

MIKLOS ZRINYI NATIONAL DEFENSE UNIVESITY
DOCTORIAL COUNCIL

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**Modern treatment of craniocerebral gunshot injuries
on the basis of organising and medical aspects,
*focused on challenges of Hungary's NATO-membership***

PhD dissertation

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Definition of the scientific problem

Since 09.11. a new era began in the history of the Nato. The basic goal of the organisation became the liquidation of international terrorism. It has started a multi-national military offensive against groups destabilising security. The global anti-terror behaviour means expedition warfare. The military activity shows the obligations and possibilities for Hungarian Defense Forces in relation to Nato. Nowadays the basic function of the armed forces is not territorial defense, but to take part in the multinational military missions. Our soldiers are exposing themselves to danger in crisis-areas of the world because of terror actions. The ability to survive becomes a current problem for the Hungarian Army.

The craniocerebral injuries are one of the leading cause of battlefield death. The medic can't guarantee the life saving of all the wartime injured, so we have to investigate the modern possibilities of immediate treatment. The military physician can more effectively protect human life with new methods of his specialty. During the Nato-missions we can prove the special capacities of the Hungarian Defense Forces. As a small country, we can delegate sophisticated unites to the missions, like the health service.

I have focused on the battlefield treatment, because the majority of the serious head injured die before reaching the definitive care. The organising aspects mean the coordination of the rescue, evacuation and treatment, while using the modern informatic and communication systems. To reach the „health information superiority” the army needs flexible usage of medical materials and equipments within a global information data management.

The medical aspects mean the early and effective diagnostic and therapeutic capability. Using the informaton-based virtual dimension we can treat the injured on the field. To the problem-oriented investigation of the scientific question I have used multi-disciplinary method.

Goals of the investigation

1. To elaborate a method for preventing the gunshot injuries of the skull and to conclude a more active prevention for the soldiers.
2. To develop a more effective injured-evacuation system with professional management of the life signs at the level of first responders. In this way the most amount of wounded can reach the definitive treatment.
3. To elaborate the standard and quality therapy during the entire battlefield treatment system, using the modern diagnostic and treatment guidelines. I decided to create an evidence based and hospital-like wartime medical care.
4. To create a new method for reducing the brain edema, we can moderate the secondary brain damage after the gunshot injury of the brain . The basic goal of my investigation was to develop a global, problem-oriented system to reduce the mortality rate of gunshot injuries of the brain. I didn't wish to investigate new surgical or medical procedures, but during my *military* investigations I have been integrating the methods of logistics, data management, and telecommunication for more sophisticated treatment of the gunshot injured warriors.

Methods of investigation

I have been studying the new results of investigation of the topics within the Hungarian and international publications. At the level of basic sciences I studied the possibilities for reducing the secondary brain damage, performing animal research to examine the reducing factors of secondary central nervous system injury.

At the level of applied research I used the adaptation as method. While studying the domestic and American special literature I investigated which equipments and methods can represent the usable direction for the Hungarian Army.

At the level of developmental investigation I created a new method for enforcing the defense mechanisms against the secondary brain injury.

The usage of various methods of experience (observation, analysis, synthesis, comparisons, generalization and simulation) originating the complexity of the scientific problem

Short description of the investigation

1. In the first chapter I have shown the possibilities of prevention of the craniocerebral gunshot injuries, as a part of full dimensional protection. I've been investigating the ability of wireless real-time physiologic monitor system, in order to solve the problem of battlefield load and security of the soldiers from point of view of a military doctor. Thus help the battlefield risk-management by using the threshold parameters to indicate personal vulnerability. This system can help and support the decision process of the commander.

2. In the second chapter I investigated how the effectiveness of life saving interventions at the level of first aid may improve the physician's task. I examined the ability of the students of the Miklos Zrinyi National Defense University to perform complete cardio-pulmonary resuscitation by using interactive simulation phantoms. I demonstrated, that the telemetric verbal instructions of the doctor improved the effectiveness of the artificial breathing and cardiac compressions. Using this method we can help more injured to reach the evacuation-system and the definitive care.

3. In the third chapter I investigated an early and evidence-based system for battlefield injured care. I summarised the possibilities of forward diagnostics, prehospital treatment materials and methods to reach a global sophisticated battlefield medical care.

4. In the fourth chapter I researched the secondary brain damage, especially the brain edema. Using animal surgery I created a new method for measuring and improving the total antioxidant capacity. Also investigated the correlation between the free radical scavenging capacity and brain edema. The vasogenic brain edema is one of the most important post-traumatic pathology.

