. Patients must be stimulated to face the outside world without creating dependence, without being afraid. The right time when they can go out is made known and the return to the location always remains important. The importance of a companion is insisted on if there is a need or desire to go out, an event that is also made possible by the therapist.

Occupational therapy - orients and keeps under control the autonomy of the elderly and favors the improvement of daily living conditions. It is defined as "the treatment of physical and psychological conditions, which through specific activities, helps the individual to achieve the maximum level of performance of functions and independence in all aspects of daily life". Apraxia manages to condition the elderly in the performance of functional tasks, in the accuracy of gestures, so finalizing the movement is an extremely difficult task for the elderly. The hands are unable to close the buttons of the shirt, they cannot tie their shoes, it is impossible to open a door, brushing their teeth is difficult, closing the window is impossible, etc.

Occupational therapy takes into account the needs, interests, and remaining abilities of the individual and defines the following objectives for action:

- the elderly to maintain as long as possible the autonomy of daily life activities without the patient being helped in situations that they can still cope with.
- to stimulate the interest and motivation of the elderly through real activities that encourage the patient to exercise their remaining abilities.
- to maintain the highest level of physical function and mental health of the elderly.

People suffering from Alzheimer's disease with complete cognitive loss and a tendency to wander (wander) are safer if the room where they stay is not overloaded with furniture; the opposite happens with patients who are in the initial stage of cognitive loss, who need a familiar environment. The elderly are offered a place with a table, bookcase, chair, bed to bring them a familiar and welcoming atmosphere.

Last but not least is the situation when the elderly person does not recognize objects that are dangerous to health. For this purpose it is useful:

- to leave only objects of daily use in operation (in more advanced stages, even a toothbrush with toothpaste can be used for other purposes).
- Do not leave in use medicines or products that are harmful to the elderly, tools that endanger their life, adhesives with dyes (vinovil), etc.

10.PROGRESSIVE DISEASES OF THE CENTRAL NERVOUS SYSTEM

10.1 Physiotherapy in PARKINSON'S disease Epidemiology

Parkinson's disease is a degenerative disease of the central nervous system characterized by bradykinesia, muscle rigidity, and tremor; morphologically characterized by degeneration of neurons in the substantia nigra area of the ventral mesencephalon of unknown etiology.

The name of the disease comes from the English physician and politician James Parkinson (1817), who first described many of the symptoms of the disease in a unified manner, coining the term Shaking Paralysis. Clinical observations of Parkinson were then expanded at the end of the last century, by Trosseau, Charcot, and Brissaud, who described in detail all the clinical characteristics of this disease.

Parkinson's disease affects 1% of the population over 55 years of age. The prevalence of the disease in the USA is 187 cases per 100,000 inhabitants, with a male/female ratio of 3 to 2. This is a disease with a mean age of 55-60 years and a progressive decline over 15-20 years. Based on these data, we can see that at least in industrialized countries, the average life expectancy of an individual with Parkinson's is not different from that of normal subjects.

Symptomatology

Parkinson's disease is classified based on several parameters:

- age of onset of the disease
- speed of disease progression
- predominance of tremor and akinesia
- presence of cognitive impairment and altered mood. All of these factors significantly affect the prognosis.

Akinesia

Akinesia refers to difficulty in initiating a movement and bradykinesia refers to slowness in movement (the speed, amplitude and rhythm of movement are altered). Essentially, akinesia and bradykinesia are two aspects of the same phenomenon. Akinesia, which is almost always the most important clinical symptom in Parkinson's disease, worsens during the course of the disease and manifests itself in different ways depending on the body segments affected.

Among the various manifestations of akinesia, you should remember: facial hypomimia (loss of facial expressions, expression), fixed gaze, monotonous speech like a whisper altered by automatic repetition of syllables or phrases (palilalia), difficulty in swallowing by the pharyngeal muscles, increased production of salivary glands, loss of spontaneous movements (to sit down, cross legs, to finalize gestures), micrographia (small and difficult to understand writing).

Sequential tasks (consecutive) such as altering hand movements in prono-supination, as well as complex tasks - to fasten shirt buttons, appear difficult for the patient.

Gait is modified in a characteristic way, accompanied by a decrease in the amplitude of the pendulum movements of the hands during the step; The beginning of walking is slow and the pace of the steps is reduced. When the patient moves, he takes small steps, dragging his lower limbs. After a few years, the phenomenon of paradoxical akinesia "Freezing" is observed, which consists in the difficulty of taking the first step and the difficulty of changing direction while walking. It becomes very difficult to reach the destination, such as in bed or in a chair.

