

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

185,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



## **Pulmonary Embolism in the Elderly – Significance and Particularities**

Pavel Weber, Dana Weberová, Hana Kubešová and Hana Meluzínová  
*Department of Internal Medicine, Geriatrics and Practical Medicine  
Masaryk University and University Hospital, Brno  
Czech Republic*

### **1. Introduction**

The development of civilization and extreme technical progress leads to increasing hope of longer survival and makes the average life expectancy longer. Both in absolute and relative numbers the amount of the elderly, very old and long-aged people are increasing (Blackburn & Dulmus, 2007; Ratnaïke, 2002). This tendency will continue and it will be emphasized by ageing volumes of people born after the World War 2 in the years 2010 -2015 (Kalvach et al., 2004). The basic survey and knowledge of geriatric medicine will be necessary in the future, especially for professionals such as doctors, nurses, psychologists, social workers, physio- and occupational therapists etc.

Knowledge of at least basic extraordinarities and specifics of geriatric medicine will be of huge practical significance, because in the year 2050 there will live 2 billions of people older than 60 years on the Earth. (Moody, 2009). From this fact it is obvious, that there is an objective need to master the basic knowledge of gerontology and geriatrics among professionals (including doctors of all medical branches).

In this brief chapter it is not possible to include the whole issue dealing with the medical care of old-aged patients with PE, even if this issue deserves the attention because of its practical meaning and close relationship with other branches (internal medicine, surgery etc.). The emergency situations together with polymorbidity and exhaustion of functional reserves in advanced age (Campbell et al., 2008; Friedman et al., 2008) will be more frequent in all of the organ systems - cardiovascular, respiratory, GI (gastrointestinal) tract, endocrine, immune etc. (Bongard & Sue, 2003; Roberts & Hedges, 2009). We refer to the study of the clinical picture description (incl.therapy) of each of critical states in the old age in appropriate specialized chapters in this monograph and in other gerontologic literature (Hall et al., 2005; Stone & Humphries, 2004).

General knowledge of these aspects can substantially influence an approach of intensivists who face an increasing number of old patients in their practice (Brunner-Ziegler et al., 2008; Pathy et al., 2006). Among the aspects we would like to mention there are: global situation, specific problem of geriatric medicine, pharmacotherapy in the elderly, at last but not least problems of ageing organism as reflected in particularities and pitfalls of medical treatment in multi-morbid old patients.

Ageing and its manifestation as currently understood such as frailty, functional disorders and decreasing mental abilities are not standard symptoms of ageing process but they are

mostly consequences of simultaneously on-going diseases (Goldmann et al., 2000; Fauci et al., 2008). The target of new **interventional gerontology** is extension of active life period and sustaining functional abilities for maximum time.

Information about function can be used in a number of ways: as baseline information, as a measure of the patient's need for support services or placement, (Tallis & Fillit, 2003) as an indicator of possible caregiver stress, (Asplund et al., 2000) as a potential marker of specific disease activity, to determine the need for therapeutic interventions, and to indicate prognosis.

**2. Comprehensive geriatric assessment (CGA) as basic tool of modern geriatry**

Clinical gerontology emphasises an individual approach to old patients (Harari et al., 2007; Soriano et al., 2007). The method of operation is **comprehensive geriatric assessment - CGA** (Gupta, 2008; Gurcharan & Mulley, 2007; Williams, 2008). Apart from somatic aspects of the health status there are significant items to be underlined: self-sufficiency evaluation, knowledge and evaluation of psychic state and social conditions (see tab. 1).

Much of what has been written on evaluation of the older patient is simply attention to the details of careful clinical assessment. Contemporary emphasis on efficiency and effectiveness of clinical care requires thoughtfulness about any extension of the already lengthy evaluation of complex chronic medical problems that commonly cluster in older persons. Brief screening questions rather than elaborate instruments are appropriate for the first encounters (Stuck, 1995); more detailed assessment should be reserved for patients with demonstrated deficits (Applegate et al., 1990).

Subject of assessment	Way of evaluation
Somatic status	Somatic examination, posture, mobility, continence, nutrition, sight, hearing, geriatric syndromes, etc.
Self-sufficiency	ADL- test, ability to keep own household, IADL- test
Mental status	cognitive function - MMSE- test, Clock test; depression scale according Yesavage, etc.
Social status	social contacts, people available to summon help, bereavement, removal, dwelling and loneliness risks

Table 1. Comprehensive geriatric assessment

In its multidisciplinary context the geriatry does not substitute other clinical medical branches in care of an old person but completes them with application of **specific geriatric regimen**, which aims to reinforce the independence and improve self-sufficiency of the older patients (Williams, 2008). Following methods are based on principles of **specific geriatric regimen**.

- Considerate tailor-made diagnostics and treatment aimed at improvement of life quality
- Follow up physiotherapy
- Multi-disciplinary team active approach aimed at improvement of self-sufficiency and/or prevention of dependence

- Social work creating conditions enabling patients to return to home environment (incl. home-care)

Main target of these efforts is improvement in independence and self-sufficiency improvement in older patients (Zavazalova et al., 2007). Geriatric regimen brings benefits especially for patients aged 75+ or even 80+ who are endangered with following risks typical for this age:

- Development of immobilisation syndrome
- Self-sufficiency loss
- Atypical pathway of more diseases influencing simultaneously each other
- Occurrence of early impairment of organ function as a consequence of exhaustion of their functional reserve (lungs, kidneys etc.)
- Maladaptation towards changes
- Ageism (discrimination because of the old age).

Evaluation of the older patient can be time-consuming (Topinkova, 2005), even when it is tailored to the problem. Yet, such initial investment can reduce subsequent morbidity and resource utilization and enhance both patient's and physician's satisfaction. Additionally, the assessment can often be accomplished over several visits. Moreover, much can be gleaned from questionnaires filled out by the patient or caregiver in advance as well as from observation.

### 3. Geriatric patient – particularities of health status

Geriatric patients are people of higher age (formally above 65; practically above 75 years), their involutionary and morbid changes (usually multi-morbidity) significantly influenced their functional state, adaptability, ability of regulation, toleration to stress. These patients profit from specific geriatric attitude, they need more complicated coordination of services, often active observation of health and/or functional state, they are in risk of sudden loss of self-sufficiency, danger of delay, adverse effect of remedies is more frequent, institutional care is often needed (geriatric hospitalism), also they are in danger of frequent professional mistakes for atypical symptoms in comparison to clinical picture, which is for certain disease typical in adult middle age (Friedman et al., 2006; Pathy et al., 2006; Williams, 2008). The following principles of geriatric medicine are helpful to keep in mind while caring for older adults:

1. Diseases often present atypically.
2. Many disorders are multifactorial in origin.
3. Not all abnormalities require evaluation and treatment.
4. Polypharmacy and adverse drug events are common problems.

Comorbidities are common in older people, and the diagnostic "law of parsimony" often does not apply. A disorder in one organ system may lead to symptoms in another, especially the one that is compromised by preexisting disease. Since these organ systems are often the brain, the lower urinary tract, and the cardiovascular or musculoskeletal systems, a limited number of presenting symptoms – i.e., confusion, falling, incontinence, dizziness, and functional decline – predominate irrespectively of the underlying disease. Thus, regardless of the presenting symptoms in older people, the differential diagnosis is often similar.

Many abnormal findings in younger patients are relatively common in older people and may not be responsible for a particular symptom. Such findings may include asymptomatic

bacteriuria, premature ventricular contractions, and slowed reaction time. In addition, many older patients with multiple comorbidities may have laboratory abnormalities that, while pathologic, may not be clinically important. A complete workup for a mild anemia of chronic disease in a person with multiple other issues might be burdensome to the patient with little chance of impacting quality of life or longevity.

Ageing is associated with a decline in expectation of healthiness. Those over age 65 generally give more positive evaluations of their healthiness in the face of increasing burden of disease and disability (Kriegsman et al., 1996; Tinetti et al., 2000). The older the person is, the more likely they are to report very good health status (Gross et al., 1996). However, overestimating healthiness (also called normalization) often results in explaining away symptoms or problems as caused by minor illnesses or even by external events. In either case, late recognition and delayed intervention are the usual outcome. Previous neglecting of symptoms by health care professionals is also likely to teach older patients that frailty and loss of independence are normal and to be expected with ageing; again, late detection and intervention are likely, resulting in high cost and discouraging outcomes. Perhaps these attitudes explain the finding of greater pessimism in older persons compared with those middle-aged, even when health status was factored in. *Underreporting of symptoms* is a common theme in discussions of illness behavior of older persons.

The problems identified were common and usually treatable diseases; congestive heart failure, correctable hearing and vision deficits, tuberculosis, incontinence, anemia, bronchitis, claudication, cancers, malnutrition, diabetes, immobility, oral disease preventing eating, dementia, and depression were frequent. Considerable underreporting was also seen among people with chronic diseases. More than a half of chronically ill individuals, who were surveyed in one study, failed to report at least one disease. Older people tend to report inaccurately cardiac disease, arthritis, and stroke (Kriegsman et al., 1996).

The riskiness of underreporting of symptoms by older patients is obvious; late identification of disease (inclusive of PE) leads to late initiation of treatment, usually after substantial morbidity associated with advanced pathology has already occurred and caused major functional losses. Rehabilitation to independence from these losses is difficult; permanent dependence in spite of "successful" treatment may occur.

Majority of all biological functions culminates before the age of 30 y. Some of them gradually continuously decrease afterwards (Masoro & Austad, 2006). This decay is practically of no significance in terms of current everyday activity but it can matter under stress or extended load (Humes, 2000; Hunter et al., 2002).

Seniors as such represent very heterogenous group and from the point of view of fitness, risk and need of help (or specific service) they can be divided to the 3 basic areas with different focus of health attention:

- **Fit seniors** – Seniors in good condition and physical efficiency. Medical attitude towards them should be the same as standards which are valid for adults in middle age. However, there can be also risk of atypical symptoms of diseases in them.
- **Independent seniors** – do not need extraordinary care and services, they can live independently in standard condition, however in stress situations (severe diseases, surgery, injuries, viral infections in epidemics, extreme variation of the weather, sudden change of social state – death of partner, loneliness, moving etc.) they fail.
- **Frail seniors** – are instable and in the risk even in standard condition. These frail seniors usually need help in common daily activities or they are limited in motion, moreover they are confined to bed (Fried et al., 2005; Wawruch et al., 2006). This group



of patients contains those with higher risk of falls, dementia syndrome, with very bad mobility, labile somatic disease (i.e. frail cardiac with repeated cardiac failure or electric instability), also with complicated orientation (visual disturbance and hearing loss), people in social distress and very old above 85 years old, especially when they live alone (Leng et al., 2007; Yaffe et al., 2007).

Health status in ageing is a result of many factors, including the chronic diseases of ageing and many other prevalent conditions that cannot be defined as classic "diseases" because they do not result from a single pathologic cause. Falls, which occur in one third of older adults, result in injuries, fractures, and high risk for disability and mortality. Severe cognitive impairment and urinary incontinence have a substantial adverse impact on an elderly person, as does sensory isolation resulting from hearing and visual impairment; all of these conditions are frequent with aging.

Older patients differ from young or middle-aged adults with the same disease in many ways, one of which is the frequent occurrence of comorbidities and of subclinical disease.

A second way in which older adults differ from younger adults is the greater likelihood that their diseases present with nonspecific symptoms and signs. As a result, the diagnostic evaluation of geriatric patients must consider a wider spectrum of diseases than generally would be considered in middle-aged adults.

#### 4. Biology of ageing

Ageing and advanced age is a terminal phase of ontogenetic development of every individual (Beers et al., 2006; Pathy et al., 2006). **Specific degenerative morphological and functional changes** occur in individual organs at all levels from the cells to whole organism (Heltweg, 2006). Important role in aging is **apoptosis**. In the cell, which may compromise the body (eg, activated leukocyte, as malignant cells), respectively a correction would be difficult to run programmed cell death.

