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Therapy of acute ischemic stroke in the Military Hospital: management of the acute phase maintenance of the military personnel in the military health care

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General actuality, corroboration of the topics´ importance

The establishment of the stroke thrombolysis program in the military health care, as explained in these theses, became a topic of high importance for the military health care during the last few years. With the increasing prevalence of the cerebrovascular diseases, the expressed value of a well-trained soldier, the expansion of the preventional opportunities, the continuously multiplying number of tasks requiring attendance and the strengthening connections with the civilian population, the importance of my topic in the military practice became severally proved.

The establishment of this new military health care ability was supported by the ongoing changes in the Alliance after the Cold War. The structural, functional and fundamental system of the allied armed forces and military health care service became severally altered.

The reformed strategically conception of the NATO intensifies the importance of peace time security maintenance efforts and crisis management operations. The execution of these fundamental needs requires more significant resources from the members to be able to deploy crisis management forces into distant areas within a short time and to execute long term operations. These abilities require extremely valuable and high trained personnel able to execute special tasks, past the monetary and supply needs.

Due to the researching and upgrading efforts to protect the personnel operating in armed conflicts, the modern soldier achieves a higher fighting value. However, the training, equipment and installation of these personnel require greater human and material expenditures too. As a member of the Alliance, the members of the Hungarian Armed Forces personnel are affected too, so even a temporary incapacitation due to a medical state can cause a severe loss in the military competence. The maintenance of eligibility for the military service and the medical tasks required within the armed forces and the civilian forces became of greater importance due to these changes in the approach.

The most important medical factors causing disabilities and incapacitation affect the central nervous system. The leading cause for lesion of the CNS is the stroke in the advanced, industrialized societies of the Alliance, causing a major damage in a typical sudden way.

Its military importance became extremely highlighted, because even a temporary impairment in the central nervous functions can cause further danger leading to severe personal and material losses, even to catastrophes. If the military health care system is unprepared to the occurring disease, even major problems might happen. As an endemic disease of our modern societies, the most active and socially leading population is affected. Within the armed forces, due to the age distribution of the personnel, the high ranked officers might be the most exposed population. The early recognition and the fast, effective, and casual acute phase treatment has the most important role.

Due to the ER therapeutical success of the cerebrovascular diseases achieved in the civil sphere I had no doubt that the early recognition and treatment of the stroke and its initiating

diseases has the same priority for the personnel of the Hungarian and the other allied armed forces. These statements were further affirmed by the fact that the right for health and high quality health care is an important requirement by many allied states. Within the high quality health care, the continuous availability of the ER care has top priority, reinforcing the significance of the stroke HDU care. These social requirements have the same enforcing power within the armed forces too, often empowering the achievements of the operations` objectives too. For the operating personnel the proper medical state and its preservation mean a significant moral factor. An efficient and reliable medical backup can be a significant positive factor on several operational fields, including crisis management missions, disaster and humanitarian care, local civilian health care reestablishing and developing missions.

It was clear even at the beginning of my career, that simple and highly efficient ER protocols, just like the cerebrovascular acute phase intravenous thrombolysis, should become tasks of the military health care, due to these requirements of the allied states. However, the applicability of these protocols demands the presence of basic ER diagnostic tools (e.g. CT and med. chem. labor.) and the permanent availability of well trained personnel required to operate the equipment and to interpret the data.

The recruitment, support and availability of the medical personnel's satisfying quality and quantity (to be able to operate continuously) is a leading task for the whole Alliance. Due to the decreasing financial support, to maintain the supply of the required medical equipment became an important question. To achieve a satisfying solution, the NATO proposes the multinational health care support, conditioning the interoperability and the developing cooperation between the member states. The increasing potential to develop our cooperation availabilities was indicated with the appreciating fact, that Centre of Excellence for Military Medicine was founded in Budapest, indicating the performance of the Hungarian medical health system.