In summary, the characteristics of akinesia can be:

Simple movements

- delay in the initiation of movement
- slowing down during the execution of the movement
- slowing down in the activation of corrective movements Complex movements
- slowing down and fatigue during repetitive actions
- inability to perform many actions at the same time
- difficulty in performing consecutive actions

- Mechanisms of visual reactions during the execution of movements
- The phenomenon of paradoxical akinesia.
  Postural adjustments
- Disappearance of preliminary postural reflexes
- Disappearance of postural linearization reflexes
- Disappearance of primitive reflexes.

Tremor

It is often the first obvious sign; tremor is present initially in about 70% of cases but although important, it is not the most disabling symptom of the disease. Usually the tremor begins in the most distal segments of the upper limbs; thus it is most pronounced in the thumb and index finger of the hand. It then involves the entire hand. The tremor also affects the lower limb of the same side, returning later to the upper limb. It is characterized by a rhythmic movement of the fingers with a frequency of 4-7 cycles per second; it usually reproduces the act of counting coins. This is the resting tremor which is clearly visible when the elderly person is in an upright position with the upper limbs abandoned along the trunk. This tremor is lost or adapted when the patient moves the limb. In advanced stages, it can spread to other body segments such as the jaw, lips, tongue, etc. Typically, parkinsonian tremors are accentuated by emotional stimuli and disappear during sleep.

Rigidity (stiffness)

Rigidity (or Parkinsonian hypertonia) is characterized by its plasticity and by its presence in all the muscles of the body. A muscular hypertonia is observed during passive mobilization of the body segment. The consequence of Parkinsonian rigidity is the posture of the elderly person with slight flexion of the head, trunk and limbs which is characterized by the usual Parkinsonian posture (camptochromic posture). Rigidity is often unilateral and can change during the day depending on the medications that the elderly person takes, depending on the mood and depending on emotional disorders.

Postural Instability

Represents the most severe manifestation and the least likely to be treated effectively. The Hoehn and Yahr scale has been developed for postural instability and is widely used in the stages of Parkinson's disease. Postural instability with consequent loss of balance is caused by a combination of factors including akinesia, rigidity, physiological postural modifications, and loss of linearization reflexes. Clinically, the phenomenon of ante and retropulsion is observed, which balance the patient's movement when going forward and backward. After a disturbing event in normal posture, balance is stabilized with a single step; patients with fluctuations in postural reflexes need to take two or more steps to regain balance. In the advanced stage, patients may fall if the therapist does not hold them. Loss of postural reflexes is responsible for the incidence of femoral fractures in parkinsonian patients.

Rehabilitation Aspects

The role of neuromotor rehabilitation in parkinsonian patients consists in improving motor performance by favoring the execution of movement in all its aspects, reducing stiffness, preventing unilateral positions, correcting postural changes, adapting movement strategies, improving balance and ambulation. All of these offer the elderly maximum autonomy that improves their quality of life. Rehabilitation has been progressively approached pharmacological and surgical therapy with the aim of strengthening the effectiveness of treatment by preventing short-term and long-term complications of the disease.

Recently, to overcome the time limits of rehabilitation, new rehabilitation techniques such as music therapy and dance therapy have been proposed, which not only develop mobility but also favor the increase in cognition. This type of therapy is organized in groups; enables the elderly to overcome social isolation, to face other elderly people who have the same problems and also to recognize their own limits.

In normal individuals, complex movements are enabled by central programming given by continuous proprioceptive feedback. This program is realized by sensory information (sensitivity) that is achieved by the extension of the articular kinetic chain, by the load receptors and by the positioning of the main articulations of the body.

Other important aspects that are achieved by the visual, vestibular system and by the capacity for concentration should not be forgotten. In the analysis of the posturology of patients with Parkinson's, it is noted that instability is a consequence of the immediate contraction of antagonistic muscle groups and the inability to make postural modifications in different clinical conditions.

Dance therapy, compared to conservative therapies, includes other aspects in rehabilitation such as intensity, rhythm, harmony of movement, reinforcement of postural reflexes, re-education of the gait cycle, muscular normalization. These new rehabilitation methods are based on the capacity to memorize movements and how Parkinson's patients in the second stage, who do not have very pronounced cognitive disturbances, manage to borrow motor behaviors that they can use in case of need.