Despite the biologic controversy, from a physiologic standpoint human ageing is characterized by progressive constriction of the homeostatic reserve of every organ system. This decline, often referred to as *homeostenosis*, is obvious by the third decade and is gradual and progressive, although the rate and extent of decline vary. The decline of each organ system appears to occur independently of changes in other organ systems and is influenced by diet, environment, and personal habits as well as by genetic factors.

Even beyond age 85, only 30% of people are impaired in any activity required for daily living and only 20% reside in a nursing home. Yet, as individuals age they are more likely to suffer from disease, disability, and the side effects of drugs, all of which, when combined with the decrease in physiologic reserve, make the older person more vulnerable to environmental, pathologic, and pharmacologic challenges.

This happens in different periods of times and in different speed. It affects any living substance from the moment of its birth (conception). The life expectancy of an individual in nature is species specific and has important inter-individual variability. Ageing speed of an individual is genetically coded – it is presumed that this type of genetics is a multi-factorial one (Masoro & Austad, 2006). Maximum potential life expectancy of a human being attainable under ideal circumstances could be 110 - 120 y. The influence of genetic factor on the life expectancy is considered about 35 per cent. The resting 65 per cent represent an influence of a life style and external environment.

Common and **typical features of ageing** in general:

1. loss of functional parenchyma of individual organs = **involution**
2. decay of physical performance, deteriorated regeneration after load and reduced tolerance towards load
3. influence of one or more diseases
4. disintegrated ageing: big inter- and intra-individual differences (organs and systems)
5. effort to create new own homeostatic mechanisms (which accompanies growing involution) = **adaptability**.

Senile performance decline is a consequence (Beers et al., 2006) of general weakness, impaired locomotion and balance, lower stamina. The life expectancy is significantly influenced by risk factors, contingent metabolic changes and level of resistance to stress. A choice of life style is also essential. Ageing in human population is often connected with increased occurrence of degenerative affections, tumours and Alzheimer's disease (Holmerova et al., 2007).

In fact it should be a period of life in which broad harmonic development of human personality goes on and on. Most people of advanced age should remain independent, self-sufficient and retaining their good psychic condition up to the terminal period of their life (Nemeth et al., 2007).

## 5. Epidemiology and demography of ageing

In the beginning of the 20<sup>th</sup> century 3 to 5 per cent of population in European industrial countries (similarly in USA) were people aged 65+ y. This percentage has grown up to 14 – 20 nowadays. Up to the fifties of previous century people died prematurely. During the last hundred years the life expectancy (LE) almost doubled which is one of the greatest achievements of mankind and science in general. Length of human life begins to approach to its biological limit. Probability of achieving advanced age is no longer exceptional, on the contrary it becomes a standard (Fauci et al., 2008; Pathy et al., 2006; Ratnaike, 2002).

Demographically, the ageing population due to changes in mortality and fertility decline – fewer children are born and more people live to old age. Crucial in this is played by more improved standard of living than in the past and progress of medicine.

Absolute and relative growth of number of the elderly both in developed and developing countries is a main feature of population development in the 21<sup>st</sup> century (Scherl, 2003). We speak about **population ageing**. There are approx. 580 mil. people aged 60+ in the today's world out of which 355 mil. live in developing countries. In 2050 there will be 2 billions of our planet inhabitants aged 60+ y. This age category will overweight children of < 14 y. The most rapid increase during the next decades is envisaged in the 80+ y. group in the industrial countries. It is the ageing of old population (Buttler, 2003). In the USA (fig.1), Canada and majority of European union countries it has been found that the most rapidly increasing group of population is the one of 85+ y.

**Ageing in the industrial** (developed) **countries** can be considered:

- prevailing gradual
- connected with birth rate decrease
- a consequence of improving life conditions after the industrial revolution
- progress in medicine

In the **developing countries** on the other hand:

- ageing is more rapid
- birth rate decrease is dramatic

- life expectancy grows as a consequence of improving medical care
- ageing leads to enhanced poverty

In 2020 aged 60+ - 70 per cent of them will live in the developing countries. The highest proportion of these elderly is envisaged in Japan (31 per cent), than in Greece and Switzerland (28 per cent), USA (23 per cent), etc.

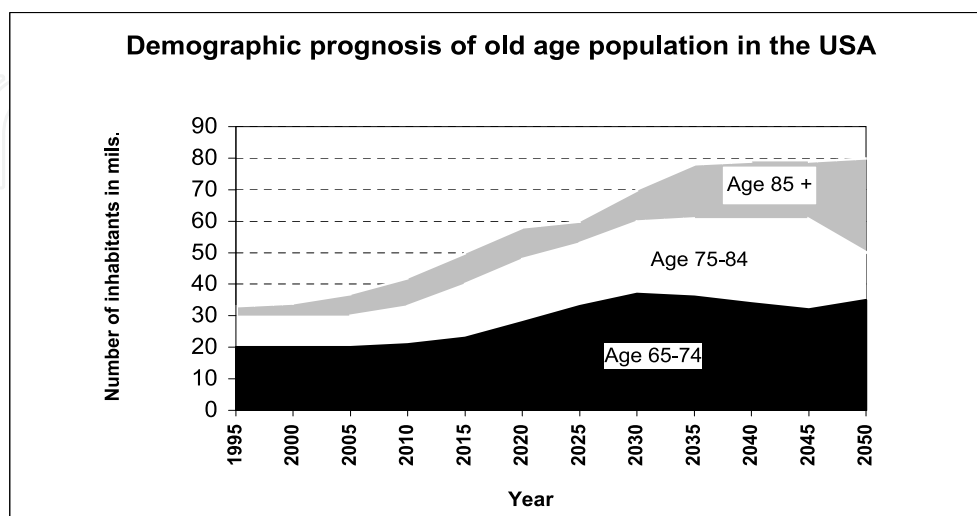


Fig. 1. Demographic prognosis of old age population in the USA

The growth of population aged 65+ in Europe and Northern America during the next 30 years is estimated to reach 24 – 35 per cent. Growing number of the elderly brings also both absolute and relative increase of occurrence of affections which are typical for the advanced age and this becomes a serious worldwide social problem (Seitz, 2003). This covers not only typically somatic diseases such as atherosclerosis, cardio- and cerebrovascular events, heart failure, peripheral vasculopathies, parkinsonism, hypo-thyreoses, diabetes, osteoporosis and osteoarthritis, diverticulosis, anemias, etc. but also mental diseases with all manifestations and consequences of dementia, especially the Alzheimer's type (Braunwald et al., 2001; Sinclair & Finucane, 2003).

Analogically to the population ageing in society also medical science has experienced a phenomenon of the so called "**geriatisation of medicine**" which means a significant prevalence of the elderly among all the patients to be treated (Asplund et al., 2000). This aspect penetrates practically all the branches of medicine to begin with the front line up to the various special fields including ophthalmology.

## 6. Characteristics of ageing

The elderly are highly heterogeneous group, and individuals become more dissimilar as they age. Individuals over 65 years – with or without chronic diseases – vary widely in their physical, behavioral, and cognitive functions.

The **ageing** – is an inevitable physiological process, which is the last ontogenetic period of the human life. People mostly achieve their old age without any enormous problems. They live to their „**successful ageing**“. in quite comfortable physical, psychical and social balance (Duthie et al., 2007; Williams, 2008). The somatic (diseases), psychical (dementia, depression) and social (loneliness) problems begin to appear apparently after 75th year (more in women) (Barba et al., 2000)



*The old age and the disease cannot be considered the same thing* no matter how often it happens in both non-professional and professional community. In most cases the individual in old age is self-sufficient and fit until the last period of his/her life (many times until the last days). The dependence on care of the others comes with the disease, which can be both somatic and psychical. In between 65 and 75 years nearly 85% of people do not suffer from any significant modifying or common life restricting disease. Even in the age above 85 years 40% of the elderly can live self-sufficiently their normal life (Gammack & Morley, 2006).

Women live usually 7 – 8 years longer than men (Tallis & Fillit, 2003). The explanation can be found most likely in gender specific genetic factors and also in biological factors of the environment. The differences in surviving between genders has not changed even in contemporary era, when women smoke more often than ever before and perform originally male professions.

In gerontology we speak sometimes about the so-called **male overmortality**. The consequence of this phenomenon is increasing number of widows as the age increases. This is the base for the typical phenomenon in gerontology – the phenomenon of lonely old women. That fact indirectly increases the consumption of both institutional and non-institutional care in the health and social sphere.

The beginning of the **social old age** is usually seen in the moment of entitlement to regular retirement or the actual retirement (Blackburn & Dulmus, 2007; Woodford & George, 2007). The classification of the human age in social sphere is as follows: *the first age* (before productive age, childhood and youth, learning, preparation for profession, acquisition of social experience), *the second age* (productive age, adulthood, biological productivity – breeding, economical and social productivity), *the third age* (postproductive, the old age), eventually *the fourth age* (the period of dependance), which does not take place in every person inevitably. The calendar age is uniquely determined but does not reflect the individual differences of the real health status among the human beings.

The determination of the age zones for the old age is conventional and it is a social frame outgoing from the administrative needs of the social state. In the demographic statistics it is usually worked with the border of 60 or 65 years. Nowadays the beginning of the old age is thought 65 years and the old age itself is considered from 75 years on. From this pattern also the most used division of the old age results:

- 65 – 74 years old belong to group of young seniors, the main problem is the retirement, the free time, activities, self-fulfillment.
- 75 – 84 years, the old seniors, the problem of adaptability, toleration to stress, specific ailment, loneliness. The **age above 75 years**, when the old age begins in the strict sense of the word, it seems to be breaking point of ontogenesis, when more significant changes connected with physiological ageing proceed.
- 85 and more years very old aged seniors („oldest old“) – they are segregated as an individual category for the high occurrence of frail seniors and high risk of sudden rise of dependency.

## 7. Geriatric syndromes and frailty as golden grail of geriatric medicine

Presentation of illness in older persons less often is a single, specific symptom or sign, which in younger patients, announces the organ with pathology. Older persons often present with nonspecific problems that are in fact functional deficits (Kalvach et al., 2008). Stopping eating and drinking, or the new onset of falls, confusion, lethargy, dizziness, or incontinence

in older patients may be the primary or sole manifestation of diseases with classic signs and symptoms in the young (e.g., pneumonia, myocardial infarction, pulmonary embolus, alcoholism or myxedema). These deficits have been named *geriatric syndromes*; they devastate independence without producing obvious or typical indications of disease. Geriatric syndromes may be defined as a set of lost specific functional capacities potentially caused by a multiplicity of pathologies in multiple organ systems. Comprehensive evaluation (Tinetti et al., 2000) is usually required to identify and treat underlying causes. Although in many instances a geriatric syndrome has several contributing causes, remedying even one or a few may result in major functional improvement.

The most likely explanation for nonspecific presentation is that the additive effects of ageing restrict capacity to maintain homeostasis. Perturbation of homeostasis by disease, trauma, or drug toxicity will be manifested in the most vulnerable organ, or the weakest link, resulting from interactions of biologic ageing and chronic disease. In addition to nonspecific presentation, disease in older patients can present in other atypical ways. Blunting or absence of typical or classic symptoms and signs is well described in many conditions (Doucet et al., 1994; Perez-Gusman et al., 1999; Trivalle et al., 1996).

Health status in ageing is a result of many factors, including the chronic diseases of ageing and many other prevalent conditions that cannot be defined as classic „diseases“ because they do not result from a single pathologic cause. Many of the problems affecting aged individuals should be viewed as geriatric syndromes (GS), that are a collection of signs and symptoms with a number of potential causes (Hazzard, 2007). Only nowadays the causes and effective treatments of these conditions are beginning to be understood.