In my opinion, the interoperable propositions, trainings and expansions must cover special fields of the health care too (e.g. international collaboration to modernize the cerebrovascular treatment protocols of the military health care, as explained in this work).

Objectives

The not properly diagnosed cerebrovascular disease means a ´time bomb´ for the hazardous lays of the armed forces and law enforcement services. I took the objective to modernize the cerebrovascular care of the armed forces according to this fact, since the management of the hazards caused by an occurring acute cerebrovascular crisis at the active personnel has the biggest priority. During my health care managing and scientific work, I had to apply and frame the cerebrovascular ER care to the capabilities of the military health care. I had to introduce new ways of treatment to the military medicine, to be able to use thrombolysis, noninvasive breathing support and invasive intracranial decompression as a routine part of the cerebrovascular intensive care.

In my opinion, the methods used by the regional civilian stroke centers can assure the modernization of the military cerebrovascular health care. My primary task was to set the principles in the causal and supportive treatment applied by the Military Hospital Stroke Centre, followed by the improvement and fine tuning of the operational infrastructure.

My objective, considering the available possibilities, became exactly clear.

I must decrease the severity of military losses caused by the occurring mass accidents or disasters, following a loss of human control in one of the armed forces hazardous lays, due to a unit´s loss of CNS function, by giving the chance of a curative treatment using the fast and efficient diagnostic methods. To adapt the modern system of the stroke care to handle the acute cerebrovascular diseases of the military personnel, the specifics of the military ER care must be recognized. Furthermore, to achieve a proper security level of the operation, the resources of the central division of the military health care must be integrated to the civilian regional stroke care as an accentuated center.

As a further objective, the roles of the ER factors affecting the input and the output of the thrombolysis protocol must be studied by collecting the data of the stroke care handled by military ER care using the reformed operational system. By monitoring the time lapse of the stroke care, the maintenance and the reduction of the thrombolysis protocol is objected. Due to the reduction of the therapeutical time lapse, the earlier revascularization of the brain cells is objected, resulting in the minimalization of the consequential losses.

In my opinion, with the modernization of the stroke care, the military health care achieves a new ability, capable of saving the structure of the human brain, the center of the personality of the structural force with the biggest value, the soldier. By saving the bigger part of the brain, the reintegration of its functions and the early active rehabilitation, the military health care can preserve the reusability of the heavily acquired knowledge.

Scientific hypotheses

My objectives and the way I interpreted the results were based on these hypotheses:

1. The continuous availability of the modern ER stroke care can be achieved through the military health care by applying the results of the civilian stroke care programs to reduce the military losses caused by acute cerebrovascular diseases.

2. The new stroke caring methods can be introduced to the Hungarian military health care, and its principles can be adapted to the specially integrated emergency care system of the Military Hospital through the establishment of an applicably functioning stroke-thrombolysis center.

3. Through the operation of the military stroke care, a data file, used as a monitoring system in the future can be gathered to increase the effectiveness and safety of the acute revascularization by following time lapse acquired by each steps of the treatment protocol.

4. By introducing the recognition of the provoking factors and the modern stroke care to the public knowledge of the military staff the time of service can be elongated by the armed forces and the law enforcement services.

Research methods

To obtain the previously explained goals the following methods were used:

- I have studied the local and international literature, the results and recommendations of the recently published studies.
- I have studied and analyzed the available military health care materials connected to the topic.
- I have systemized the special knowledge and observations acquired in the course of my military career.
- I have studied and analyzed the legal issues pertained to this topic.
- I launched a major study to follow and improve the modern ER stroke care adapted to the military health care.
- I participated in several local and international conferences and symposes.
- I have consulted with specialists and researchers to comprehend and summarize my results.

My preliminary results were demonstrated in several military and medical publications, written studies, and oral lectures to introduce the importance of this topic and to acquire the scientific judgment of the public.