Rehabilitation Treatment

Parkinson's disease is characterized by movement disorders in the executive, organizational and motivational components. Rehabilitation aims to utilize at least one functional component to use during therapy.

Specific Rehabilitation Activity

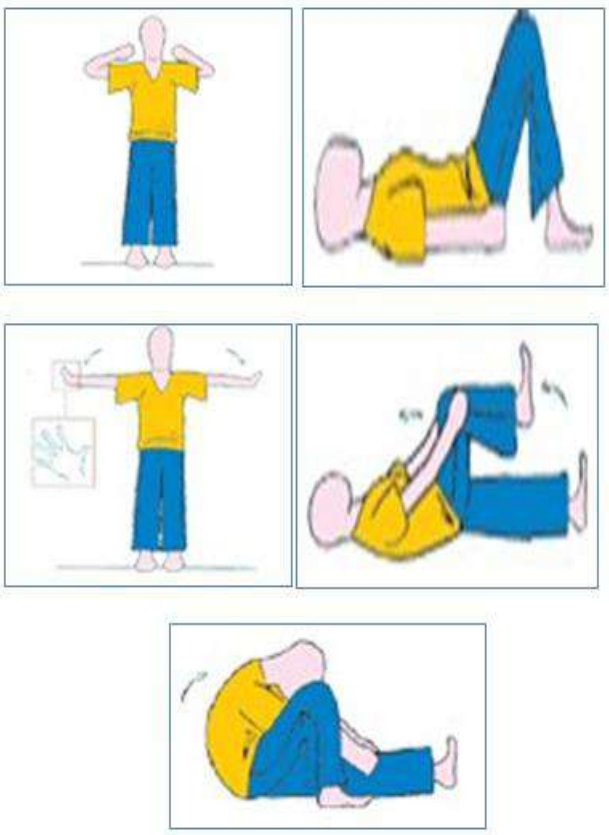
Specific rehabilitation initially consists of finding the patient's needs and organizing an efficient path for the stage of the disease in which he presents. It is important to form rehabilitation protocols for each patient. Neuromotor reeducation includes mobilization exercises of the cervico-dorsal column and limbs, to maintain articulation and muscle tone, exercises must be slowed down and modified so as not to cause structural damage. Treatment of akinesia is achieved by stimulating and normalizing postural reactions such as: rotational movements and exercises for the recovery of accompanying movements. Balance re-education includes exercises in hand-foot positioning, in the sitting and standing positions; coordination exercises and regulating movements of the center of gravity. To improve the gait pattern, broad-based deambulation exercises, obstacle crossing, stop order, etc. are proposed. The compensatory exercise strategy is important and should be used throughout the rehabilitation of the disease.

Strategies that use visual stimuli (white strips of paper to increase the length of the step); auditory stimuli (rhythm, music); proprioceptive stimuli (taking a step back before starting to walk) to start and maintain the movement and cognitive stimuli (memorizing a movement by repeating it often), etc. are important. It is advisable for the patient to follow the training at the peak of the drug dose; when the effect of the drug is released at its maximum.

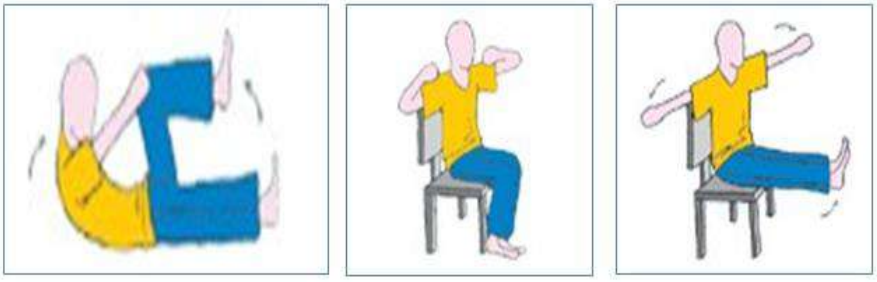
In the early stages of the disease, education of the elderly and their families should be taken into account to maintain the patient's functional autonomy at high levels. These activities can be practiced in a group with the help of music or rhythm. With the deterioration of the clinical picture and the lack of postural stability, a rehabilitation protocol should be designed and adapted for each patient typology. In the disabling phase, special care should be taken with monitoring vital parameters, preventing falls and maintaining respiratory capacity at normal levels. If possible, help should be given to the elderly through braces and orthoses to improve activities of daily living. Environmental analysis is also important, avoiding and adapting architectural barriers and thus preventing fractures - consequences of falls.