In spite of indisputable significance of the atypical clinical picture of diseases in the old age, the **crux of geriatric medicine** is involutionarity conditioned *decline of health potential, frailty* and *related geriatric syndromes* and *function deficiency* with their multicausal reasons. This status is connected with exhaustion of organ reservoirs – “**homeostenosis**”. Geriatric syndrome is different from the convenient meaning of the word “syndrome” in clinical medicine, where the symptoms are typical for certain disease (Inouye et al., 2007; Pathy et al., 2006). For the geriatric syndromes numerous and various causes are typical which lead to the occurrence of geriatric syndrome at the end. Geriatric syndromology is an essential component of the so-called comprehensive geriatric assessment (CGA) which is extended over the clinical examination in younger non-geriatric population (Gupta, 2008; (Gurcharan & Mulley, 2007; Williams, 2008).

Geriatric giants (Chase et al., 2000; Sherman, 2003;) as geriatric syndromes (GS):

- **immobility** (pressure sore etc.),
- **instability** (dizziness, posture and gait disorders, falls),
- incontinence,
- **intellectual disorders** (delirium, dementia and depression),
- **iatrogenia** (dangerous polypharmacy).

They are characterized by their:

- a. Multicausality
- b. Chronic course
- c. Reduced independence
- d. Demanding care and difficult curability

As further geriatric syndromes are respected (44,49):

- **syndrom of hypomobility, decondition and sarcopenia**
- **anorexia syndrom and malnutrition**

- syndrom of dual combined sensoric deficiency (visual and hearing)
- syndrom of dehydration with subsequent manifestation of acute renal failure
- syndrom of thermoregulatory disturbance
- syndrom of elder abuse, neglect and self-neglect sy
- syndrom of geriatric maladaptation
- syndrom of terminal geriatric deterioration - FTT („failure to thrive“)

The above mentioned geriatric syndromes not always threaten patient's life but they essentially influence quality of their following life (Fauci et al., 2008; Salvedt et al., 2002). Patients become fully dependent on other people's assistance (family, friends, neighbours, community services). Not exceptionally they must be admitted to an institutional care (hospitals, nursing homes etc.) because of domestic care system failure or necessity to manage an acute phase of a disease. The expression of the concept of geriatric syndromes in the last decades is a very fundamental step forward in geriatric medicine. The marked part of multi-morbid disabled handicapped seniors can be better understood and earlier and effectively solved (Williams, 2008). GS are more complicated problem with inner connections very often. Their proper identification is made possible by:

- screenig tests and observation
- optimisation of geriatric hospital regime
- optimal coordination of community and institutional services
- influence on anorexia by adjustment of nutrition ( proteins 1.3g/kg)
- psychotherapeutical support with elimination of the depression
- lasting physiotherapy ( everyday walking at least for 30minutes)
- attempting to influence the disinterest and weariness by interesting daily activity
- using all of the occupational utilities, which can minimise the dependence ( walker, rods, crutches, wheelchairs and other – glasses, magnifying glass, hearing aids
- recondition programs
- adjustment of the living ( lightning, grab handles on toilet and corridors, the correct hight of the bed and furniture)

The involutionary loss of muscle tissue in the old age is called **sarcopenia** and it is characterized by reduction of muscle tissue, reduction of the force, tenacity, plasticity and speed of contraction (Roubenoff & Hughes, 2000a). The probable cause of sarcopenia in senium (Roubenoff, 2000b) is apart from somatopausis (lowered level of anabolic IGF-1, growth hormone and testosterone) also influence of oxidatory stress and free radicals produced by muscle mitochondrias (Masoro & Austad, 2006). The metabolic result of sarcopenia in the old age is also impaired glucose tolerance and higher risk of diabetes of 2<sup>nd</sup> type (Fauci et al., 2008; Sinclair & Finucane, 2001).

The meaningful concept which is tightly connected with ageing is **frailty** (Friedman et al., 2008; Rockwood & Hubbard, 2004; Woodhouse & O'Mahony, 1997). This belongs to key characteristics of geriatric patients, the next milestone and the keystone of geriatric medicine. Frailty is a biologic syndrome (Crome & Lally, 2011) of decreased reserves in multiple systems that results from dysregulation that can occur with ageing and is initiated by physiological changes of ageing, disease, and/or lack of activity or inadequate nutritional intake.

It is rather more multidimensional concept than just the expression of a degree of dependence in the everyday life activities. Frailty is basically connected with the grow of fatal somatic ailments and lowering of functional reserve of the old person, which is wasting away excessively without any fundamental cause disease (Juraskova et al., 2010). **Frailty** can be

defined as a status of reduced physiological reserves connected with increased inclination towards invalidisation (falls, fractures, daily life restrictions, loss of independence – Leng, 2007; Walston, 2006). Apart from the clinical observations there is elevation of CRP, leukocytes (monocytes), IL-6, IL-1 and TNF. Frailty is not the synonym of multi-morbidity or disability, multi-morbidity can cause this and disability can be the consequence (Fried et al., 2005).

**Frailty** is understood mainly as a risk of sudden deterioration of the status of very risky person. (above 80 years, living alone or with handicapped spouse, with serious somatic or psychical disease).

The outcome for those defined frail seniors is the long term need of help of institutions and community (nursing service). The risks of the development of frailty (Friedman et al., 2006; Szanton et al., 2010) are represented by hypomobility in pre-senium, social isolation, depression, bad subjective feeling of the own health etc.

The concept of frailty is at least coming nearer to the term risky geront, used in the past. The emphasis is put on the retrieval of these people because they can not show their frailty out. Both (the ageing and physical frailty) are conditioned by the decline of proteosynthesis in the muscles, decline of immune function, elevation of the mass of fat in the body and lowering of the amount of body water, lowering of the bone mineral density, loss of the whole body mass and strength.

The main etiological and patogenetic mechanisms (Leng et al., 2007; Walston et al., 2006) of the syndrome of frailty are:

- the inflammation or hypercoagulation
- oxidative stress
- insulin resistance
- anorexia with loosing of the weight and malnutrition
- sarcopenia
- fall of efficiency of lower hints
- loosing of spontaneous action – nutrition, hydration, movement, behavioral and social
- dysfunction of autonomic nervous system ( falls, sarcopenia, decubital ulcer and healing – with the consequence like loosing the weight, incontinence, delirium, disturbance in thermoregulation etc.)
- apathy – as the consequence of lack of the dopamine in CNS ( depression, dementia)
- depression, anxious status, organic psychosyndrome
- development of cognitive deficiency
- menopause and andropause as the consequence of hormone deficiency with the development of the syndrome ADAM and PADAM, somatopause as the result of lack of IGF-1
- chronic pain
- hypomobility with the sedentary lifestyle
- chronic stress
- functionally important consequences of chronic diseases which limit in an activity (hemiparesis, severe diabetic neuropathy, respiratory or heart insufficiency, hard anemia of chronic diseases)
- adverse effects of the medicaments

## 8. Polypharmacy in the elderly

Polypharmacy is a common problem in the elderly. Particularly in those who have multiple comorbidities. Their therapy should be guided by the estimated life expectancy and



the patients' values and goals. Interventions that are likely to help the elderly, who are well, may differ from those that will benefit the ones who are frail. Estimating life expectancy can help a health care provider to focus on those issues to be most likely beneficial in the given patient.

There are several reasons for the greater incidence of iatrogenic drug reactions in the elderly population, the most important of which is the high number of medications that are taken by the elderly, especially those with multiple comorbidities (Blackburn & Dulmus, 2007; Duthie et al., 2007). Older individuals often have varying responses to a given serum drug level. Thus, they are more sensitive to some drugs (eg. opioids) and less sensitive to others (eg. beta-blockers).

Following aspects should be considered in the old-age pharmacotherapy (Katzung, 2003):

1. Responses to drugs are different from preceeding age categories which is a consequence of changed pharmaco-dynamics and pharmaco-kinetics.
2. Increased occurrence of undesired effects of drugs in general
3. Increased non-compliance in the elderly
4. Increased occurrence of drug interactions

Multi-morbidity of advanced age often leads a physician in clinical practice to **polypharmacotherapy** (Nikolaus, 2000; Soriano et al., 2007), which is many times inevitable but still is sometimes hazardous because with increasing age an occurrence of undesired drug effects grows. The elderly are generally more vulnerable and the therapeutic range gets narrower. Compliance decreases inter-individual variability of an effect increases the same way as the risk of drug interactions. Basic requirement for phamacotherapy in advanced age is that it should be simple, purposeful and effective. Polypharmacy can be often risky and ineffective, many times it can be even damaging – **iatrogenia** as a syndrome. In geriatric medicine generally symptomatic treatment overweights the causal one. Its undesired effects can substantially alter the clinical picture of diseases.

The consumption of drugs in the elderly treated within the institutional care is three times higher when compared to the same number of individuals from general population and female patients need twice as many drugs as the male ones.

Distribution of drugs depends on the body composition as mentioned, bonds to plasmatic proteins and blood flow trough tissues. Poorly nourished or frail elderly persons may have a low serum albumin. A cardiac output in advanced age decreases, peripheral vessel resistance grows, liver gets smaller and blood flow trough liver and kidneys decreases. Bigger part of the cardiac output in comparison to the younger ones flows through the brains, heart and skeleton muscles. This also plays a role in the drug distribution.

## 9. Problems and complications of polypharmacy

Occurrence of **undesired drug effects** is generally 3 – 5 times higher in advanced age when compared to preceding age categories (Beers et al. , 2006). Higher consumption of drugs brings along higher risks (including deep venose thrombosis - DVT and PE). Side effects occur in 2 per cent of the elderly using less than 3 drugs at a time during a year. This percentage grows up to 17 in those who use 10 drugs. Combination of more drugs is preferred recently more and more frequently to mono-therapy. Except for expected and beneficial effect of synergism it can bring also adverse side effects. Number of new drugs especially in psychiatry and neurology grows dramatically during last decades. The most frequently prescribed drugs today are anxiolytics and antidepressants. They are often



required also by the elderly and their usage grows also in internal medicine, geriatrics and other non-psychiatric medical branches. One third of the undesired drug effect is predictable and mere reduction of a dosage can eliminate two thirds of them.

These undesired effects are often wrongly diagnosed which leads to prescription and administration of further drugs – it is a so called prescriptive cascade. Correct medication (both with prescription drugs and commercially available medicaments) is based on the right indication appropriate dosage and forms adapted to intellectual potential and somatic skills of a patient, elimination of predictable undesired effects and drug interactions and minimisation of their impacts on patient, consideration of optimum period of drug administration and consistent monitoring of permanent administration connected with continuous evaluation of compliance (Katzung, 2003). Non-compliance occurs in 25 – 50 per cent of older patients taking drugs regularly.

When prescribing a drug the physician should ask:

- Which drug is the most convenient one regarding multi-morbidity and predictable drug interactions?
- What is the optimum dosage?
- Is a drug indication definite and undoubtful?

## 10. Multimorbidity in old age and its relations

Multiple pathology, or concurrence of diseases, is common among older persons. An early Scottish study of community-dwelling persons over age 65 reported 3.5 major problems per person; for those being admitted to hospitals, 6 disorders were documented per patient. Multiple pathology (Crome & Lally, 2011) poses multiple risks to older patients and their physicians. The first hazard is that active medical problems frequently interact to the detriment of the patient -*disease-disease interactions*.

Late detection of treatable problems whose neglecting and interaction have led to functional decline is common in older patients and can be one of the few discouraging features of geriatric care. Preventive dental and medical care could have avoided the sepsis, worsening of diabetes, fall, hip fracture, postoperative heart attack, stroke, and loss of independent living.