Structure of the dissertation

In the first chapter the effects military medical effects of the acute cerebrovascular diseases are explained. I demonstrate the varying tasks of a modern soldier required by the altered roles of the armed forces, regarding the transformation of the national security and defense issues. I enter into the details of the significant effects caused by an occurring stroke on the military performance, due to the value of a modern and well-trained serviceman´s enhanced fighting potential. With the review of the disease, I point at the military medical importance and applicability of the hypothetic base of the acute, emergency revascularization treatment protocols, the penumbra hypothesis.

In the second chapter I review the history of the military stroke care modernization executed under my leadership in the first five years connected to the shift to the primary revascularization process. I demonstrate my help to evolve the order of functioning required

by the diagnostic and therapeutic aspects of the modern stroke care. The background and future aspects of the military medical stroke-thrombolysis program is interpreted considering the international literature.

In the third chapter I summarize the protocol of the primary revascularization stroke care elaborated for the MH Military Hospital, as a result of the adapting process launched as the director of the stroke department of the military health care central division.

In the fourth chapter I demonstrate the baselines of the supportive acute phase stroke care introduced under my guidance, from the rescue and evacuation to the intensive care and early active rehabilitation.

In the fifth chapter the effectiveness of the primary revascularization stroke care is compared to the time factor resorted by the ER tasks during the first two initiating and three progressing years of the military stroke-thrombolysis program. The method used by this research is interpreted as a monitoring system applicable for quality insuring aspects by analyzing the therapeutic time.

In the last chapter I summarize my scientific results as a medical officer. I propose reflections and recommendations about the past and future roles of the stroke care for the armed forces. I point at the need for reevaluating the medical aptitude tests due to the shift in the military approach caused by the introduction of the modern stroke care.

Summarized conclusions

The shift of approach of the cerebrovascular care in the military and military medical public opinion of the national armed forces

Major changes took point in the military health care of cerebrovascular patients.

The nihilist approach of the past was based only upon the cerebral spontaneous reintegration in cases with severe and permanent neurological symptoms, guided by the “there is nothing to do at this point” stance. The ´cerebrovascular cramp´, as a popular nomenclature, suggests the transient aspect of a case with regressive symptoms, leading to the neglect of the real pathogenesis and the application of empiric neuroprotective treatment. Only pharmaceutical cerebrovascular perfusion enhancers were the main institutional therapeutic line for decades.

As the first sign of the ongoing changes in the Hungarian stroke program, the English terminology shifted the previously used inaccurate, ambiguous nomenclature. This terminological change supported the shift of the previous nihilist approach, together with the expansion of the ER causal therapy based on the ethio-pathogenetic diagnose, and the post-acute reconstructive cardio- and cerebrovascular interventions.

With my first acute intravenous thrombolytic intervention, a new era began in the military health care. The determining program of this era, the stroke-thrombolysis program gave us opportunities to draw the military medical attention to the importance of the secondary

preventive strategies and the reconstructive interventions (capable of permanently correcting the alterations found by the ER diagnostics) along the primary preventive approach.

According to the approach of this new era, insignificant cerebrovascular shubs don´t exist anymore, only not satisfyingly diagnosed ones of unclear origin with further hazards. It should not be questionable in this era, that an unknown cerebrovascular disease means a time-bomb for the highly hazardous lays of the armed forces and the law enforcement services.

Due to the meanwhile ongoing shift in the military and military medical public opinion could the acute stroke care (with the stroke-thrombolysis program) become the most dynamically developing care form of the military health care. The person´s right to preserve one's health became an expectation of the whole society, therefore the demand of the personnel for the high quality ER care became attenuated, supporting the expansion of the modern stroke care.

My goal was to answer these expectations by modernizing the underdeveloped military medical cerebrovascular care.

