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**Changing of approach in diagnostics and therapeutic adjudication of  
abdominal casualties in extraordinary circumstances and compound  
situations**

**PhD**

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## 1. Introduction

Despite of the developing technique the forces of nature cannot be tamed. Nowadays as well natural and civil disasters like floods, earthquakes, volcanic eruptions, nuclear accidents (Csernobil 26. April, 1986.), traffic and industrial adversities are common and mean possible danger.

Accruing local wars and armed conflicts claim significant human casualties. Special form of armed conflicts is terrorism. Globalizing "dijhadist" and "islamist" form of it are remarkable appearances, which connect to some kind of muslim religious fundamentalism. For instance the Al-Kaida's attack against the twin towers by hijacking two airliners above USA territory in 11.09.2001.

The last decade of the 20th century and the 21st century so far have brought a meaningful development and breakthrough. Along the disintegration of the great regimes civil expectations have changed. Individuals do have the right for health and high quality health service not only in peace but in warfare and disasters as well. The warfare and disaster doctrines published in the second half of the 90's, specify the revealing standards, specially time standards. The well known concept of "golden hour" i.e. the injured must be medically (surgically) treated within the first hour of the trauma, marched in the military controls of casualty service.

Knowing these facts the devices of military prevention must be re-drawn to satisfy new demands. Because of the altered military power relations since 1999, the NATO membership of our country, the significant decrease of our army, the change of its compound of age, its increased junction to civil associations and the altered requisition of it the health service of national defense is also changing. The principle of compromise free healthcare service of NATO doctrines requires another structure of military healthcare service.

In 5-8% of the cases with multiple surgical treatment suffer abdominal injury and third of them are poly traumatized. The mortality in these cases is high even in peace. The compound of our country's medical loss associated with our operational consent makes the problem of abdominal injuries remarkable. The soldier is armored with a helmet on his head an armored vest on his chest whilst lethal injuries of the extremities are rare. The abdominal region is relatively unarmored, the trauma of it threatens with fatal complications. The mortality in these cases is high even in peace. The reason of poor recovery is complex.

The injuries of abdominal organs don't always show unambiguous symptoms. The two phase rupture of the spleen is well known but the covered perforation could be thought as well. There is not a sharp difference between abdominal contusion (which is a slight injury alone) and blunt abdominal trauma. The kind of the injury is determined by the injury of the intra abdominal organs not by the trauma of the abdominal wall. To settle it by a "blick" diagnose is almost impossible. Careful examination leads to proper diagnosis.

Literature discusses the abdominal compartment syndrome (ACS) in a special solid perspective. The substance of the clinical picture is the increased pressure in abdominal cavity a solid anatomical space, which leads to MOF (multi organ failure) via humoral (renin-angiotensin-aldosteron system) and mechanical ways. The mortality overtakes 60-80%. In extraordinary circumstances this rate can increase, but with early diagnose and adequate therapy the prevalence of ACS can be reduced and the treatment of it can be more

effective.

In my Ph.D. thesis diseases in extraordinary situations with less known pathology will be examined, requiring special knowledge at treatment. This contains the injury of abdominal organs, specially organs with parenchyma, the role of the digestive system in septic shock, traumas by shot or detonation and ACS.

The approach starts from the experiences in peace. Different types of traumas caused different injuries will be examined and the similarity between warfare traumas.

Diagnosing the severely traumatized abdominal injured is often difficult in limited material and personal conditions. Beside physical examination I mean to introduce well known but less used in the common healthcare service modalities to facilitate diagnosing the injured and getting therapeutical guidance.

It is reasonable to care about technical and organizational problems too in order to ensure the fluent healthcare of numerous casualties.

Therapists of different surgical disciplines must be educated for a special challenge in extraordinary conditions.

## **2. Research directions. Placing the substance into the Healthcare Service of National Defense**

We start from trauma care in peace. Principles of Damage Control Surgery (DCS) introduced in the last decades can be used effectively at multitudinous service. This modality is being used by everyday traumas in operative areas as well. I determined the place and role of DCS in modern warfare surgery leaning on datas of the literature and own patients.

Closing the abdominal wall tightly during primary surgical treatment of critically traumatized abdominal injured can lead to ACS. Proceeding from this point we apply Temporary Abdominal Closure (TAC).

Collecting my clinical experiences the possible modalities of TAC were studied.

The mucosal barrier function and the peristalsis of the small bowel were examined at clinical measuring of abdominal pressure and controlled increased intra abdominal pressure in Wistar rats.

Service protocol and educational plan were made. I worked on hard in order to offer a usable commendation for servicing tactic of abdominal injured in compound situations and furthermore for teaching the members of the Healthcare System of Hungarian National Defense. This study is meant to be a compensation because no other studies have been published by the Hungarian National Defense in the past decades. The changing world, new claims, NATO missions, modern armory and modified methods all mean a new challenge to healthcare service. Only by answers on the level of this era can our tasks be done either in compound situations or in mission - far from home.