The interaction between old age and illness causes specific changes of diseases in senium (Beers et al., 2006; Pathy et al., 2006; Ratnaike, 2002).

Particularities of illness in old age include:

- Multi-morbidity – parallel occurrence of more illnesses in one person with or without causality relationship
- Mutual causality of social and health situation – each of the changes of the health state in old age influences their social status and vice versa
- Among the specialities of clinical picture of illnesses in old age we can list:
  1. microsymptomatology – minimal symptoms of diseases (the iceberg phenomenon)
  2. mono- or oligosymptomatology – sporadic symptoms from those, which occur usually in middle or young age
  3. distant signs – to the forefront of clinical picture there are symptoms, which belong to the difficulties of other organ than the basic one ( “the innocent organ complains, not the sick one”)
  4. tendency to chronicity – even in the diseases which are in younger and middle age acute, moreover in old age there is higher risk of death

5. tendency to complications - either of type of "chain reaction" or it is the complication, which does not have the direct relation ("crowd-out effect")
6. atypical picture of the diseases - „For the diseases in the old age it is typical that their running is atypical“

The proper symptomatology of the basic disease is usually inconspicuous. In the clinical picture manifestation of non-specific and universal symptoms dominates. These are the results of the secondary brain decompensation. Among those the universal *neurologic and psychiatric symptomatology* conditioned on hypo-perfusion (hypoxia) of the brain (TIA, delirium etc.) belong. The senior's brain is usually affected with the degenerative or vascular changes and reacts usually as the first organ.

Among the causes of the morbidity in old age the forward position (Tallis & Fillit, 2003) is being taken by the diseases of the cardiovascular system conditioned with atherosclerosis like CHD (coronary heart disease), MI (myocardial infarction), angina pectoris, stroke, transient ischemic attack, ischemic disease of the lower limbs (atherosclerosis - AS is present in 90% of the people above 75 years.). In old age we find common: the diseases of the locomotive system, sense organs, tumours, accidental injuries, the diseases of the respiratory tract, gastrointestinal tract (biliary problems etc.) and urogenital tract (the prostate in men, gynecological in women). Diabetes, mental and neurological disorders are common (Beckman et al., 2002; Sinclair & Finucane, 2003). Their coincidental and usually independent occurrence is typical for the senior's multi-morbidity. After the age of 60 there is continuous increase mainly of the cardiovascular diseases as CHD, stroke, hypertension (Ferrari, 2003; Oskvig, 1999). Similarly with the age prevalence of diabetes rises (Sinclair & Finucane, 2003).

For the quality of the senior's life crucial matter is not the presence of the disease itself (or more diseases) but the grade of the disability, it means functional disturbance, into which it is proceeding. The full self-sufficiency can be untouched even when there are more diseases present together.

The inclination of the seniors to the diseases is higher (Khaw, 1997) and the balance of the organ homeostasis is very frail (eg. homeostenosis). Similarly it is the case of "primary" mental disorders (dementia, depression, delirium) or in the geriatric social syndromes (neglect sy, elder abuse, geriatric maladaptation sy). The stressor is usually in psychosocial sphere and its clinical manifestation appears most often in cardiovascular area (heart failure, MI, stroke) or in impaired immunity (pneumonia).

As it was mentioned, the diseases and the morbid conditions in old age are marked by many extraordinarities. The diseases in old age have the tendency to cumulate and potentiate each other. In the geriatric medicine multidimensionality is typical. It is needed to comprehend the sick person in old age as the bio-psycho-social unit in more holistic way than in younger age from the viewpoint of etiopatogenesis of the disease and also in the case of everyday clinical practice.

The quoted problems from the somatic, psychic and social areas which are in the mutual interaction are hardly treatable, they are chronic with the progression of the condition and they have relatively unfavourable prognosis. They bring a lot of hardly solvable situations and problems to the ill and the surroundings. By the „old old“ people ( $\geq 80$  years) the diseases proceed in the way (Crome & Lally, 2011), which differ from the progress of the diseases in middle age and they need the different approach which can improve the health condition or at least maintain the self-sufficiency and they accent the comeback home.

The most of the biological functions achieve the top before the 30<sup>th</sup> year of the life. Some of them slightly decrease afterwards linearly. For the everyday activity this decrease has not

any practical importance, but can be relevant in the time of bigger stress or in the load. The physiological processes which are decreasing as the age grows are: blood flow through the kidneys, the clearance of the creatinin, the maximum heart rate and pulse volume in stress, glucose tolerance, vital capacity of the lungs, body weight, cell immunity. On the contrary the total lung capacity and the liver function do not change with increasing age, the production of the ADH is even growing.

Many of mentioned declines, which were thought as natural consequence of the ageing, are significantly influenced by the life style, behaviour, diet and environment in which the senior has been living. The most important physiological change in old age is the predisposition to the higher occurrence of severe diseases. The respiratory functions of a 70 year old healthy man are the 50% of the 30 years old man. The renal function usually goes down in 70 years by 50% and more. This decline in physiological reserve capacity does not influence the everyday life but it can influence the ability to recover from the severe disease (grave infection, life threatening internal diseases, operations, injuries etc.)

Some of the physiological changes can simulate a disease even if they are just a usual component of the ageing. Diabetes mellitus can appear and disappear in the old age. The ability of the insulin to stimulate the take up of the glucose declines with the age and is usually manifested as postprandial hyperglycaemia with normal fasting level of insulin and glucose. In the stress situations diabetes can be detected in seniors, but it can disappear when the situation gets normal. This loss of the physiological reserves contributes to the rising prevalence of diabetes with the rising age.

The age conditioned changes, which make the old age people more vulnerable in their everyday life, are usually mild. In the elderly there is an onset of hypo- or hyperthermia easier during the exposition to extreme surrounding influences, because there are a lot of changes in the coordination of the lead of the thermoregulation also in the neurological area. The loss of neurotransmitters in brain stem can cause typical senile walk, as well as it predisposes genetically determined individuals for e.g. to the progress of the Parkinson's disease. Some of the age conditioned changes cause the specific consequences. The menopause is the physiological process connected with normal ageing but it leads to the symptoms, which predispose the organism to the loss of the bone mass and atherosclerosis.

Apart from clinically obvious forms of the diseases in the elderly the sub-clinical form is common as well. Among 6 000 individuals above 65 years which were in the Cardiovascular Health Study (Fried et al., 1991) 31% of them had clinically apparent cardiovascular disease, another 37% had sub-clinical form of the disease which was found by non-invasive methods.

The half of the people above 65 years have two or more diseases and these can mean an added risk of unfavourable consequences like mortality. In some of the seniors the cognitive disturbance can imitate symptoms of a severe disease. The therapy of one disease can act in an undesirable way on the other place – such as e.g. use of aspirin as the prevention of the ictus in the individual with the anamnesis of the gastroduodenal ulcer. The risk leading to disability or dependence on the help is getting higher with the number of co-morbidities. Certain couplets of the diseases can increase the risk of disability synergistically. The arthrosis and the diseases of the heart co-exist in 1/5 of the elderly, even though the risks of progress of disability are 3- or 4-times higher with one of them alone, the risk of both together is 14-times higher (Cassel et al., 1997).

At the end the severe and common consequence of the chronic disease in old age is physical disability, defined as the presence of difficulties or dependence on the others when

doing common everyday activities, from the basic self-service ( the toilet and washing up) to the tasks needed for leading the independent life ( shopping, preparing food, paying the bills etc.).

On the onset and the progress of the critical conditions in old age following factors can significantly participate: the poor mobility, loneliness, bad eating habits, insufficient hydration, mental deterioration, disturbance of the sight and hearing. The mentioned ill individuals have, as it is with multi-morbidity in old age common, an atypical picture, or they can be without symptoms or the problems are seemingly moved to the other organ area. The important role is played also often by rich pharmacotherapy in old age, which can itself cause different organ symptoms (also by the mutual interactions).

The management of the critical ill persons in old age will demand very active approach from the all clinical doctors (not only intensivists) and sometimes also usage of more invasive procedures in the diagnostics and therapy of PE, which can act unfavourably in some of the cases and sometimes also iatrogenically.

## 11. Pulmonary embolism in the elderly - general view of a geriatritian

The entities of deep venous thrombosis (DVT) and pulmonary embolism (PE) present a continuum of venous thromboembolic disease (VTE), which is of crucial importance for elderly patients, and offer constant diagnostic and therapeutic challenges to physicians caring for patients of any age. For multiple reasons, the incidence of both DVT and PE increase with age (Hansson et al., 1997). First, there is often a decrease in the leg muscle mass, setting the stage for stasis. There are increased thrombotic tendencies in the elderly (Price et al., 1997), beginning around the age of 60, which may involve up to 20% of those over age 85; these include impaired vascular wall fibrinolysis and hypercoagulable states.

The diagnosis of venous thrombembolism (VTE) in the elderly is difficult, although the presentation is usually quite similar to that seen in younger patient groups (Matějovská-Kubešová et al., 2009). The most common presenting symptom of PE is some complaint of chest discomfort or pain, seen in approximately 35% of patients in most series, usually without hemoptysis. Dyspnea and tachypnea occur frequently. Although circulatory collapse occurs in a relatively small proportion of the elderly, these latter patients are much more likely to have sustained massive pulmonary emboli and often have evidence of neurologic deficits and findings of pulmonary hypertension. Although virtually all younger patients present with one of these syndromes, about 10% of the elderly do not, and in the setting of respiratory distress this minority may show only confusion or atypical new radiographic findings. The major diagnostic strategy (Wells, 1998) required is one of constant suspicion and concern and a consideration that, in any older hospitalized patient who is "failing to thrive," to ask whether this could be due to pulmonary embolism, because both the symptoms and standard laboratory findings are nonspecific and the diagnosis is too often made postmortem. The classic triad of hemoptysis, pleuritic chest pain, and clinically apparent thrombophlebitis is infrequently seen, in less than 10% of elderly patients with VTE.

Half of the people, who have PE, have no symptoms. With increasing age the amount of people with silent PE is growing. This is, after myocard infarction and cerebrovascular events, the third most frequent cardiovascular cause of the death. Simultaneously it is one of the least often correctly diagnosed cardiovascular diseases.

That is a medical emergency because a large embolism, or sometimes many repeated smaller ones, can be fatal in a short time. When the heart is continually overworked, it may



enlarge, and it may eventually fail to perform. A large PE can cause heart or lung failure. This seems to be especially important in advanced age where CHD (heart failure too) has growing tendency. Fortunately chances of surviving a PE increase when a physician can diagnose and treat the patient quickly.

The acquired and genetic factors contribute to the likelihood of VTE. The acquired predispositions include generally long-haul air travel, obesity (Barba et al., 2008), cigarette smoking, oral contraceptives, pregnancy, postmenopausal hormone replacement (LaCroix et al., 2011; Sare, 2008), surgery (Einstein et al., 2008; Secin et al., 2008), trauma, and medical conditions such as antiphospholipid antibody syndrome, cancer, systemic arterial hypertension, and chronic obstructive pulmonary disease. Some patients with predisposing genetic factors will never develop clinical evidence of clotting (Reynolds et al., 2009).

PE and DVT are common problems in the elderly (Kniffin et al., 1994). They both increase with age, but the effects of race and sex are small. Current treatment patterns appear to be effective in preventing both PE after DVT and recurrence of PE. They both are associated with substantial 1-year mortality, suggesting the need to understand the role of associated conditions as well as the indications for prophylaxis and the methods of treatment. Gangireddy (Gangireddy et al., 2007) describes preoperative risk factors associated with symptomatic VTE older age, male gender, corticosteroid usage, COPD, recent weight loss, disseminated cancer, low albumin, and low haematocrit but not DM. Patients with a low probability of PE have a good prognosis in comparison to those having risk factors (Bertoletti et al., 2011). In isolation, they have limited diagnostic value and none can be used to rule in or rule out PE without further testing (West et al., 2007).