The HM Military Hospital – State Health Care Centre stroke care service provided an excellent organizational background to coordinate all aspects defined by these expectations. While configuring the new organizational and functional order, I must have consider, that the management of the acute and post-acute phase of an occurring disease belongs to the neurological ER care according to the tradition of the military health service and the prevention (including the post-stroke risk management) belongs to the preventive care. The specially centralized state of the institutional ER care and diagnostics drew an accentuated attention during the modernization process.

My adaptation efforts were targeted to be able to introduce the acute phase causal and supportive care to the military health care.

The military medical stroke care center became one of the most dynamically developing Hungarian stroke centers due to the adaptation process under my guidance after my first thrombolysis, reaching the first place in the number of performed stroke-thrombolyses in a year in Budapest, and reaching the second place nationally.

The military stroke care with the stroke-thrombolysis program under my leadership became capable of analyzing the true nature of the disease in great details in the first few hours. As parts of the modern diagnostics, along the pre-interventional ER native cerebral CAT scan, perfusion tests and cervical – intracranial angiographic scans enabled the early and detailed recognition of the disease´s background and characteristics, helping the worldwide renown quality of the military stroke programs preventive and curative efforts. Due to the proper imaging in the first hour and the cardio- and cerebrovascular examinations in the first few days, vascular surgery, neuro-radiologic and cardiologic interventions, stent implantation, cardiac surgery and anticoagulant therapy can be indicated.

The military stroke care is an ER care form including neurological and intensive elements too, capable of utilizing the vigilance specialties of the Military Hospital.

The helicopter landing ERU on the top of the building, the departments capable of fast isolation, the high capacity ERU capable of wide profile triaging, the multi-unit shock-room, the ER OP, the haemodynamic OP with excellent capabilities and the arrhytmologic center provide a further support. In cases with further surgical needs, the pluripotent (neural, cardiac, vascular, thoracic, abdominal, traumatologic, orthopedic and urologic) central OP provides a safe support.

The future of the military stroke care is well defined by its background, the head institute of the military health care. Our goal is to provide the ER care and the preventive (stroke and cardiologic) interventions to the most patients belonging to the armed forces as possible.

To obtain this goal, the military stroke center must preserve its place among the highest performing providers. With its connection to the national regional stroke center system as an accentuated center, and considering the principle of progressivity, the military health care can provide further prospects to the military personnel.

The keystone of my conception is the cooperation with the regional stroke centers, to support the military personnel with advantageous caring pathways. The MH military Hospital stroke care has already gained great respect in the military and civilian medicine, being specialized to the high quality and resource demanding tasks performed by accentuated centers and to the exquisite care of the military staff within cooperation on different levels. Considering the principle of progressivity and the interests of the military health care, the most manifest prospect is the development of mutually advantageous cooperative activities launched due to my proposals with the health care providers of the districts and the regional stroke centers.

The fact could be proved by my work explained in this study, that a new care form, consisting of intensive an neurologic elements could successfully be developed between the frames of the military ER care. In this profile, the MH Military Hospital provides the care for the personnel as a NATO unit, and, in addition, successfully integrates into the civil sphere as a national head center.

In the course of the newly formed, dynamically progressing stroke care, the data of multiple patients could be gathered due to the civilian care, which can be applied by the military health care with an excellent efficiency in the daily routine and on the operational fields too.

With the raising of the age required for the retirement, the planned reserve system and the regional health care system will significantly raise the number of population requiring the institutional care. So, in the near future, the parallel (for the personnel and the civilian population) provided high level stroke care will provide a new situation for our hospital, which has been serving as a NATO unit till this day.

The most important military medical result of the local and international stroke program is its acknowledged support for preserving the military serviceability through the preventive force of the reconstructive interventions, which are capable of the corrections of any alterations found during the examinations connected to transient symptoms. According to my opinion, formed after the review of the literature, the symptoms, reduced however by the acute recanalization methods (intravenous, arterious, mechanic), should be considered in the

preservation of the service aptitude. In the course of my work, I always made efforts to support the decision-makers of the armed forces and the law enforcement services at the examinations of aptitude in the usage of the apt qualification in diseases with transient symptoms too, through the familiarization of the new diagnostic and therapeutic methods and their effectiveness. I am confident, that the shift of the military and military medical public opinion (through education) can affirm this tendency too. This way, by the using of the earlier elaborated qualifying categories under the ´transient functional alterations of non-organic origin´, the number of the personnel returning to service can further increase.