Aerobic Training

It is essential for the elderly to practice physical activities combined with poly-articular mobilization, strengthening exercises for the trunk and lower limbs. An aerobic type of exercise enables optimal conditions for the cardiovascular, musculoskeletal, neuromuscular systems. An active lifestyle for the elderly is very important as it can overcome the tendency of the elderly to have a sedentary life. Over time, Parkinson's patients reduce the activity of daily life by adapting to the disease. Those affected by Parkinson's in the mild and moderate stages, if they continue physical activity by regularly undergoing aerobic exercise, are able to maintain a normal working capacity, which implies the adaptation of the body to respond to physical exercise through respiratory and cardiovascular modifications, achieving considerable muscular potency. Physical activity also helps older adults adapt and communicate with other members of the group.



Stretching and mobilization exercises



Coordination exercises

11.AMYOTROPHIC LATERAL SCLEROSIS (ALS)

ALS is a progressive and degenerative disease of the nervous system that selectively affects motor neurons – central (at the level of the cerebral cortex) and peripheral (at the level of the brainstem and spinal cord). It is also called Lou Gehrig's disease, an American basketball player who was the first to be affected by this disease; or Charcot's disease after the French neurologist Jean-Martin Charcot who first described this disease in 1860.

Clinical classification

Sporadic forms

- Spinal form: affects 60% of cases; characterized by loss of strength and muscular atrophy of the upper limbs.
- Bulbar form: affects 30% of cases and the first symptoms consist of difficulty in articulating speech and the appearance of progressive tongue atrophy, hypophonia, dysarthria.
- Pseudopolyneuritic form: 10% of cases; characterized by a muscular deficit of the antero- external area of the foot with progressive atrophy of the entire lower limb.

Hereditary-familial forms

- Typical ALS in the white race: primary form of ALS
- Guam ALS
- Infantile ALS: rare forms of ALS that appear in adolescence; characterized by atrophy of the upper limbs followed by spastic paraparesis with subsequent extension to the lower limbs; or the disease may begin with a deficit of the orbicularis oculi frontalis muscles accompanied by deficits of chewing and pharynx and larynx.

Signs and symptoms

Typical signs of first motor neuron involvement:

- progressive muscle stiffness - spasticity
- presence of exaggerated reflexes - hyperreflexia - or pathological reflexes - immobile toes - Babinski's sign

Typical signs of second motor neuron involvement:

- presence of muscle atrophy innervated by the second motor neuron

- muscle spasms - muscle contractions
- decreased muscle tone and osteotendinous reflexes

These disorders develop in the form of weakness or atrophy involving both the lower and upper limbs.

Onset of the disease

Spinal: 75% of individuals affected by ALS have symptoms starting in one of the legs and become aware when they begin to walk or run; when they realize that they have started to slip and stumble frequently. Other patients affected by spinal cord injury feel the effects of the disease in one hand or arm; they often lose manipulative capacity, showing difficulty in following simple tasks such as: holding a knife or writing something.

Bulbar: 25% of cases with ALS have difficulty articulating words or phrases (dysarthria); it can also be accompanied by vocal cord problems which lead to dysphonia; an increasing difficulty in swallowing liquids, food or both (dysphagia). There is always a slight fatigue of the masticatory (chewing) muscles which together with dysphagia lead the patient to weakness and malnutrition (intervention with the PEG implant becomes necessary).

Progression of the disease

Regardless of the localization of the disease in one of the patient's limbs, muscle weakness and atrophy are observed, which extend to other parts of the body as the disease worsens. Patients have problems with movement and speech formation. Dysphagia worsens as a result of spasticity of the pharyngeal sphincter, which does not allow the passage of secretions (sputum). All this can be accompanied by the exit of fluids from the nose and the passage of food into the airways, which causes choking. Respiratory complications also appear: the diaphragm and intercostal muscles weaken; vital capacity and forced inspiratory pressure decrease. The progressive loss of anterior horn cells leads the elderly to a progressive disability. Patients are unable to stand or walk, get out of bed or climb in bed alone, use their hands or arms. Communication becomes increasingly difficult; bilateral weakness of the facial muscles eliminates facial expression. Although the patient does not move, he does not present decubitus ulcers; this may be a sign of a relative preservation of pain sensitivity and autonomic regulation of superficial (skin) blood flow.

Fractures of long bones are often observed as a result of bone demyelination from prolonged immobilization. Usually the disease does not affect cognitive capacity, so these patients are aware of the progressive functional loss and become increasingly depressed.

All forms have a progressive prognosis that leads to the death of the patient within 5 years of the onset of the disease. Survival is greater for younger patients.

Rehabilitation Intervention

Treatments for ALS aim to alleviate symptoms and improve the quality of daily life. The design of the rehabilitation protocol should be based on the assistance provided by the therapist; on the basis of the machines that can be used in such cases and also on the basis of the place where the rehabilitation session will take place. These patients have no autonomy and most of the therapies are followed in the nursing home with the assistance of the nurse for the care of the PEG implant and of the family.

In the first period of the disease, it is possible to indicate the patient for cycling, swimming, walking; these exercises with low aerobic consumption that help in cardiovascular health.; help in the fight against depression, anxiety. Stretching exercises help the patient in relaxing the muscles and in stopping muscle contractures. When the patient's legs weaken, the physiotherapist suggests orthopedic braces, crutches and wheelchairs. It is important to mobilize the patient in the terminal phase. Special care should be taken for large joints. If the patient is able to follow active assisted exercises, do not switch to passive ones. Mobilization should be short-term and repeated many times during the day; always accompanied by deep, relaxing breathing. Until the last days, respiratory therapy is important for ventilation of the lungs and maintaining the normal functioning of the responsible muscles.

12. MULTIPLE SCLEROSIS

Multiple sclerosis is an inflammatory disease of the white matter of the central nervous system that leads to demyelination of nerve cells. The element that characterizes the anatomo- pathological framework is made up of “plaques” – areas of demyelination with glial reaction.

The etiology of the disease is unknown. Many theories have been spread but the most trusted ones recognize the disorientation of immune mechanisms, it is thought to be a viral disease. It is a disease that does not lead to death but brings motor disability, at a still young age when physical activities and the intensity of life are at their peak (around 17 years). The most affected age is around 20-40 years. Women are more predisposed in the ratio 3 women / 2 men.

Reeducation of patients with Multiple Sclerosis

To determine the criteria for the application of an efficient rehabilitation protocol for patients with MS, the complex situations that characterize the pathological stage of the disease must be taken into account. Special attention must be paid to the relationship established with the patient and motivation. It has been noted that psychosocial factors influence the pathological conditions of the disease. The greatest obstacles that a therapist encounters in programming the rehabilitation plan are: the significant change in signs and symptoms; as well as the unpredictable course of the disease. Always based on the functional, social, professional and autonomy objectives of the elderly, the aspect of globality is advisable; the use of a language familiar to the elderly based on the I.C.D.H classification (1980). This classification provides for parts of: disease, impairment, disability, handicap.

IMPAIRMENT- is defined by the WHO (World Health Organization) as any loss or abnormality of psychological, physiological and anatomical structures or functions.

DISABILITY- is defined as any impediment or deficiency to perform an activity properly or within normal limits.

HANDICAP- is defined as a disadvantage for certain individuals involved in a disability or impairment that limits or prevents the fulfillment of a role considered normal (based on age, sex, social and cultural factors) for that individual.

Dimensions of IMPAIRMENT

First dimension of impairment:

- Disturbance in the organization and control of motor acts
- Musculo-articular alterations
- Increased energy cost

Musculo-articular alterations are caused by neuro-muscular plasticity processes. In patients, these alterations are expressed by changing daily life habits replaced by a sedentary life. This process is known as "motor freezing". If this motor freezing lasts for a long time, it brings about a disruption of the balance between muscle groups (some work more, others less); sedentary life brings about a loss of degrees of freedom and the articular range is not fully used; the muscle adapts to the duration of the exercise – it shortens from a functional point of view.

It is characterized by: Decreased strength, Decreased muscle length

Disturbance of the functional structure of the muscles In the patient, the energy cost increases after:

- The compensatory strategy is put into function of the muscles
- The metabolic demand of the muscle increases (small and resistant muscles are put into function).

According to the above-mentioned factors, the critical point of rehabilitation is noted since this energy can be compensated with the breathing typology, but we know that the respiratory synergy is compensated only with muscular forces. The breathing of these patients contributes to the deterioration of the metabolic conditions of the working muscular system; there is a disruption of the acid-base balance of the organism.

Care must be taken in all phases of the patient's illness, since only in this way can we organize the most efficient re-education. All pathological aspects of the disease must also be considered, not only the motor ones (global rehabilitation). It is important that the patient is followed by a medical team: neurologist, physiatrist, psychologist, physiotherapist, social assistant.