Necropsy studies in the United Kingdom (Alikhan et al., 2004) and Sweden (Hansson et al., 1997; Nordstrom et al., 1998) continued to show a high incidence of PE, which was considered the main cause of death in about 10% of necropsies. Since the inpatient mortality in general hospitals is about 10%, it is estimated that about 1% of patients admitted to hospital die from PE. However, for every patient who dies of PE in a surgical ward, three die in nonsurgical wards. This is not only a common problem but a serious one: the in-hospital mortality of elderly patients over the age of 65 with documented pulmonary embolism was 21% in the Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED, 1990) Study, and the 1-year mortality was 39% (Stein, 2008). Recent data suggest these numbers may be even higher (Heit et al., 1998).

The clinical non-recognition of venous thrombembolism prior to fatal PE implies that its detection and treatment cannot have a major impact on its mortality; hence, identification and primary prophylaxis of hospitalized in-patients (medical and surgical) at high absolute risk of DVT is required for its prevention.

The high occurrence of PE (particularly its silent form) has crucial importance in the elderly mortality. Our recommendations would like to emphasize the need of no underestimation of this fact and to carry out preventive measures in all age groups (including “oldest old” and frail persons).

Immobilization in medical ward is due to illness (e.g. infection, malignancy, heart failure, myocardial infarction and stroke). The cumulative risk of DVT and PE increases with the duration of immobility, suggesting a role for venous stasis in the inactive leg in the pathogenesis of DVT.

Prophylaxis against PE is of paramount importance because venous thromboembolism is difficult to detect and poses an excessive medical and economic burden (Kakkar et al., 2010).



Mechanical and pharmacologic measures often succeed in preventing this complication. Patients who have undergone total hip replacement, total knee replacement, or cancer surgery will benefit from extended pharmacologic prophylaxis for a total of 4 to 6 weeks, especially with LMWH or UFH about 2 in 3 cases (Bottaro et al., 2008; Reynolds et al., 2009). Thromboembolic complications are prevalent in the perioperative period. It has been estimated that between 20% and 30% of patients undergoing general surgery develop deep venous thrombosis, and the incidence is as high as 40% in hip and knee surgery, gynecological cancer operations, open prostatectomies, and major neurosurgical procedures. Although fatal pulmonary embolism occurs in 1% to 5% of all surgical patients, it accounts for a larger proportion of operative deaths in middle-aged and older individuals. Because venous thrombosis and pulmonary emboli can be difficult to diagnose and treat, considerable effort has been focused on prophylaxis.

Patients at high risk can receive a combination of mechanical and pharmacologic modalities. Graduated compression stockings and pneumatic compression devices may complement mini-dose unfractionated heparin (5000 units subcutaneously twice or preferably three times daily), low-molecular-weight heparin, a pentasaccharide or warfarin administration.

Overall the literature suggests that any association of age with risk of bleeding on heparin or warfarin is weak, and contrasts with the strong, consistent finding of an exponential increase in thromboembolic risk with age (Kanaan et al., 2007; Kakkar et al., 2010). However, geriatricians should consider several practical considerations when prescribing oral anticoagulants to the elderly (Beers et al., 2006; Cassel et al., 2003).

1. Sensitivity to the anticoagulant effect of a given dose increases with age (e.g. decrease of daily dose of warfarin)
2. Polypharmacy (including self-medication) increases the risk of drug interactions which alter oral anticoagulant effect, or which increase the risk of bleeding (e.g. aspirin and other NSAD)
3. Increased prevalence of concurrent or intercurrent illness also increases the risk of bleeding (e.g. severe anemia, renal failure, gastrointestinal bleeding, hemorrhagic stroke, bleeding disorder)
4. Decreased compliance or decreased access to monitoring – whether performed by the general practitioner or hospital anticoagulant clinic – also increases risk of bleeding.

## **12. DVT and PE in the elderly – two sides of the same coin VTE**

The continuum of DVT and PE in the elderly is quite similar to that of the younger patient. Constant consideration of the diagnosis and application of standard diagnostic and therapeutic strategies will be a benefit for the patients and also enhance the mental equanimity and professional satisfaction of physicians caring for the elderly.

### **12.1 Deep vein thrombosis**

The incidence of deep vein thrombosis increases with age.

#### **12.1.1 Etiology**

Immobilization, prolonged sitting (as it may occur during long drives or air travel), or even a relatively sedentary existence can lead to venous stasis and predisposes to thrombosis, because the emptying of veins in the extremities depends entirely on skeletal muscles that pump blood and on one-way venous valves that inhibit retrograde flow. Since incompetent

venous valves lead to deep vein thrombosis, which damages the valves, deep vein thrombosis tends to recur.

Deep vein thrombosis occurs in 20 to 25% of patients > 40 after routine surgery and in almost 50% after hip surgery when no prophylaxis is given.

### 12.1.2 Symptoms and signs

DVT usually occurs in the leg, regardless of the cause. The hallmark symptom is rapid onset of unilateral leg swelling with dependent edema – in advanced age predominantly asymptomatic. Generally, patients first note swelling when they awaken. In ambulatory patients, swelling is maximal at the ankle and lower leg, usually developing over 1 or 2 days.

Calf vein thrombosis may produce no symptoms or mild tenderness and mild edema. Calf vein thrombosis without swelling is common only among sedentary or bedridden patients.

Complications of DVT include venous thromboembolism, particularly pulmonary embolism (which can lead to death within 30 minutes of onset).

### 12.1.3 Diagnosis

Risk factors (eg, dehydration, estrogen use (LaCrox et al., 2011; Sare et al., 2008), heart failure, hip fracture, hypercoagulable states, immobilization or decreased physical activity, malignancy, obesity (Barba et al., 2008), polycythemia, thrombocytosis, trauma, venous damage) should be sought unless the cause is clear.

### 12.1.4 Prophylaxis

**Orthopedic procedures:** DVT is common among the elderly because they commonly undergo high-risk orthopedic procedures, particularly semi-elective or urgent procedures (eg, after a traumatic fracture). If the procedure involves the extremities, the value of low-dose heparin is limited; full-dose heparin or warfarin is effective, but each has a significant risk of bleeding.

After elective total hip replacement, the incidence of proximal deep vein thrombosis (without prophylaxis after surgery) approaches 25%, and the incidence of fatal pulmonary embolism is 3 to 4%. Prophylaxis reduces the occurrence of venous thromboembolism by 30 to 50%.

Low-dose heparin or low-molecular-weight heparin reduces the occurrence of deep vein thrombosis by at least 50%.

### 12.1.5 Treatment

The objective is to prevent pulmonary embolism and chronic venous insufficiency. Patients > 70 (especially women) receiving warfarin therapy are at high risk of hemorrhage. Since many elderly persons with arthritic or neurologic disorders fall frequently, warfarin is often contraindicated in patients > 80 and frail patients > 70.

## 12.2 Pulmonary embolism

Since the symptoms and signs are nonspecific, pulmonary embolism may be overdiagnosed or underdiagnosed, especially in the elderly. Patients with cardiac and respiratory disorders are especially at risk of misdiagnosis.

The first step in making the diagnosis is a careful physical examination to evaluate alternative diagnoses, for example, congestive heart failure, coronary artery disease,

malignancy, and infections that are all frequent in the elderly and may on occasion be confused with pulmonary embolism.

The most common and serious major error is one of omissions, when the diagnosis simply is not considered clinically and is confirmed only at autopsy. Pleural changes and possibly some local asymmetric changes in vascularity may be detected if the film is keenly studied; however, the most common finding is that of an essentially normal chest roentgenogram in a very sick patient.

### 12.2.1 Etiology

Bed rest and inactivity pose the greatest risk for developing of deep vein thrombosis. Certain medical conditions common among the elderly (eg, trauma to leg vessels, obesity (Barba et al., 2008), heart failure, malignancy, hip fracture, myeloproliferative disorders) predispose them to venous thrombosis, as do smoking, estrogen usage (LaCroix et al., 2011; Sare et al., 2008), tamoxifen therapy, the presence of a femoral venous catheter, and surgery (Barba et al., 2008). Risk factors for venous thrombosis are vessel wall injury, stasis, and conditions that increase the tendency of the blood to clot, including rare deficiencies of antithrombin III, protein C, and protein S as well as disseminated intravascular coagulation, polycythemia vera, or the presence of a lupus anticoagulant or antiphospholipid antibodies. Ageing is also associated with increased coagulation and products of fibrinolysis, resulting in an overall prethrombotic state.

About 90% of blood clots that cause pulmonary embolism originate in the legs. The risk that a clot will embolize and lodge in the lungs is greater if the clot is in the popliteal or iliofemoral vein (about 50%) than if it is confined to the calf veins (< 5%). Less common sites of thrombosis that may lead to pulmonary embolism are the right atrium, the right ventricle, and the pelvic, renal, hepatic, subclavian, and jugular veins.

### 12.2.2 Symptoms and signs

In elderly patients, the most common symptoms are tachypnea (respiratory rate > 16 breaths/minute), shortness of breath, chest pain that may be pleuritic, anxiety, leg pain or swelling, hemoptysis, and syncope. Patients who have small thromboemboli may be asymptomatic or have atypical symptoms. Nonspecific symptoms suggestive of pulmonary emboli in the elderly include persistent low-grade fever, change in mental status, or a clinical picture that mimics airway infection.

Patients with pulmonary embolism (West, 2007) usually present with one of the following symptom patterns: (1) diagnostically confusing syndromes (confusion, unexplained fever, wheezing, resistant heart failure, unexplained arrhythmias); (2) transient shortness of breath and tachypnea; (3) pulmonary infarction (pleuritic pain, cough, hemoptysis, pleural effusion, pulmonary infiltrate); (4) right-sided heart failure along with shortness of breath and tachypnea secondary to pulmonary embolism; or (5) cardiovascular collapse with hypotension and syncope. Fewer than 20% of elderly patients have the classic triad of dyspnea, chest pain, and hemoptysis. If tachypnea is absent, pulmonary embolism is unlikely to occur.

The most common physical findings are tachypnea, tachycardia, fever, leg edema or tenderness, cyanosis, and a pleural friction rub. Although most elderly patients with pulmonary embolism have deep vein thrombosis as the initial source of the embolus, only 33% have clinical signs of leg thrombosis.

About 33% of elderly patients with pulmonary embolism have pleural effusions, which are usually unilateral. About 67% of these effusions are bloody. Bloody pleural effusions generally have a pulmonary infiltrate on chest x-ray that suggests hemorrhagic consolidation of the lung parenchyma. The infiltrate usually resolves over several days. About 10% of patients with pulmonary emboli, especially those with severe heart failure, develop pulmonary infarction.

Syncope, a systolic blood pressure  $< 100$  mm Hg, or a markedly decreased systolic blood pressure in a hypertensive patient suggests the possibility of a massive pulmonary embolism or, in a patient with marginal cardiopulmonary function, a significant embolus.

A patient who is hypotensive because of pulmonary embolism has elevated right atrial and ventricular pressures (as measured by a pulmonary arterial catheter). Thus, a normal right atrial or ventricular pressure in a patient with hypotension argues against pulmonary embolism as the cause.

### 12.2.3 Diagnosis

The most important consideration for determining the extent of testing is the clinical assessment of pretest probability (Bertoletti et al., 2011). The clinical probability (Wells or Geneva score) of pulmonary embolism pretest places patients into low-, moderate-, or high-probability groups. This grouping is combined with the results of ventilation-perfusion scans or of spiral chest CT scans to determine whether further testing is needed.

Very useful and easy for diagnosis of PE in daily clinical practice in elderly patients seems to be the combination of clinical pretest probability (PTP) and D-dimer result (Pasha et al., 2010). In VIDAS study the combination of a negative D-dimer result and non-high PTP effectively and safely excludes PE in an important proportion of outpatients with suspected PE (Carrier et al., 2009).