Due to the potential time reversal effect of the stroke-thrombolysis, even in the case of the artificially transient cerebral function losses, vascular reconstructions, embolization prevention, valvular- or vascular interventions, endovascular interventions, and special anticoagulant and special anti-platelet therapies can be applied in the earlier post-acute phase. These procedures, just like in the case of the spontaneously transient cerebral symptoms, can effectively and permanently reduce the higher rate of early recurrent stroke and cardiovascular attacks.

These confirmed clinical facts give the rational explanations of the individually reviewed positive (aptitude) qualifcations at the armed forces and the law enforcement services after a cerebrovascular attack with artificially transient symptoms. Hereby, medically serviceable qualifications can be obtained in the special cases of indispensably gifted, educated and experienced professionals.

To interpret these facts to the nomenclature of the medical aptitude tests, in the cases of artificially transient symptoms (due to the ER recanalizations), the fully serviceable qualification for the commandeering assignments and the tests connected to commissions, or the partially serviceable qualification for re-entering or post-retirement elongation requests could be applied as ´transient cerebral function disorder´. In my opinion this is the key to preserve and reuse the sumptuous knowledge and practice of a soldier for the armed forces.

Further actuality is given to my ideas by the recent governmental efforts to preserve the serviceable personnel for the longest term in their prime for the armed forces and the law enforcement services.

Applicable answers to my objectives based on my work

According to my objectives I was the first to summarize the history of the integration and development of the modern causal and supportive stroke care into the military health care. The antecedents of the primary thrombolytic stroke care´s introduction were analyzed annually, and the first five years of its expansion were analyzed from monthly gathered patient data. The traffic of the cerebrovascular patients at the military health care was analyzed too, considering the local and international experiences, especially during the evolved of the stroke-thrombolysis program.

While introducing the modern stroke care to the military health care, I was the first to use successful acute intravenous and intra-arterial thrombolysis, controlled noninvasive ventilation support at a stroke unit, positive pressure airways physiotherapy and operative intracranial decompression. As a department chief I helped efficiently the formation of a functional structure required by the modern stroke care within the organizational and functional order of the evolving Military Hospital.

By forming a stiff background and putting the explained adaption into practice, the military stroke care became the first center with the highest thrombolytic count in the capital, and the second center in the nation. As the most dynamically developing stroke center in the nation (by its multiple restructuring) it could obtain a high level in the ER diagnostics along its quantitative performance.

I regard the fact as a military medical success, that the fast and high level ER stroke care of the military personnel became widespread and non-stop available, due to the development of a nationally accentuated stroke center within the head institute of the military health care central division.

The worldwide direct or distant operation of an experienced medical staff (´tele-stroke system´) should be regarded as a military medical success as well.

To obtain my goals I built a uniform data set from the thrombolytic cases before the end of 2010. The data obtained from the thrombolyses between 2005 and 2007 were analyzed retrospectively, then from 01.07.2007 the analysis was a part of a prospective study. The effectiveness of the thrombolytic treatment and the quality of the ER care could be measured with the amount of time required by the diagnostic tasks estimating the applicability of the intervention. The change of the post-thrombolytic neurological status at the acute station was measured with the NIH Stroke Scale, the post-acute rehabilitational outcome was measured with the Rankin independence scale, attenuated with three- and six-month follow-up.

After the charting of the ER diagnostics´ patient pathways required by the causal therapy, a monitoring system capable of the continuous surveillance of the time required by each steps was developed to ensure the quality provided by the institute.