Summarised conclusions

We can measure the effectiveness of the military operations by examining the speed of the offensive, the territory of conquest, the success of the new techniques. For the military doctor the motivation means a finished operation without any loss of soldiers. A lot of equipments exist to improve the security of the warfighters: the armor techniques, the camouflage, the usage of intelligence data, more destructive weapons, and the robotic warfare. The passive equipments are limiting the action-freedom of the soldier by their weight. We can not perfectly solve the warfighter's security, so we have to use the modern scientific technologies for survivability. Since the serious brain injuries are the second common cause of battlefield death, the faster and more effective treatment of wounded can reduce the

mortality rate. For the medical team the prevention, evacuation, critical care and research gives the directions for best results. As a part of prevention I investigated the optimizing of the warfighter's physiologic parameters. This is just a small part of full dimensional protection, but the deterioration of vital functions may reduce the survivability. If we can monitor the soldier's physiologic status and pinpoint the danger-zone of it, then we can reduce the possibility of injuries. If the commander respects the biological characteristics of his soldiers, he can provide a balance between their security and the requirements of the fighting situation. This balance gives the basis for an objective battlefield risk-management.

Insufficient blood and oxygen supply of the brain can cause irreversible damage within few minutes. Because of this I investigated, how can the telemedicine improve the effectiveness of life saving interventions. The results show, that the telementoring has improved both the artificial breathing and cardiac compressions. Any mistakes within the evacuation system can destroy the survivability of the injured, yet a highly organised trauma system can save their lives. With data-fusion we can choose the optimal route and vehicles of the evacuation, also the real-time knowledge of free capacity of combat support hospitals help to organise the care of choice.

The overall time from battlefield injury to operating table is more than 3 hours at the Operation Iraqi Freedom, and the peak of early death occurs during the second hour, so we must see the importance of early treatment. With usage of neurosurgical evidence-based guidelines (knowledge projection), the battlefield and hospital-care becomes two parts of the same treatment process.

While I researched the secondary brain damage, especially the brain edema. Using animal surgery I created a new method for measuring and improving the total antioxidant capacity. Also investigated the correlation between the free radical scavenging capacity and brain edema. Since the vasogenic brain edema is one of the most important post-traumatic pathology, I created a new fast and sure method to minimize it, during the platinum minutes.

Recommendations

In view of my scientific results I wish to suggest for the Hungarian Army the next following recommendations.

To test a real-time, wireless warfighter physiologic status monitor system in a small military unit. During the traditional protection our soldiers could fight in a real-time integrated information system, with possibility of rapid evacuation and early special care. This system can achieve more qualified security for the entire defense sector.

To examine the following modern medical materials and equipments, that can be used during Nato-missions:

1. Projectile impact acoustic detector
2. Dead reckoning module
3. Battlefield tourniquets
4. Fibrin sealant wound dressings
5. Bone injection gun
6. Practical usage of above mentioned equipments for common soldiers
7. Mobile transcranial Doppler (TCD) at Role 1
8. Hematoscope also at Role 1
9. Breathing impedance threshold device (ITD) at Role 1
10. Fibrin Sealant Foam at Role 1
11. Oxygen carrying solution at Role 1

12. Medicine to minimize the necessity for blood-transfusion (Novoseven) also at Role 1
13. Colloid solution (Hextend) at Role 1
14. Knowledge and practical usage of the above mentioned equipments

I would like to continue the animal and human researches to investigate the correlation between the changes of the total antioxidant capacity and human illnesses. The long-time follow up can help us to investigate the effect of the free radical scavengers preconditional therapy against vasogenic brain edema.

The new scientific results and their practical use

In view of my investigations I wish to suggest for my scientific results the following issues:

1. I created the terms „action-physiologic monitor” of warfighters and „tolerable battlefield risk” as a part of battlefield risk-management. This system can determine the personal specific physiologic thresholds, using the follow up study of the soldier’s battlefiled load. Using the data of „action-physiologic monitor” the commander can respects the biological characteristics of his soldiers, and can prevent their intolerable battlefield risk. If we can improve the the soldier’s personal protection with optimizing their physiologic status, then we can reduce the possibility of injuries.
2. I examined the ability of the students of the Miklos Zrinyi National Defense University to perform complete cardio-pulmonary resuscitation and I demonstrated, that the telemetric verbal instructions of the doctor can improve the effectiveness of the resuscitation. With simulation of battlefield situation we can practice the telemetric instruction of warfighter’s first aid, also we can help more injured to reach the evacuation-system and the definitive care.
3. I created the terms „equipment and knowledge projection”. With usage of modern diagnostic and therapeutic equipments, and neurosurgical evidence-based guidelines (early, controlled, competent and continuous treatment), the battlefield and hospital-care becomes two parts of the same treatment process.
4. I created a new, fast, cheap and simple method to measure the „total antioxidant capacity” using urine analysis. I created a solution mixed from potent antioxidants, which can improve the antioxidant capacity to a supranormal level. Using animal surgery I created a new method for significantly reducing the breakdown of the blood brain barrier, and the vasogenic brain edema. After the animal measurements I would like to continue my investigation with analysis of human blood and urine samples

List of publications

1. **Gyula Kóródi:** Modern surgical treatment of traumatic brain hemorrhage, Scientific Medical Council of Hungarian Defense Forces, 1995. presentation
2. **Gyula Kóródi:** Gunshot wounds of the brain – 6th American Hungarian Conference of Military Medicine Chiemsee, Germany, 1998.09.13-17. presentation
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4. **Gyula Kóródi**

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5. **Gyula Kóródi:**
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PROFESSIONAL CURRICULUM VITAE

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Assignment carrer

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