### 12.2.4 Laboratory findings

A chest x-ray, an ECG, and arterial blood gas values should be obtained. If pulmonary embolism is still considered to be likely, the next step is usually to obtain a ventilation-perfusion lung scan. If the lung scan is likely to be indeterminate (because of underlying lung disease), spiral chest CT scans may be useful. Finding deep vein thrombosis with ultrasonography indicates the need for anticoagulation and usually eliminates the need for further testing for pulmonary emboli. The gold standard for diagnosing pulmonary embolism is pulmonary angiography.

**Chest x-rays:** Results of chest x-rays may be normal or may show nonspecific abnormalities, eg, atelectasis, an elevated hemidiaphragm, pleural effusion, or an infiltrate.

**ECG:** ECG findings are usually nonspecific; 33% of patients with pulmonary embolism have a normal ECG.

BNP (brain natriuretic peptide) and echocardiography may be also useful determinants of the short-term outcome for patients with PE (Sanchez et al., 2010).

**d-Dimer:** Levels of d-dimer, a fibrin-specific product, are increased in patients with acute thrombosis (Douma et al., 2010; Kabrhel et al. 2010). About 60% of patients  $< 50$  who are suspected of having a pulmonary embolus have an abnormal d-dimer result. In contrast, 92% of patients  $> 70$  have abnormal d-dimer levels, probably due to comorbid conditions (Douketis

et al., 2010). Therefore, if d-dimer test results are negative, deep vein thrombosis or pulmonary embolism is unlikely to be present, but positive test results are not useful in patients > 70.

The use of d-dimers as a secondary strategy to exclude the diagnosis of VTE has been recommended because the test has a high sensitivity, although a low specificity. False positives may occur in patients with recent trauma or surgery, malignancy, pregnancy, severe infections, and liver disease.

### 12.2.5 Prognosis

The mortality rate for hospitalized patients > 65 with pulmonary embolism is 21%. If pulmonary embolism is the primary diagnosis, the mortality rate is 13%; if it is a secondary diagnosis, the rate is 31%. Thus, many diseases and medical conditions—including heart failure, chronic obstructive pulmonary disease, cancer, myocardial infarction, stroke, and hip fracture—greatly increase the risk of death among hospitalized patients > 65 with pulmonary embolism. Prognosis is poorest for patients with severe underlying cardiac or pulmonary disease.

In patients > 65 with a pulmonary embolus, the recurrence rate in the first year is 8%, and the 1-year mortality rate is 39% (21% inpatient mortality and an additional 18% mortality during the first year). Elderly patients with deep vein thrombosis but without pulmonary emboli have a 21% mortality rate in the first year.

### 12.2.6 Treatment

Pulmonary embolectomy is not recommended in the elderly because it has a very low success rate and medical therapy is generally quite effective. These procedures should regularly be found in the armamentarium of geriatricians.

**Heparin** prevents clot formation and extension. As the risk of death from pulmonary embolism is the greatest in the first few hours of development of a clot and since diagnostic test results often are not available for 8 to 12 hours, heparin should be given to patients with a moderate to high clinical probability of pulmonary embolism or deep vein thrombosis until all diagnostic results are available. Low-molecular-weight heparin (LMWH) is preferred to unfractionated heparin. **LMWH** can be given subcutaneously once or twice a day, and laboratory monitoring may not be necessary.

Long-term anticoagulation is begun in the hospital with heparin and is continued after discharge, usually with **warfarin**.

**Thrombolytic (fibrinolytic) therapy** should be considered for patients with deep vein thrombosis involving the iliofemoral system. It is also useful for patients with massive pulmonary embolism who have significant pulmonary hypertension, obstruction of multiple segments of the pulmonary circulation, right ventricular dysfunction, or systemic hypotension.

### 12.2.7 Prophylaxis

Prophylaxis reduces the incidence of fatal pulmonary emboli by two thirds in hospitalized patients at risk of developing venous clots. LMWH (eg, enoxaparin 40 mg sc once daily) is as effective and safe as prophylaxis with subcutaneous heparin (5000 IU sc bid or tid) and may reduce drug-induced adverse effects. Postoperative prophylaxis with LMWH (eg, sc q 12 h for up to 14 days) also dramatically reduces the incidence of venous thrombosis after



knee or hip replacement and in abdominal surgery (Bottaro et al., 2008). For total hip replacement, some investigators find that 4 to 6 weeks of LMWH postoperatively may be more effective (Kanaan et al., 2007).

### 13. Conclusion

The approach to older patients should be consistently individualised. New diagnostic methods and therapeutic algorithms used in acute geriatric wards together enable us to treat successfully also multi-morbid patients in advanced age admitted by hospital's doctors. Modern iatrotechniques make possible also the treatment (including recovery) and protect self-sufficiency and preserve quality of life in the elderly being acutely ill.

Physicians committed to the care of elderly patients, are challenged with the diagnosis of venous thromboembolism due to a higher incidence, co-morbidities masking signs and symptoms and burdening referrals (Siccama et al., 2011).

We would like to emphasize the need to permanently think of the possibility of PE in elderly persons with present risk factors and in suspected cases the use of pretest probability scale as Wells or Geneva score as soon as possible (Carrier et al., 2009; Pasha et al., 2010). The requirement of correctly assessed diagnosis and starting of therapeutic procedures is crucial and essential proceeding for giving the hope to patient and generally, from the professional viewpoint, improvement of the prognosis.

### 14. References

- Alikhan R, Peters F, Wilmott R, Cohen AT. (2006). *Fatal pulmonary embolism in hospitalised patients: a necropsy review*, J Clin Pathol, Vol.57, No.12, pp.1254-7, ISSN 0021-9746
- Applegate WB, Blass JP, Williams TF. (1990). *Instruments for the functional assessment of older patients*, N Engl J Med, Vol.322, pp.1207-14, ISSN 0028-4793.
- Asplund K, Gustafson Y, Jacobsson C. (2000). *Geriatric- Based Versus General Wards for Older Acute Medical Patients: A Randomized Comparison of Outcomes and Use of Resources*, JAGS, Vol.48, pp.1381-88, ISSN 0002-8614
- Barba R, Martinez-Espinosa S, Rodriguez-Garcia E. (2000). *Poststroke dementia: clinical features and risk factors*, Stroke, Vol. 31, pp. 1494-501, ISSN 00392499
- Barba R, Zapatero A, Losa JE, Valdaos V, Todola JA, Di Micco P, Monreal M, Riete Investigators (2008) *Body mass index and mortality in patients with acute venous thromboembolism: findings from the RIETE registry*, J Thromb Haemost, Vol.6, No.4, pp. 595-600, ISSN: 1538-7933
- Beckman JA, Creager MA, Libby P. (2002). *Diabetes and Atherosclerosis. Epidemiology, Pathophysiology, and Management*, JAMA, Vol. 287, pp. 2570-81, ISSN: 00987484
- Beers MH, Thomas VJ & Jones TV (eds.) (2006) *The Merck Manual of Geriatrics- 7th edition*, Merck & Co, ISBN-13: 978-0911910667, New York, USA
- Bertoletti L, Le Gal G, Aujesky D, Roy PM, Sanchez O, Verschuren F, Bounameaux H, Perrier A, Righini M. (2011). *Prognostic value of the Geneva prediction rule in patients in*

- whom pulmonary embolism is ruled out. *J Intern Med*, 2011 Vol. 269, No. 4, pp. 433-40, ISSN: 0954-6820
- Blackburn JA & Dulmus CN. (eds.). (2007). *Handbook of gerontology : evidence-based approaches to theory, practice, and policy*, Hoboken, N.J. Wiley, ISBN-13: 978-0471771708, New York, USA
- Bongard FS & Sue DY. (eds.). (2003). *Current Critical Care Diagnosis & Treatment, Second Edition*, Lange Medical Books/McGraw-Hill Medical Publishing Division, ISBN: 0-07-121206-X, New York, USA
- Bottaro FJ, Elizondo MC, Doti C, Bruetman JE, Perez Moreno PD, Bullorsky EO, Ceresetto JM. (2008). *Efficacy of extended thrombo-prophylaxis in major abdominal surgery: what does the evidence show? A meta-analysis*. *Thromb Haemost*, Vol.99, No.6, pp.1104-11, ISSN: 1538-7933
- Braunwald E, Zipes DP, Libby P. (eds.). (2001). *Heart Disease, 6<sup>th</sup> edition – a Textbook of Cardiovascular Medicine*, W.B.Saunders Comp., ISBN-13: 978-0721685618, Philadelphia, USA
- Brunner-Ziegler S, Heinze G, Ryffel M, Kompatscher M, Slany J, Valentin A. (2007) "Oldest old" patients in intensive care: prognosis and therapeutic activity. *Wien Klin Wochenschr*, Vol. 119, pp. 14-19, ISSN 0043-5325
- Buttler G. (2003). *Increasing life expectancy - what are the promises of demography?* *Z Gerontol Geriatr*, Vol.36, pp. 90-94, ISSN (printed): 0948-6704
- Campbell AJ, Cook JA, Adey G, Cuthbertson BH. (2008). *Predicting death and readmission after intensive care discharge*. *Br J Anaesth*, Vol. 100, pp. 556-562, ISSN 1471-6771
- Carrier M, Righini M, Djurabi RK, Huisman MV, Perrier A, Wells PS, Rodger M, Wuillemin WA, Le Gal G. (2009). *VIDAS D-dimer in combination with clinical pre-test probability to rule out pulmonary embolism. A systematic review of management outcome studies*. *Thromb Haemost*, Vol.101, No.5, pp. 886-92, ISSN: 1538-7933
- Cassel ChK, Cohen HJ, Larson EB et al. (eds.). (2003). *Geriatric medicine: an evidence-based approach*, Springer, ISBN-13: 978-0387955148, New York, USA
- Chase P, Mitchell K, Morley JE. (2000) *In the steps of giants: the early geriatrics texts*. *J Am Geriatr Soc*, Vol. 48, No.1, pp. 89-94
- Crome P & Lally F. (2011). *Frailty: joining the giants*. *CMAJ*, Vol.183, No.8, pp. 889-90, ISSN 0820-3946
- Doucet J, Trivalle CH, Chassagne PH. (1994). *Does age lay a role in clinical presentation of hypothyroidism?* *J Am Geriatr Soc*, Vol.42, pp.984-986, ISSN: 0002-8614
- Douketis J, Tosetto A, Marcucci M, Baglin T, Cushman M, Eichinger S, Palareti G, Poli D, Tait RC, Iorio A. (2010) *Patient-level meta-analysis: effect of measurement timing, threshold, and patient age on ability of D-dimer testing to assess recurrence risk after unprovoked venous thromboembolism*. *Ann Intern Med*, Vol.153, No.8, pp.523-31, ISSN: 0003-4819
- Douma RA, le Gal G, Sauhne M, Righini M, Kamphuisen PW, Perrier A, Kruip MJ, Bounameaux H, Balller HR, Roy PM. (2010). *Potential of an age adjusted D-dimer cut-off value to improve the exclusion of pulmonary embolism in older patients: a retrospective analysis of three large cohorts*. *BMJ*, Vol.340, c 1475, ISSN: 0959 8138