In the Healthcare System of Hungarian National Defense the treatment of abdominal injured goes both in the troop department and in the central department. On average 2-5 abdominal injured needed surgery go from the troop department to the central department, i.e. State Health Center Central Hospital of National Defense. The primary service in the troop department - first aid, stabilizing the vital functions and evacuation - realizes usually during oversea military missions (MedEvac, Role 1-2).

### **3. The goal of research, the actuality of the issue**

The general warfare idea has been changed in the leading armies of the world: the war industry tries to make and deploy subsequent and more destructive armors. Injuries caused by these are different like those we got used to in peace therefor new approach and treatment tactics must be worked out. Military doctors have to pursue changes sum their experiences and give solutions for problems of treating new kind of injuries. For instance injuries caused by lately introduced weapons of small calibre with high muzzle velocity, or different modifications of abdominal trauma caused by fragment resistant armor vests. In addition the large number of multiple and explosive abdominal injuries and difficulties in treating them can be mentioned as well.

Military doctors of this era must face the subsequent forces of destruction made by the war industry and have to be prepared - and prepare their associates - for giving answers, giving health.

### **4. Research methods**

Leaning on experimental, clinical and literature datas diseases, their formation and their pathology, from the previous chapter will be analyzed. The treatment and recovery of critical abdominal injured were followed up in clinical trial. The possibility of preventing ACS was examined.

Our workgroup is intended to create an international score system feasible to determine the state of the injured. This method expresses the state of the casualties numerally, helps to have a prognosis and therapy plan, and facilitates the scientific analysis of the cases.

Controlled increased intra abdominal pressure was created in animal models and the developing pathology and human relations were investigated.

This study would like to help our physicians in postgraduate studies. Only with competent staff can trauma care do well specially in extraordinary conditions. This study would like to be a part of the whole solid service system by adding something to the more effective activities.

### **5. Raising issues, tasks**

1. During the analysis of mechanical abdominal injuries in warfare I'm looking for the facts responsible for pathological outcomes. Searching for the causes that makes obligate changes in the service.

2. I'm planning the realization of applying the principles of DCS in treating abdominal casualties in peace and war.

3. ACS had got a new, solid judgement in the 80s. Circumstances leading to ACS were studied.

4. Investigation were made whether the mortality and morbidity results of ACS could be developed by recognizing its pathological process.

5. I'm intended in determining the influence of increased abdominal pressure to splanchnic organs. Changes of absorption and digestion are measured which shows the evolution of ACS. It is tried to be answered whether animal models are capable for studying ACS

6. The fitting of the treatment protocol of ACS into the solid service system were examined.

7. I want to answer the questions of financial challenges during the proceed towards our goals.

8. As a result a commendation for service protocol of the abdominal casualties in compound situations were made.

9. This protocol is going to be tried out in general practice and will be recommended as educational plan in different levels.

## 6. Consistence of the study

There is about the place of servicing abdominal casualties in Hungarian National Defense in the introduction. At the same place we can read the justification of choosing this very issue, the research goals and methods and further the judiciary definition of compound and catastrophe situation. In the next part I give a historical overlook of the development of trauma care. The main part of the study begins with abdominal injuries in warfare. Applying the principles of DCS is presented in cases of abdominal injuries. Pathology, symptoms and treatment of ACS were presented in the next chapter and also the controlled increased abdominal pressure in animal model with all the influences on mucosal barrier function and peristalsis. At the end of the chapter modalities of temporary closure of the abdominal wall and own cases were presented. There are the conclusion of the scientific activity, new results, assumptions and recommendations. The substance recommended for education was integrated into the educational plan.

## 7. Summary of the scientific activity

1. During the development of warfare techniques the goal is to make living forces more destructive. Special extended injuries are representative for modern modified armory. Bayonets with multiple points cause different wounds like stabbed or cut. Even at surface stabs tearing out the tissues results more blood lost. At shot wounds increases the absorbed energy by the body because of the higher muzzle velocity. The lateral hit of the projectile gets bigger so does the tissue necrosis. **In case of abdominal injuries the secondary necrosis in certain bowel segments - perforating the bowel wall days after the trauma causing the well known peritonitis - plays a significant role. Beyond the shot wound explosive traumas harm with barotrauma, heat and toxic chemical effects.**