From a rehabilitation point of view, patients are divided into 3 groups (A, B, C)

Group A is characterized by reversible clinical forms; patients have mild disability and are able to have an autonomous social and working life. In this group, the patient reports fatigue, difficulty in movement, but with the evolution of the disease it can lead to slowing down of gestures; loss of quality of motor act is also noted - the initial phenomenon of loss of movement synergy, i.e. disorders of synergistic coordination control.

Rehabilitation consists mainly in the coordination of postural and locomotor synergy; therefore, we must work with the quality, safety and autonomy of movement.

Group B is characterized by more moderate forms which lead to a decrease in locomotor activity. Patients have moderate disability but manage to maintain autonomy. Normality no longer exists and problems are observed in various exercises or games. Synergistic disorders are also noted:● Poor motor repertoire

- Cognitive overload
- Alterations in muscle tone

Rehabilitation is achieved by compensating for disability; assistive devices are used (braces, orthoses, walking canes). It continues with the intervention of respiratory, postural synergies and with the coordination of breathing-posture, breathing-locomotion.

Group C is characterized by chronic-progressive forms. Patients have severe disability, decreased independence to the point of degradation. It is impossible to return to normal. Such a patient no longer struggles with the disease. The patient has preserved the past but has lost the future. Along with psychological and physical factors, they require special attention and assistance support from family members.

The main objective of Multiple Sclerosis rehabilitation is the stabilization of the damage and disability.

13. INFLAMMATORY PATHOLOGIES

13.1 Rheumatoid arthritis. Rehabilitation

Rheumatoid arthritis is the most common chronic inflammatory disease, with long periods of exacerbation and improvement. It is a disease that affects 1-3% of the population, mainly women in a 4/1 ratio, and the peak of the outbreak is at the most hormonally active age. The disease is widespread throughout the world and is not influenced by geographical factors.

There are several forms of the onset of the disease: ACUTE form

SLOWLY DEVELOPING form INTERMEDIATE form

Acute form - is characteristic of infants, children and adolescents. The patient has a temperature higher than 40ºC, severe joint and muscle pain, weight loss, enlargement of the lymph nodes, liver, spleen, as well as involvement of the serous membranes (pericardium, pleura). In this form, the involvement of joints is rare. Only allergies and not true arthritis are seen.

In the Slow Development form – about 80% of patients complain of inflammatory joint pain, morning stiffness, subfebrile temperature (37.2º 37.8º), fatigue, sweating, anorexia, etc.

The pain is symmetrical, mainly in small joints and in advanced cases after a few years, arthritis can cause deformations: fingers like a camel's neck, fingers like a spinning spindle, zig-zag fingers. The hand takes on the appearance of a camel's back, the hand and foot take a lateral position.

Pain with a mechanical inflammatory character

Characteristic in the foot is the lateral deviation of the big toe, the jumping of the fingers over each other, total deformation of the foot. It can affect all joints. In advanced stages, ankylosing (fusion of bones) of the joints predominate in these patients.

Against pain, FANS, analgesics and small doses of corticosteroids are used. To act on the mechanisms that cause the disease, medications such as: gold salts, salazopyrine, imuran, methotrexate (voltaren), etc. are used.

Rehabilitation of Rheumatoid Arthritis

Depending on the age of the patient and the affected phase, an efficient rehabilitation protocol is adapted. Mainly for this typology of the disease, warmer therapy is very effective. Thermal cures are fully effective. They are typical rehabilitation therapies of the third age. Hot sand deports to the inflamed joint and relieves the patient from pain. Mud therapies (mud therapy) should also be mentioned, which are based on thermal equilibrium. The heat of this therapy spreads throughout the affected limb or the entire body and is very relaxing and soothing. Thermal pools - hydrokinesitherapy are also of great importance, which, through mineral salts and the natural heat of the water, sufficiently meet the needs of the bone.

Physical therapy such as infrared, tekar therapy, laser therapy, magnetotherapy, ultrasound can also be applied, which help reduce edema, relieve pain and favor the movement of the affected joint with ease. Warm water bags placed on the affected joint are also very helpful to the patient, as well as subcutaneous gelatinous pharmacotherapy: fastum gel, voltaren emul gel, arthrostopi; which the therapist is indicated to give. Patches containing piroxicam are also indicated, which cover the entire painful area and release anti-inflammatory substances.

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