- Duthie EH, Katz PR & Malone ML. (eds.). (2007). *The practice of geriatrics 4th ed.*, Saunders Elsevier, ISBN-13: 978-1416022619, Philadelphia, USA
- Einstein MH, Kushner DM, Connor JP, Bohl AA, Best TJ, Evans MD, Chappell RJ, Hartenbach EM. (2008). *A protocol of dual prophylaxis for venous thromboembolism prevention in gynecologic cancer patients*, Obstet Gynecol, Vol.112, No.5, pp.1091-7, ISSN: 0300-8835
- Fauci AS, Braunwald E, Kasper DL, Longo DL, Jameson JL, Loscalzo L. (eds.). (2008). *Harrison's Principles of Internal Medicine 17th Edition*, McGraw-Hill Medical Publishing Division, ISBN-13: 978-0071466332, New York, USA
- Ferrari AU, Radaelli A, Centolla M. (2003). *Aging and the cardiovascular system.*, J Appl Physiol, Vol. 95, pp. 2591-97, ISSN: 8750-7587
- Fried LP, Borhani NO, Enright P, Furberg CD, Gardin JM, Kronmal RA, Kuller LH, Manolio TA, Mittelmark MB, Newman A. (1991). *The Cardiovascular Health Study: design and rationale*, Ann Epidemiol, Vol.1, pp. 263-276, ISSN: 1047-2797
- Fried LP, Hadley EC, Walston JD, Newman AB, Guralnik JM, Studenski S, Harris TB, Ershler WB, Ferrucci L. (2005). *From bedside to bench: research agenda for frailty*, Sci Aging Knowledge Environ, Vol. 31: pp.24, ISSN 1539-6150
- Friedman SM, Mendelson DA, Kates SL, McCann RM (2008). *Geriatric co-management of proximal femur fractures: total quality management and protocol-driven care result in better outcomes for a frail patient population.* J Am Geriatr Soc, Vol. 56, pp. 1349-56, ISSN: 0002-8614
- Friedman SM, Steinwachs DM, Temkin-Greener H, Mukamel DB. (2006). *Informal caregivers and the risk of nursing home admission among individuals enrolled in the program of all-inclusive care for the elderly*, Gerontologist, Vol. 46, pp. 456-463, ISSN: 0016-9013
- Gammack JK & Morley JE. (eds.). (2006). *Geriatric medicine*, Saunders, ISBN-13: 9780801635267, Philadelphia, USA
- Gangireddy C, Rectenwald JR, Upchurch GR, Wakefield TW, Khuri S, Henderson WG, Henke PK. (2007). *Risk factors and clinical impact of postoperative symptomatic venous thromboembolism*, J Vasc Surg, Vol. 45, No.2, pp.335-41
- Goldmann L, Ausiello DA, Arend W. et al. (eds.). (2007). *Cecil Medicine: Expert Consult - Online and Print*, W. B. Saunders Comp., ISBN-13: 978-1416028055, Philadelphia, USA
- Gross R, Bentur N, Einayany A. (1996). *The validity of self-reports on chronic disease: characteristics of underreporters and implications for the planning of services*, Public Health Rev, Vol.24, No.2, pp. 167-82, ISSN (printed): 0301-0422
- Gupta A. (2008). *Measurement scales used in elderly care*, Radcliffe Publishing, OBE, ISBN-13: 978-1846192661, Oxford, UK
- Gurcharan RS & Mulley GP. (eds.). (2007). *Elderly medicine : a training guide, 2nd ed.*, Churchill Livingstone Elsevier, ISBN 9058232344, 9789058232342, Edinburgh, UK
- Hall JB, Schmidt GA, Wood LDH et al.(eds). (2005). *Principles of Critical Care. care.3. ed.*, McGraw-Hill, Medical Publishing Division , ISBN 0-07-141640-4, New York, USA

- Hansson PO, Welin L, Tibblin G, Eriksson H. (1997). *Deep vein thrombosis and pulmonary embolism in the general population. 'The Study of Men Born in 1913*, Arch Intern Med, Vol.157, No.15, pp.1665-70, ISSN 0003-9926
- Harari D, Martin FC, Buttery A, O'Neill S, Hopper A. (2007). *The older persons' assessment and liaison team 'OPAL': evaluation of comprehensive geriatric assessment in acute medical inpatients*, Age Ageing, Vol. 36, No. 6, pp. 670-5, ISSN: 0002-0729
- Hazzard WR. (2007) *Scientific progress in geriatric syndromes: earning an "A" on the 2007 report card on academic geriatrics*, J Am Geriatr Soc, Vol. 55, pp. 794-96, ISSN: 0002-8614
- Heit JA, Silverstein MD, Mohr DN. (1999). *Predictors of survival after deep vein thrombosis and pulmonary embolism: a population-based cohort study*, Arch Intern Med, Vol. 159, pp. 445-56, ISSN 0003-9926
- Heltweg B. (2006). *Antitumor Activity of a Small-Molecule Inhibitor of Human Silent Information Regulator 2 Enzymes*, Cancer Research, Vol. 66, pp. 4368-77, ISSN: 0008-5472
- Holmerová I, Jurasková B, Kalvach Z, Rohanová E, Rokosová M, Vanková H. (2007). *Dignity and palliative care in dementia*, J Nutr Health Aging, Vol. 11, No. 6, pp. 489-94, ISSN (printed): 1279-7707
- Humes D. (ed. in chief). (2002). *Kelley's Textbook of Internal Medicine*, Lippincott Williams & Wilkins, ISBN-13: 978-0781717878, Philadelphia, USA
- Hunter JA, Haslett C, Chilver AR, Boon NA, et al.(eds.). (2002).: *Davidson's Principle and Practice of Medicine*. Churchill Livingstone, 2002, ISBN-13: 978-0781717878, Edinburgh, UK
- Inouye SK, Studenski S, Tinetti ME, Kuchel GA. (2007). *Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept*, J Am Geriatr Soc, Vol. 55, pp. 780-91, ISSN: 0002-8614
- Juraskova B, Andrys C, Holmerova I, Solichova D, Hrniciarikova D, Vankova H, Vasatko T, Krejssek J. (2010). *Transforming growth factor beta and soluble endoglin in the healthy senior and in Alzheimer's disease patients*, J Nutr Health Aging, Vol. 14, No. 9, pp. 758-61, ISSN (printed): 1279-7707
- Kabrhel C, Mark Courtney D, Camargo CA Jr, Plewa MC, Nordenholz KE, Moore CL, Richman PB, Smithline HA, Beam DM, Kline JA. (2010). *Factors associated with positive D-dimer results in patients evaluated for pulmonary embolism*, Acad Emerg Med, Vol.17, No.6, pp.589-97, ISSN 1069-6563
- Kakkar VV, Balibrea JL, Martinez-Gonzalez J, Prandoni P. (2010). *CANBESURE Study Group: Extended prophylaxis with bemiparin for the prevention of venous thromboembolism after abdominal or pelvic surgery for cancer: the CANBESURE randomized study*, J Thromb Haemost, Vol. 8, No.6, pp. 1223-9, ISSN: 1538-7933
- Kalvach Z., Zádák Z, Jiráček R., Závázalová H., Holmerová I., Weber P. a kolektiv (2008). *Geriatrické syndromy a geriatrický pacient*. Galén, ISBN 978-80-247-2490-4, Praha, Czech Republic
- Kalvach Z., Zádák Z, Jiráček R, Závázalová H., Sucharda P. a kol. (eds.- in czech). (2004). *Geriatric and gerontology*, Grada Publishing a.s., ISBN 80-247-0548-6, Praha, Czech republic



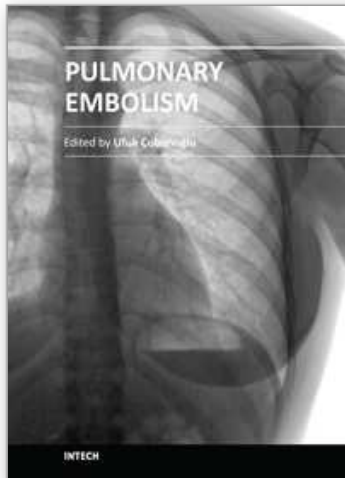
- Kanaan AO, Silva MA, Donovan JL, Roy T, Al-Homsi AS. (2007). *Meta-analysis of venous thromboembolism prophylaxis in medically ill patients*, Clin Ther, Vol.29, No.11, pp. 2395-405, ISSN: 0149-2918
- Katzung BG. (ed.). (2007). : *Basic and Clinical Pharmacology*. McGraw- Hill Professional Publishing, ISBN 0071451536, 9780071451536, San Francisco, USA
- Khaw KT. (1997). *How many, how old, how soon*. BMJ, Vol. 319, pp. 1350-52, ISSN: 0959 8138.
- Kniffin WD Jr, Baron JA, Barrett J, Birkmeyer JD, Anderson FA Jr. (1994). *The epidemiology of diagnosed pulmonary embolism and deep venous thrombosis in the elderly*, Arch Intern Med. Vol.154, No.8, pp. 861, ISSN 0003-9926
- Kriegsman DM, Penninx BW, van Eijk JT. (1996). *Self-reports and general practitioner information on the presence of chronic diseases in community-dwelling elderly. A study on the accuracy of patients' self-reports and on determinants of inaccuracy*, J Clin Epidemiol, Vol. 49, No.12, pp. 1407-17, ISSN: 0895-4356.
- LaCroix AZ, Chlebowski RT, Manson JE, Aragaki AK, Johnson KC, Martin L, Margolis KL, Stefanick ML, Brzyski R, Curb JD, Howard BV, Lewis CE, Wactawski-Wende J; WHI Investigators. (2011). *Health outcomes after stopping conjugated equine estrogens among postmenopausal women with prior hysterectomy: a randomized controlled trial*, JAMA, Vol.305, No.13, pp. 1305-14, ISSN: 00987484
- Leng SX, Xue QL, Tian J, Walston JD, Fried LP. (2007). *Inflammation and frailty in older women*, J Am Geriatr Soc, Vol. 55, 864-71, ISSN: 0002-8614
- Masoro EJ & Austad SN (editors). (2011). *Handbook of the biology of aging, 7th ed.*, Elsevier Academic Press, Burlington, MA, ISBN: 978-0-12-378638-8, London, UK
- Matějovská- Kubešová H et al. (2009). *Akutní stavy v geriatrii*, Galén, ISBN 978-80-7262-620-5, Praha, Czech Republic.
- Moody HR. (2009). *Aging : concepts and controversies, 6th ed.*, Pine Forge, ISBN 1412969662, 9781412969666, London, UK
- Nemeth F, Koval S, Zavazalova H, Banik M. (2007). *End of life*, Bratisl Lek Listy, Vol. 108, No. 6, pp. 239-45, ISSN 0006-9248
- Nikolaus T. (Hrsg.). (2000). *Klinische Geriatrie*, Springer, Springer, ISBN-13: 978-3540665687, Berlin, Germany
- Nordstrom M & Lindblad B. (1998). *Autopsy-verified venous thromboembolism within a defined urban population – the city of Malmo, Sweden*, APMIS, Vol. 106, No.3, pp. 378-84, ISSN (printed): 0903-4641
- Oskvig RM. (1999). *Special problems in the elderly*, Chest,, Vol. 115, pp. 158-64, ISSN: 0012-3692
- Pasha SM, Klok FA, Snoep JD, Mos IC, Goekoop RJ, Rodger MA, Huisman MV. (2010). *Safety of excluding acute pulmonary embolism based on an unlikely clinical probability by the Wells rule and normal D-dimer concentration: a meta-analysis*, Thromb Res, Vol.125, No.4, e123-7, ISSN: 0049-3848
- Pathy MSJ, Sinclair AJ, Morley JE. (eds.) (2006). *Principles and practice of geriatric medicine, 4th ed.*, Wiley, ISBN: 0-470-09055-3, Chichester, UK
- Perez-Guzman C, Vargas MH, Torres-Cruz A. (1999). *Does aging modify pulmonary tuberculosis? a metaanalytical review*, Chest, Vol.116, No.4, pp. 961-7, ISSN: 0012-3692
- PIOPED Investigators. (1990). *Value of the ventilation/perfusion scan in acute pulmonary embolism: results of the prospective investigation of pulmonary embolism diagnosis (PIOPED)*, JAMA, Vol. 263, pp. 2753-59, ISSN: 00987484