2. In cases when the lethal triad realized (body temperature less than 35 degrees, pH less

than 7.2, and partial thromboplastin time more than 19 seconds) the mortality within a one step treatment is above 90%! Jonson, Aoki, Garrison, Morris, Bursh and Cue proved, analyzing numerous clinical cases, that mortality can be significantly decreased by breaking one step up to multiple steps. **Primary service is confined to save life, extremities and organs. After lifesaving surgery vital functions are stabilized and kept in an ICU.** In this phase patients' core temperature, acidosis and coagulopathy should be corrected and additional traumas should be revealed. Definitive second step surgery comes after stabilizing these parameters. **As a surgical compromise, the definitive service is delayed. The name of the method is Damage Control Surgery. This principle is used not even in critical cases but in multitudinous catastrophes.**

**3. The ACS has been accepted by the literature as an individual entity since the 80s. At this disease abnormally high pressure develops in the anatomically closed abdominal cavity. Most often among poly traumatized with additional abdominal injury.** These damage the regulation of splanchnic and liver blood flow. This circulus vitiosus leads to exitus letalis.

**4. Lethal outcome can be avoided by early recognizing of ACS, careful patient follow up, continuous measuring of intraabdominal pressure and decompression laparotomy.**

**5. Controlled intraabdominal overpressure of 0-30 Hgmm was created and held for two hours in animal model. Methylene-blue was administered in order to examine peristalsis and absorbance. At increasing pressure the decrease of peristalsis could be recognized. The failure of absorbing function of the mucosal could not be proved with this model.**

**6. In critical cases primary closure of the abdomen should not be done** after a primary surgery along DCS principles and at threateningly increased abdominal pressure. In these cases temporary closure of the abdomen should be done. The point of the method is to lower abdominal pressure via enlarging the volume of abdominal cavity. In our surgical department we use vacuum assisted abdominal closure and visceral pack for this goal. **The vacuum assisted abdominal closure could be preferred in warfare mission.**

**7. TAC can be fitted into the service protocol of abdominal casualties. The procedure can easily be learned. Vacuum assisted abdominal closure is an elegant, easy but expensive modality.** Not even the dischargeable set but the device for the permanent vacuum are expensive. **The visceral pack is cheaper and can be easily learned.**

**8. I have made a service protocol for treating abdominal injury. Its goal is to offer a treatment algorithm in catastrophes and war. One of the intends evolved this study is Hungary's NATO offering for the development of a ROLE-2 field hospital. Important part of it how abdominal casualties are being treated in compound situation. The most important algorithms were to be planned in our study.**

**9. Educational plan was made** in order to make working possible for associates with peace experiences in compound situations and in warfare.

## **8. New scientific results of mine.**

1. I have made a service protocol for treating abdominal injury in compound situation. In war lifesaving surgery should be done in ROLE-2 according to the principles of DCS (saving life, extremities and organs). Because of Hungary's NATO offering of an

individual ROLE-2 field hospital I find it very important to know DCS principles and methods of TAC as well. TAC can prevent from ACS which is an individual entity since 1984.

2. Procedures of TAC have been used in our hospital since 2004. Primary closure of body cavities - including abdominal cavity - is widely accepted. Despite of that ACS had been recognized at the end of the 20th century proving the harm of increased intra abdominal pressure. Because of that TAC and opened treatment had been worked out. We do not apply the opened method because of the absence of sterile patient room. TAC is more widely used now. According to DCS principles TAC should be used at the first abdominal surgery and in cases of ACS. The point of it is the lowered pressure by enlarging the abdominal cavity in order to improve splanchnic and liver blood flow. We were the first to use the vacuum assisted closure in our country.

3. The mucosal barrier function and the peristalsis of the small bowel were examined at clinical measuring of abdominal pressure and controlled increased intra abdominal pressure. I was the first to prove the damage of peristalsis according to the increase (even 5 Hgmm was enough to slower peristalsis) of intra abdominal pressure in Wistar rats. The quantity of mucosal barrier function failure could not have been significantly evaluated. Measuring the mucosal permeability with an absorbent material needs to be developed in the future using methyltionin and leukomethylene blue at the same time connected to fluid-chromatograph. For determining the barrier function of the mucosa blood levels of absorbent materials should be used.

## **9. Assumptions and commendations.**

1. Modern armory makes new kind of abdominal injuries which have to be examined permanently.

2. DCS can be a useful device of the surgeon in compound situations. TAC after primary surgery and planned re-operation significantly lower mortality.

3. Literature datas and own investigation proved that increasing intra abdominal pressure harms the peristalsis of small bowel, increases the permeability of the bowel wall and the risk of peritonitis. Measured abdominal pressure is a valuable device monitoring patient state.

4. It has been proved that TAC compensates and fits the principles of DCS and can be useful during the multistep service of battlefield casualties. The injured can be transported after TAC. During transport intra abdominal pressure can be held on a decreased level and the drainage of abdominal cavity is done as well. By the time of second look intra abdominal approach is fast and atraumatic.

5. The service protocol of abdominal casualties appended to the file of mission preparing duties can significantly improve the work of peace experienced medical staff even in compound situation.

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