Scientific results

The objectives set for my study were successfully accomplished. I could confirm my hypotheses with the applied methods, and affirm their execution. Summarizing my results at the end of the dissertation, I regard the following statements as new scientific results:

1. Being first to summarize the history of the military medical stroke care modernization process, I could reveal that the continuous availability of the modern ER stroke care for the military personnel, the introduction of the cerebrovascular thrombolytic care with the development of its applying system took place under my personal guidance.

2. I was the first to apply intravenous systemic and intra-arterial selective thrombolysis, operative intracranial decompression and noninvasive ventilation support as the part of an ER stroke care routine within the military health care. For further applications, I developed a new order of function and defined the keystones of the applicable care forms with the potential and required range of development.

3. The primary thrombolytic cases of the MH Military Hospital Stroke Care were analyzed in a retrospective (2005-2007) and a prospective (01.07.2007-) study. A monitoring system was developed based on a uniform and expandable dataset to preserve and enhance the safety, efficiency and effectiveness of the treatment by continuously monitoring the time required by each steps of the ER care. I proposed the usage of the monitoring system for the quality insurance of the ER care.

4. Based on the stroke care introduced under my leadership and its potential to change the military and military medical public opinion, I elaborated a factual proposal (including the expanded interpretation of the factors related to the cerebrovascular diseases with transient symptoms) to reform the medical aptitude testing systems of the armed forces and the law enforcement services.

Recommendations, proposals

As a result of the present study, the following recommendations were proposed to the Hungarian Defense Forces and the law enforcement services:

- I recommend, that the ´transient cerebral function disorder´ could be qualified as serviceable and partially serviceable (serviceable for the commandeering candidates and for the judgments related to assignments, partially serviceable for the reentry requests and the post-retiremental elongation requests), while the ´recurring function disorders of organic origin´ and the ´function disorders of organic origin with moderate loss´ could be qualified KLGS for the symptoms regressing after ER revascularization at the medical aptitude tests of the armed forces.

- I recommend putting the serviceability aptitude under a separate judgment for the III. and the IV. age group (36-40 and 41-49 years) by the reason of the artificially transient neurological symptoms at the aptitude tests of the armed forces.

- I recommend the usage of the elaborated monitoring system as a quality insurance measurement to measure, follow and analyze the time costs of every ER tasks required for the cerebral thrombolysis.

- I recommend the complementation of the missions and consulates´ ER and lifesaving medical kits with a thrombolytic medicine.

- I recommend forming tele-stroke units (cameras capable of targeting at the patient and proper encrypted connections capable of sending CAT scans and medical finds, and

mainstreaming consultations with professionals) in missions and consulates for the medical staff.

- I recommend, that assuming the proper conditions, the medical officer should adapt the patient on the spot for further evacuation (requiring the medical attention of a significantly lower level).

- I recommend the enhancement of the military medical neuro-interventional capabilities by the deployment of modern tools and the acceptance of the professional staff liberated by the governmental health care program.

Fields of interest requiring further research

I account the further fields of exquisite importance to expand and intensify the research:

- Using the elaborated monitoring system, the further study of the institutional factors affecting the time cost of the pre-thrombolytic phase (the headcount, content, education, experience and suppression of the ER staff, the distribution of the suppression, bedside tests, logistic background, MICU usage).

- The study of the pre-hospital factors´ effects on the therapeutic time cost (the headcount, education and experience of the evacuating staff, and the conditions on the multiple levels of the evacuation).

- Studying the effect of the medicines (desmoteplase) and methods (perfusion scans, intra-arterial thrombolysis, US attenuated cerebral thrombolysis) enabling the use of an extended therapeutic window on the pre-thrombolytic time cost.

- Studying the factors of the preconditioning (e.g. sevoflurane) connected to the revascularization methods in the DSA OP affecting the elongability of the time lapse.

- Studying the effects of the monitored ER factors on the long term rehabilitational outcome (6, 12, 18 months Bartell-index, FIM-scale).