- Price DT & Ridken PM. (1997). *Factor V Leiden mutation and the risks for thromboembolic disease: a clinical perspective*, Ann Intern Med, Vol. 127, pp. 895-903. ISSN: 0003-4819
- Ratnaike RN (ed.). (2002). *Practical Guide to Geriatric Medicine*. Mc Graw Hill Comp., Inc., ISBN-13: 978-0074708019, New York, USA
- Reynolds MW, Shibata A, Zhao S, Jones N, Fahrbach K, Goodnough LT. (2008). *Impact of clinical trial design and execution-related factors on incidence of thromboembolic events in cancer patients: a systematic review and meta-analysis*, Curr Med Res Opin, Vol.24, No.2, pp.497-505, ISSN (printed): 0300-7995
- Roberts JR & Hedges JR. (eds.). (2009). *Clinical Procedures in Emergency Medicine, 5th ed.*, Saunders, An Imprint of Elsevier, ISBN: 978-1-4160-3623-4, New York, USA
- Rockwood K & Hubbard R. (2004). *Frailty and the geriatrician*, Age Ageing, Vol.33, No.5, pp.429-30, ISSN (printed): 0002-0729
- Roubenoff R, Hughes VA. (2000). *Sarcopenia: Current Concepts*, J Gerontology, Vol. 55, pp. 716-24, ISSN 0022-1422
- Roubenoff R. (2000). *Sarcopenia and its implications for the elderly*, European J of Clinical Nutrition, Vol. 54, pp. 40-47, ISSN: 0954-3007
- Salvedt I, Ophdal Mo E-S, Fayers P. (2002). *Reduced Mortality in Treating Acutely Sick, Frail Older Patients in a Geriatric Evaluation and Management Unit, A Prospective Randomized Trial*, JAGS, Vol.50, No.5: pp. 792-8, ISSN: 0002-8614
- Sanchez O, Trinquart L, Caille V, Couturaud F, Pacouret G, Meneveau N, Verschuren F, Roy PM, Parent F, Righini M, Perrier A, Lorut C, Tardy B, Benoit MO, Chatellier G, Meyer G. (2010). *Prognostic factors for pulmonary embolism: the prep study, a prospective multicenter cohort study*, Am J Respir Crit Care Med, Vol.181, No.2, pp.168-73, ISSN: 1073-449X
- Sare GM, Gray LJ, Bath PM. (2008). *Association between hormone replacement therapy and subsequent arterial and venous vascular events: a meta-analysis*, Eur Heart J, Vol.29, No.16, pp.2031-41, ISSN 0195-668x
- Scherl H. (2003). *Increasing life expectancy – the big social issue of the 21<sup>st</sup> century?* Z Gerontol Geriat, Vol.36, pp.95-103, ISSN (printed): 0948-6704
- Secin FP, Jiborn T, Bjartell AS, Fournier G, Salomon L, Abbou CC, Haber GP, Gill IS, Crocitto LE, Nelson RA, Cansino Alcaide JR, Mart nez-Pi  ero L, Cohen MS, Tuerk I, Schulman C, Gianduzzo T, Eden C, Baumgartner R, Smith JA, Entezari K, van Velthoven R, Janetschek G, Serio AM, Vickers AJ, Touijer K, Guillonneau B. (2008). *Multi-institutional study of symptomatic deep venous thrombosis and pulmonary embolism in prostate cancer patients undergoing laparoscopic or robot-assisted laparoscopic radical prostatectomy*, Eur Urol., Vol.53, No.1, pp.134-45, ISSN: 0302-2838
- Seitz M. (2003). *A long life – a wish and its limits. Aging with dignity and meaning*, Z Gerontol Geriat, Vol.36, pp. 104- 9, ISSN (printed): 0948-6704
- Sherman FT. (2003). *The geriatric giants. Don't miss their footprints!* Geriatrics, Vol.58, No.4, pp.8, ISSN: 0016-867X
- Siccama RN, Janssen KJ, Verheijden NA, Oudega R, Bax L, van Delden JJ, Moons KG. (2011). *Systematic review: diagnostic accuracy of clinical decision rules for venous thromboembolism in elderly*, Ageing Res Rev, Vol.10, No.2, pp.304-13, ISSN (printed): 1568-1637
- Sinclair AJ & Finucane P (eds.). (2002). *Diabetes in Old Age. second edition*. John Wiley & Sons, Chichester, U.K.

- Soriano RP, Fernandez HM, Cassel ChK, Leipzig R (eds.). (2007). *Fundamentals of geriatric medicine : a case-based approach*, Springer, ISBN 0-387-32326-8, New York, USA
- Stein PD, Gottschalk A, Sostman HD, Chenevert TL, Fowler SE, Goodman LR, Hales CA, Hull RD, Kanak E, Leeper KV Jr, Nadich DP, Sak DJ, Tapson VF, Wakefield TW, Weg JG, Woodard PK. (2008). *Methods of Prospective Investigation of Pulmonary Embolism Diagnosis III (PIOPED III)*, Semin Nucl Med, Vol.38, No.6, pp.462-70, ISSN: 0001-2998
- Stone CK & Humphries R (eds.). (2007). *Current Emergency Diagnosis & Treatment 6th Edition*, McGraw-Hill Companies, Inc., ISBN-13: 978-0071443197, New York, USA
- Stuck AE. (1995). *A trial of annual in-home comprehensive geriatric assessments for elderly people living in the community*, N Engl J Med, Vol.333, pp.1184-9, ISSN 0028-4793
- Szanton SL, Seplaki CL, Thorpe RJ Jr, Allen JK, Fried LP. (2010). *Socioeconomic status is associated with frailty: the Women's Health and Aging Studies*, J Epidemiol Community Health, Vol. 64 pp. 63-7, ISSN: 0141-7681
- Tallis R & Fillit H (eds.). (2003). *Brocklehurst's Textbook of Geriatric Medicine and Gerontology 6th ed.*, Churchill Livingstone, ISBN-13: 978-0443070877, London, U.K.
- Tallis R. & Fillit H. (eds.). (2003). *Effects of aging on the heart*, In: *Brocklehurst's Textbook of Geriatric Medicine and Gerontology 6th ed.*, Churchill Livingstone, ISBN-13: 978-0443070877, London, UK
- Tinetti ME, Williams CS, Gill TM. (2000). *Dizziness among older adults: a possible geriatric syndrome*, Ann Intern Med, Vol.132, pp.337-44, ISSN: 0003-4819
- Topinková E. (2005). *Geriatric pro praxi*. Galén, ISBN 8072623656, 9788072623655, Praha, Czech Republic
- Trivalle C, Doucet J, Chassagne P, (1996). *Differences in the signs and symptoms of hyperthyroidism in older and younger patients*, J Am Geriatr Soc, Vol.44, pp. 50-3, ISSN: 0002-8614
- Walston J, Hadley EC, Ferrucci L, Guralnik JM, Newman AB, Studenski SA, Ershler WB, Harris T, Fried LP. (2006). *Research agenda for frailty in older adults: toward a better understanding of physiology and etiology: summary from the American Geriatrics Society/National Institute on Aging Research Conference on Frailty in Older Adults*, J Am Geriatr Soc, Vol. 54 pp. 991-1001, ISSN: 0002-8614
- Wawruch M, Zikavska M, Wsolova L, Jezova D, Fialova D, Kunzo M, Kuzelova M, Lassanova M, Kruty P, Kriska M. (2006). *Perception of potentially inappropriate medication in elderly patients by Slovak physicians*, Pharmacoepidemiol Drug Saf, Vol. 15, pp. 829-34, ISSN: 1099-1557
- Wells PS, Ginsberg JS, Andersen DR. (1998). *Use of a clinical model for safe management of patients with pulmonary embolism*, Ann Intern Med, Vol.129, pp.997-1005, ISSN: 0003-4819
- West J, Goodacre S, Sampson F. (2007). *The value of clinical features in the diagnosis of acute pulmonary embolism: systematic review and meta-analysis*, QJM, Vol.100, No.12, pp.763-9, ISSN 1460-2725
- Williams ME. (2008). *Geriatric physical diagnosis : a guide to observation and assessment*, McFarland & Co. Inc. ISBN-13: 978-0-7864-3009-3, Jefferson, N.C. , USA
- Woodford H & George J. (eds.) (2007). *Essential geriatrics*, Radcliffe Publishing, 184619170X, 9781846191701, Abingdon, USA

- Woodhouse KW & O'Mahony MS. (1997). *Frailty and ageing*, Age Ageing, Vol. 26, pp. 245-6, ISSN (printed): 0002-0729
- Yaffe K, Haan M, Blackwell T, Cherkasova E, Whitmer RA, West N. (2007). *Metabolic syndrome and cognitive decline in elderly Latinos: findings from the Sacramento Area Latino Study of Aging study*, J Am Geriatr Soc, Vol. 55, pp. 758-62, ISSN: 0002-8614
- Zavazalova H, Nemeth F, Zikmundova K, Zaremba V, Rais V. (2007). Some indicators of quality of life in senior age in two regions international comparative study--the Czech Republic and the Slovak Republic, Bratisl Lek Listy. Vol. 108, No. 4-5, pp. 212-7, ISSN 0006-9248



## **Pulmonary Embolism**

Edited by Dr. Ufuk Çobanoğlu

ISBN 978-953-51-0233-5

Hard cover, 236 pages

**Publisher** InTech

**Published online** 14, March, 2012

**Published in print edition** March, 2012

Pulmonary embolism is a serious, potentially life-threatening cardiopulmonary disease that occurs due to partial or total obstruction of the pulmonary arterial bed. Recently, new improvement occurred in the diagnosis and treatment of the disease. The aim of this disease is to re-review pulmonary embolism in the light of new developments. In this book, in addition to risk factors causing pulmonary embolus, a guide for systematic approaches to lead the risk stratification for decision making is also presented. In order to provide a maximum length of active life and continuation of functional abilities as the aim of new interventional gerontology, the risk factors causing pulmonary embolus in elderly individuals are evaluated, and the approach to prevention and treatment are defined. The risk of the development of deep vein thrombosis and pulmonary embolism, combined with obesity due to immobility, the disease of this era, irregular and excessive eating, and treatment management are highlighted. Non-thrombotic pulmonary emboli are also covered and an attempt is made to constitute an awareness of this picture that can change the treatment and prognosis of the disease to a considerable extent. In addition to the pathophysiological definition of pulmonary embolus, the priority goal of quick and definitive diagnosis is emphasized, and diagnostic strategies are discussed in the book. A numerical analysis of the vena cava filters, which is a current approach to prevent pulmonary emboli recurrences, is presented in the last chapter.

### **How to reference**

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Pavel Weber, Dana Weberová, Hana Kubešová and Hana Meluzínová (2012). Pulmonary Embolism in the Elderly - Significance and Particularities, Pulmonary Embolism, Dr. Ufuk Çobanoğlu (Ed.), ISBN: 978-953-51-0233-5, InTech, Available from: <http://www.intechopen.com/books/pulmonary-embolism/pulmonary-embolism-in-the-elderly-significance-and-particularities->

**INTECH**  
open science | open minds

### **InTech Europe**

University Campus STeP Ri  
Slavka Krautzeka 83/A  
51000 Rijeka, Croatia  
Phone: +385 (51) 770 447  
Fax: +385 (51) 686 166

### **InTech China**

Unit 405, Office Block, Hotel Equatorial Shanghai  
No.65, Yan An Road (West), Shanghai, 200040, China  
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元  
Phone: +86-21-62489820  
Fax: +86-21-62489821

[www.intechopen.com](http://www.intechopen.com)

IntechOpen

IntechOpen



© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](https://creativecommons.org/licenses/by/3.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen