"Lucian Blaga" University of Sibiu

DOCTORATE THESIS

Retrospective study of polytrauma pathology on a case study of 12,000 cases treated between 1978 and 2014

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Content

Summary

Trauma remains a major problem in emergency pathology worldwide.

As a result of trauma, millions of people die or remain in disabilities.

International statistics show that trauma has the greatest familiar social and individual consequences.

The severe, many definitive consequences led trauma schools to develop trauma systems, whereby the mortality of polytraumas was reduced to 25% of cases(1).

The 2012 Trauma Congress in Rio de Janeiro highlighted the importance of multidisciplinary management in therapy and strategy to follow.

The paper is based on the retrospective clinical study of a group of 12,000 polytraumatized people, treated in two emergency hospital centers.

The complex clinical study of polytrauma in this paper contains two distinct stages between 1980-2000 and the post-2000 period to 2016.

Several studies are posted from the thesis, which include:

a) Thoraco-abdominal trauma

b) Cranio-thoraco-abdominal trauma

c) Abdomeno-pelvic trauma with retroperitoneal hematomas

d) Study on the evaluation of ultrasound in abdominal trauma.

Traumatized patients in the emergency department:

Polytraumatized patients brought into the emergency and examined, benefits from immediate basic investigations : electrocardiography, TA take, pulse and body temperature, peripheral oxymetry and laboratory determination on biochemistry, hemoleukogramma, coagulation.

At the same time as these investigations to conscious polytraumatized, without IOT (oro-tracheal intubation) anamnesis and complete clinical examination are performed.

Completing imaging investigations is essential in establishing the therapeutic and diagnostic strategy.

In the last two decades multidisciplinary treatment in mixed teams has improved survival, in all of which 50% of deaths are due to uncontrollable bleeding that persists or occurs in the first 48 hours after admission.

The disorder of hemostasis factors falls into acute traumatic coagulopathy syndrome (TAC). The presence of CTA at the presentation of polytraumatized in emergency has therapeutic significance, obvious prognosis since these patients are those who require intensive resuscitation, are politicized with increased incidence of multi-organic insufficiency, severe complications and significantly more deaths compared to polytraumatizations without CTA syndrome.

Table 1. Coagulopathy in trauma

<table>
<tr><td colspan="3">Acute traumatic coagulopathy (TAC) immediately after trauma (endogenous)</td><td colspan="2">Iatrogen and coagulopathy (CI)
Tardiv after trauma (exogenous)</td></tr>
<tr><td colspan="3">Tissue trauma
Inflammation
Hypoperfusion/ Soc
Simpato-adrenergic activation</td><td colspan="2">Factor delet
Volemic resuscitation
Hemodilution</td></tr>
<tr><td colspan="3">Endothelial activation
Wound
Hypermeability</td><td>Acidosis</td><td>Hypothermia</td></tr>
<tr><td>Protein Path C - Active</td><td>Degradation of Weibel-Palade bodies</td><td rowspan="2">Self-heparining</td><td colspan="2" rowspan="2">Vicious circle</td></tr>
<tr><td colspan="2">Anticoagulation fibrinolysis</td></tr>
</table>

Hydro-osmolar resuscitation of traumatized patients by controlling internal, external blood loss, associated with combating pain by immobilizing mobile fractured segments and combating hypoxia by ensuring the freedom of the air horses is an essential element in the initial phase of treatment.

One of the major problems in polytrauma is the state of hemorrhagic collapse through acute loss of blood mass, requiring a massive and immediate volemic refill(45).

The modalities of immediate volemic refilling have changed over the decades, currently considered volemic resuscitation with colloid solution (human albumin, gelufusine, etc.), crystalloid solutions (physiological serum), lactate Ringer solution.

Ultrasonography has become a standard method of emergency diagnosis, the accuracy of the method being dependence on the examiner's experience.

Studies published by Morris and Colab. shows that the mortality of elderly patients with identical lesions observed in young people is much higher due to the metabolic, cellular, systemic response effects significantly influenced by chronic comorbid conditions of the elderly.

Studies published by Grossman and Al.C. , Likewise, Milzman et al. Considers that age is not the essential trigger of adverse developments after more hasty polytrauma 5 chronic evolutionary conditions:

- unoperated pathology
- COPD
- kidney failure
- chronic hepatitis
- ischemic heart disease

The interval between the occurrence of the accident and the first examination carried out in the hospital environment does not differ among survivors, but an increased risk factor for death is the severity of the injuries, which shows that the polytraumatized intubated at the accident site has an increased risk of death due to the severity of the injuries sustained.

In severe polytraumas, the early occurrence of coagulopathy, through acute fibrinolysis, is accompanied by high mortality, and the association with acute liver failure with severe hypoxic cytolysis, is accompanied by a mortality of over 90%.

The trimodal distribution of trauma deaths was established in 1982, which found that the highest incidence of deaths included the first 60 minutes (45% of deaths), with the majority of victims having cardiovascular damage.

The second incidence is represented by the range of 1-4 hours (34% of deaths) through cardiovascular and neurological lesions.

The third incidence includes deaths of one week or more (20% of deaths) due to organic insufficiency (88%).

Antibioprophylaxis in polytraumatized has three essential practical elements:

a) Prophylaxis of secondary infections of surgical interventions

Prevention of secondary infections that are usually multibacterial, multi-resistant, through intrahospital flora on a biologically debilitated and metabolic-immunity altogether.

b) Prevention of infections related to surgery

The incidence of infections related to the surgical gesture itself is reduced, being estimated at about 17-18% of the total number of infections occurring in polytraumatized (78).

Of the infections, suppurations of the abdominal, thoracic wall, represent 11-12% (78)

Antibiotherapy has peculiarities in trauma since the trauma produced is accompanied by contamination of damaged tissues, which raises the question, whether antibiotic therapy in the presence of contamination is considered purely prophylactic, since the aim is to prevent the initiation of infection in already bacterially contaminated tissues, but still uninfected.

c) In this concept antibioticprophylaxis should be applied early with targeted spectrum on the flora that most commonly contaminates traumatized tissues.

In recent decades, mortality from polytrauma has diminished, but it remains a major problem in intensive surgical therapies.

In the presence of a polytraumatized it is essential to establish as quickly as possible the ranking of lesions in relation to topography, lesional degree and the need for specialized therapy.

Achieving this goal is not always fast original, as imaging investigations (CT, MRI, etc.) require time to perform.

The polytraumatized man who arrived in the emergency room may present a lesional picture of extreme urgency, a situation observed in 3 particular cases:

a) In addition to various lesions, an external arterial hemorrhage is present, which requires rapid definitive hemostasis .

b) The picture of a cataclysmic internal haemorrhage is the consequence of a parenchymal rupture (rupture of the spleen), grade 5 hepatic dilaceration, situations requiring immediate lobotomy

c) Traumatized cases arrived with tourniquet applied to an extremity, which requires rapid intervention to prevent irreversible ischemia.

Polytraumatized can be classified as simple, complicated and associated craniocerebral lesions.

Severe chest injuries influence mortality and morbidity rates, with pneumonia and ARDS syndrome associated with parking time in ATI.

Of the thoracic lesions in the polytrauma, pulmonary contusions and movable voles represent a category of high severity (96), in high mortality (98) compared to penetrating wounds in the same viscera, the latter usually do not include multi-organic lesions.

Polytraumas fall into four acute phases (104):

• acute phase (1-3 hours)= resuscitation phase

• primary phase (3-72 hours)=stabilisation phase, " day 1 surgery"

• secondary phase (3-8 hours)= "regeneration" phase

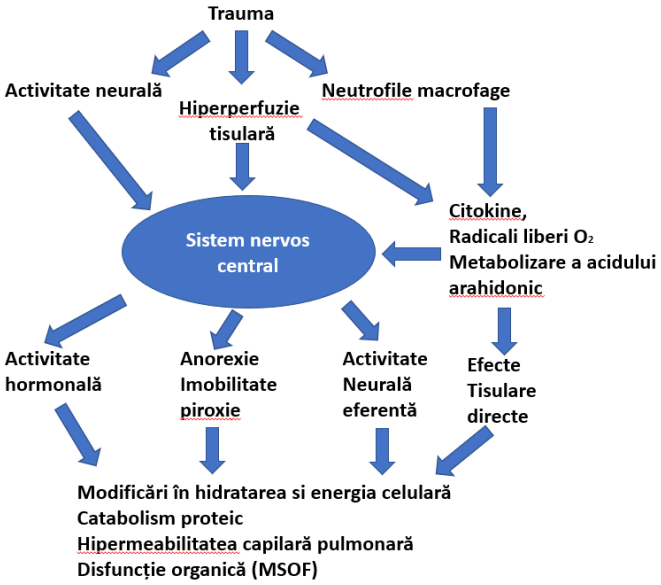
• tertiary phase (> 8 days)=rehabilitation phase

In the acute phase the therapy focuses on the state of shock and emergency interventions for life-threatening injuries of the traumatized.

Clinical studies have shown that the first 3 days after the production of polytrauma are characterized by hemodynamic instability, a period that requires cardiocirculatory volemic rebalancing, the daily amount of infusions being between 4-7 liters in relation to the presence or lack of a retention edema(230).

As a result of trauma in the interval between day two and eighth, a large loss of nitrogen occurs by decreasing the protein synthesis in the liver. The concentration of alamin and glutamine in the intracellular space decreases over a period of weeks that will cause disturbances in the immune system and the function of erythrocytes. (232)

Fig. 1. Metabolic and nerve changes in polytrauma



Personal contribution in the treatment of complex thoraco-abdominal pathology within the polytrauma .

The retrospective complex study summarises three studies on a group of 12,000 polytraumatized, of which:

Polytraumatism – the study on the complex treatment of a group of 12,000 polytraumatized people between 1978 and 2015.

Chest trauma through the prism of 7000 chest trauma treated 1978-2015.

Initial ultrasound in closed abdominal trauma and indications of exploratory laparotomy in the study conducted.

The role of video-thoracoscopy (VATS) in chest trauma.

Table 2. From the data studied there is a significant decrease in incomplete diagnoses during the 1980-2014 range from 8% to 1.3% in abdominal trauma

Localization	**1980 – 1985**		**1986 – 1991**		**1992 - 1997**		**1998 - 2004**		**2004 - 2014**	
Number	460		1628		1568		1716		1680	
Abdomen	336	88%	336	2 2%	332	22,1 %	332	11,8%	224	11,3%
Thorax	444	99%	440	22,5%	336	22,4 %	332	11,8%	228	11,6%
Fractures	228	66%	556	33,5%	448	33,1 %	448	22,8 %	556	33,2%
Total	1108	22,3%	1132	88%	1116	77,6%	1112	66,4%	1108	66.1%

Table 3. Detailed aspects of diagnosed lesions incomplete in the emergency department.

Localization	**Incompletely diagnosed lesions**	**'80-'85**	**'86-'91**	**'92-'97**	**'98-2004**	**2004-2015**
Abdomen	Spleen rupture	**24**	**20**	**16**	**12**	**4**
		5,2%	1,2%	1%	0,7%	0,2%
	Breaks of the pancreas, liver, spleen, duodenum, retroperitoneum	**81**	**12**	**12**	**12**	**8**
		7%	0,7%	0,8%	0,7%	0,4%
	Hemorrhage from mesenter	**4**	**4**	**4**	**8**	**8**
		0,9%	0,2%	0,3%	0,5%	0,5%
Thorax	Pulmonary contusion	**16**	**12**	**12**	**8**	**4**
		3,4%	0,7%	0,8%	0,5%	0,2%
	Diaphragm rupture	**12**	**12**	**8**	**8**	**4**
		2,6%	0,7%	0,5%	0,5%	0,2%
	Aorta rupture	**8**	**12**	**12**	**4**	**16**
		1,7%	0,7%	0,8%	0,2%	0,9%
Fractures	Extremities	**16**	**40**	**36**	**12**	**44**
		3,5%	2,5%	2,3%	0,7%	2,5%
	Column	**8**	**8**	**4**	**40**	**8**
		1,7%	0,5%	0,3%	2,3%	0,4%
	Hip	**4**	**8**	**8**	**4**	**4**
		0,9%	0,5%	0,5%	0,2%	0,2%

Table 4. The most important interventions carried out in the study

	Diagnosis	Number of interventions
1	Liver ruptures	248
2	Emergency thoracotomies	402
3	Retroperitoneal hematoma	202
4	Diaphragmatic ruptures	58
5	Grade II-IV duodeno-pancreatic ruptures	78

In the studied casuistics, 58 interventions for diaphragmatic ruptures and 78 interventions for grade I-V duodeno-pancreatic ruptures were performed.

Table 5. Sensitivity of peritoneal lavage (PLP) puncture in posttraumatic hemoperitoneum

Authors	number	sensibility	specificity
Hehreman	944	87	97
Day	200	85	96
Patyn	629	97	98
Fincher	2586	96	99
Kiss	460	88	95

Of the total number of 402 (5.7%) 82% were indicated in closed chest injuries, with a total number of TTs being 5760, and in 18% of penetrating thoracic wounds (1240 wounds).

28.8% TT were associated with other polytrauma lesions, with 30.2% (2140) associated with extrathoracic lesions.

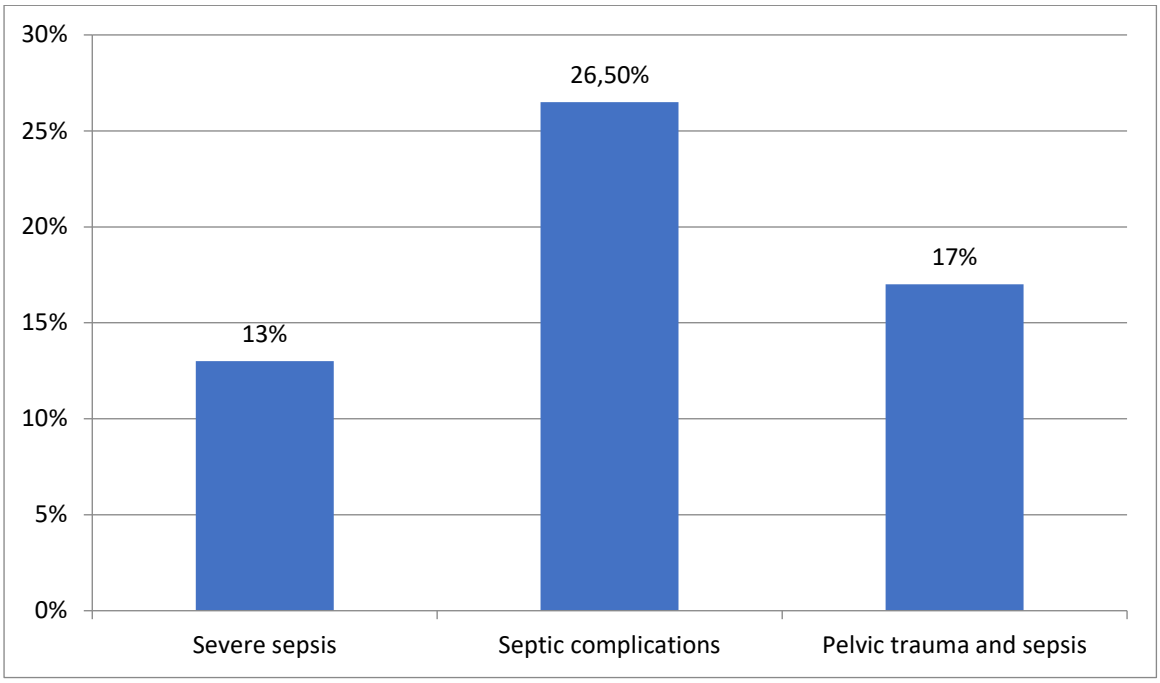
Table 6. Morbidity, mortality and incidence, complexity of post-traumatic complications differ from the existence of isolated lesions or the presence of polytrauma-type lesions

	1980-1985		1986-1991		1992-1997		1998-2003		2004-2015	
Mortality	152	33%	336	20,6%	336	22%	340	19,8%	32	19,9%
Morbidity	116	25%	488	30%	412	27%	500	29,5%	16	30,1%

Major complications within polytrauma, SIRS, MODS were evaluated in this study.

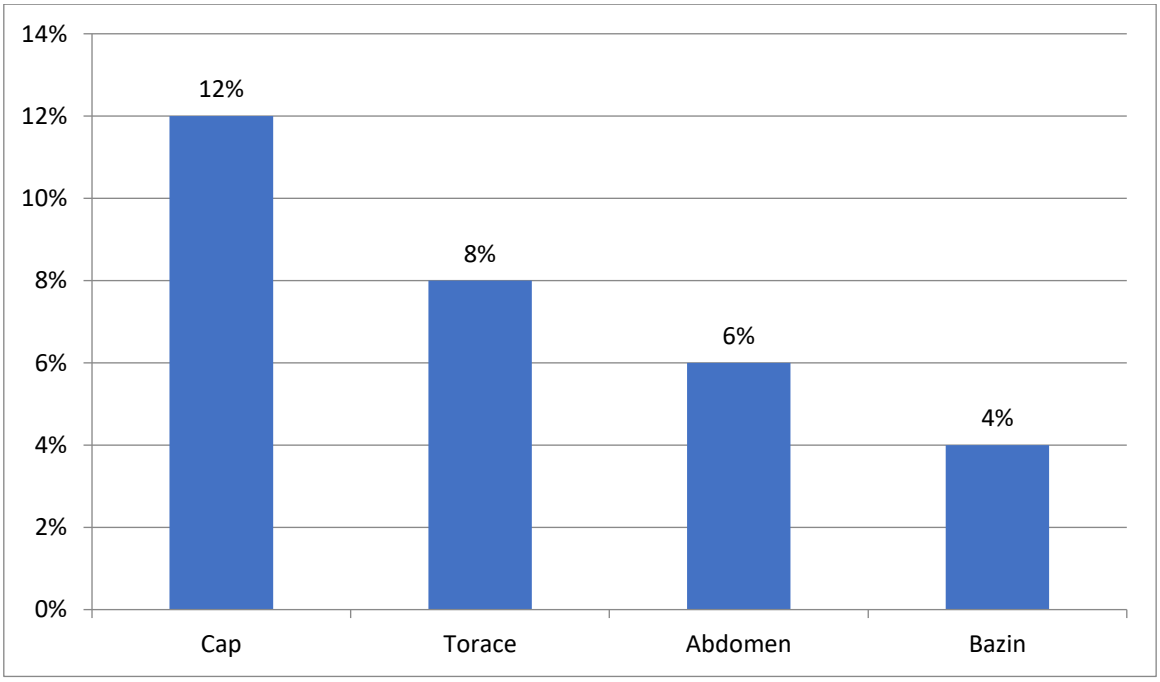
In patients with complex penetrating abdominal lesions the incidence of sepsis was 6.39% compared to closed traumatic lesions 3.18% (Chart 1).

Graphic 1.: The incidence of sepsis in graphically isolated lesions.



Patients with polytrauma in association with brain lesions had higher mortality compared to polytraumas without head lesions, but the association of lesions in other regions of the body did not influence the mortality rate (Chart 2a).

Graphic 2A.: Isolated lesions graphically



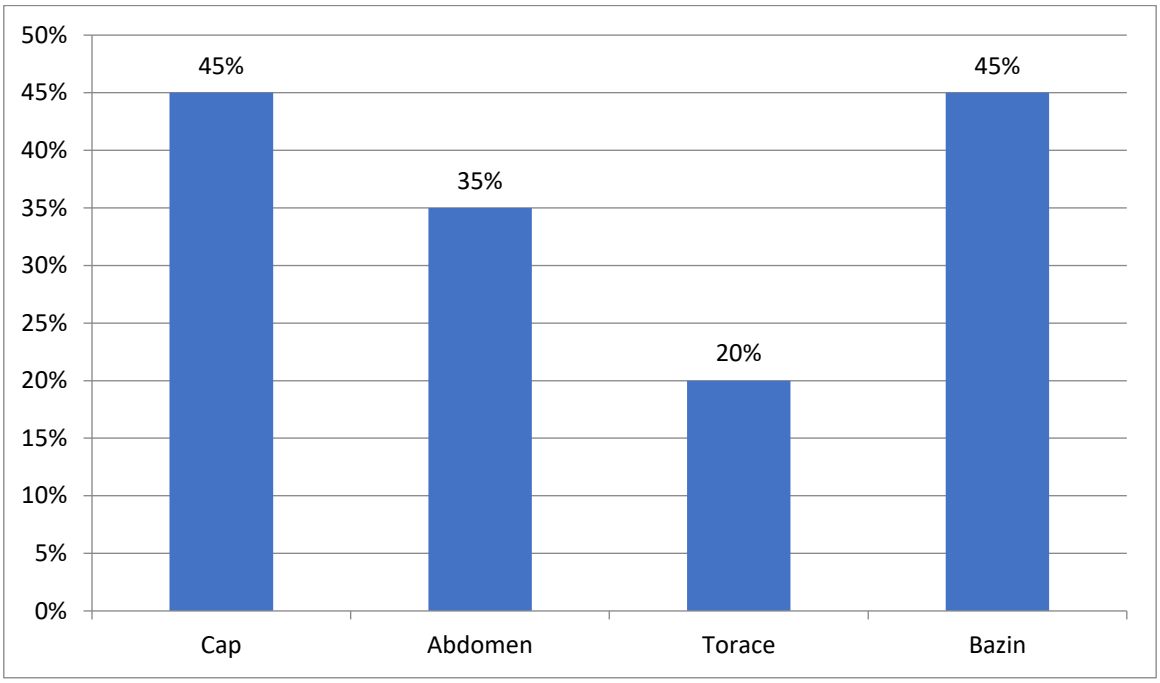
12% Head and neck

8% Torch

6% Abdomen

4% Pool

Graphic 2B.: Graphic polytrauma



The incidence of emergency thoracotomy was 5.74%(402 cases) compared to the total mass of 7000 TT, of which 82% (5760) were closed TT and 18%(1240) TT opened with penetrating thoracic wounds.

In 27 thoracotomies performed for closed TT, 25 (92%) were associated with extrathoracic lesions, 15 abdominal lesions, 10 fractures.

In 32 cases with penetrating chest wounds, 7 abdominal wounds were encountered and 10 were associated with heart wounds and fractures of the spine.

Table 8. Diseases with indication of control by thoracotomy

Causes	number	%
Severe haemorrhage after pleural drainage	9	45
Penetrating cardiac trauma	3	15
Chest wall injury with continuous bleeding	2	10
Soc (penetrating trauma)	2	10
Severe costal flap with massive hemorrhage after thoracostomy	2	10
Massive air loss after pleurotatomy	1	5
Continuous bleeding on the drain tube 3 hours continuously	1	5

Table 9. Indications of various operators in relation to traumatic injury

Affection	No.	Treatment(n)
Injuries of parenchym	**19**	**Simple ligature (11)** **Toracotomy (5)** **Lobectomy (1)** **Segmentary resection (2)**
Heart injuries	**4**	**Simple suture on atrium lesion (1)** **Ventricular suture (1)**
Major lesions of intraoracic vessels	**7**	**Suture and ligature (7)**
Costal fractures including soft thorax flap	**3**	**Fixation (3)**
Diaphragmatic lesion	**3**	**Suture, recovery with mesa (3)**
Interabdominal injuries	**5**	**Hepatic hemostatic suture (3)** **Splenectomy (2)** **Nephrectomy (1)**
Fracture of the clavicle	**1**	**Fixation (1)**

In 10% of patients the pleural empyema complicates the course of parapneumonic effusion with significant morbidity and mortality (197,198). In the publication of Seville (199) the increased rate of morbidity and mortality is in correlation with the coexistence of multiple comorbidities, such as diabetes (alcoholism), lung infection, pulmonary fibrosis, pneumonia, mental retardation of aspiration and trauma.

Table 10. Characteristics of patients

Variable	No(%) or Average(range)
Age	55(20-82)
Sex	
Masculine	30(81)
Feminine	20(19)
WBC Number	15000(5000-49000)
Level of CRP mg/dl	19,2(24-65)
Bacteriology in pleural fluid	
Positive	13(29%)
Negative	37(71%)
Bacteria	
Gram+	30(64)
Gram-	18(36)
Fever	
Yes	39 (80%)
Not	9 (20%)
Quantification of pleural fluid	
>50%	21(45%)
<50%	27(55%)
The appearance of the effusion	
Reduced	36(75%)
Free flow	12(25%0
Pleural thickening	
Yes	22(46%)
Not	36(54%)
Presence of air in the pleural cavity	
Yes	511
Not	3677

After the first years after the introduction of toracoscopy in our clinic, VATS indications and pleural suppurations were widened.

Table 12. Residual hemothorax with clinical, radiological and laboratory findings.

Initial hemothorax in ml (leak)	***Retained hemothorax requiring exhaust (n=14)[x]***	***No retained hemothorax (n=43)[x]***	***P value***
	525	400	0.24
<u>48 hours</u> Exit from chest drain (ml)	1100	840	0.12
Sao_2	92	93	0.55
Not. with ≥ 500 ml of blood retained on CxR - the opinion of the radiologist	4	4	0.14
- Surgeon's opinion	2	3	0.55
Not. with ≥ 500 ml residual blood on CT - the opinion of the radiologist	9	1	0.001
- the surgeon's opinion	13	0	0.001

This study included documentation analysis of 1,462 patients with different forms of abdominal trauma examined between 2004-2014, the study being retrospective.

The examination was carried out within the first 30 minutes after the arrival of the injured in the UPU.

The examination was considered positive in the presence of intraperitoneal fluid or the detecting of a parenchymal lesion of the abdominal viscera.

Table 13: Abdominal US results in 1462 patients:

Real positive	236 (15.1%)
False positive	38 (2.5%)
Real negative	1149 (71%)
False negative	31 (2,1%)
Excluded	8
Total	1462

Table 14 : Patients with Us preclinic.

Real positive	**No**	**False positive**	**No**
US+ and CT+	194	US+,CT-	29
US+ and Puncture+	4	US+, Puncture -	4
US+ and exploratory laparotomy +	37	US+, laparotomy -	5
US+, observation	0	US+ and observation	0
Total	236	**Total**	38

Table 15 : results obtained in patients with us negative

Real negative	**No**	**False negative**	**No**
US(-) and CT (-)	150	US(-)and CT(-)	US(-)and CT(-)
US(-) and PLP(-)	10	US(-) and PLP(+)	1
US(-) and laparotomy	4	US(-) and exploratory laparotomy (+)	1
US(-) and negative observation (-)	984	US(-) and observation (+)	5
Total	1148	**Total**	31

Of 1463 traumatized 9 (0.6%) were assessed as non-classifiable, the result being uncertain. All of these patients benefited from CT.

In critical polytraumas with massive bleeding, tamponade, there is no time for complex investigations, the indication of thoracotomy was based on the clinical condition of the patients, and the prognosis was influenced by the state of polytraumas at the time of arrival in the emergency department.

Most authors recommend pleurotomy in an emergency, but if drainage is >1500 ml or more than 250 ml per hour, thoracotomy (158, 159, 171, 173, 157, 174) is indicated within the next 3 hours.

In our experience 32 (57%) patients with penetrating wounds required haemostasis thoracotomy, 38% evolved with continuous bleeding on the pleurotomy drainage and 20% were in shock.

Survival of closed TT was small in relation to open TT. The difference in survival is explained by the association of extrathoracic lesions with closed TT, the first of which is massive bleeding from the abdomen (149).

In polytrauma thoracopulmonary lesions increase morbidity and mortality through pulmonary contusions, post-trauma pneumonia, traumatic post-atelectasis, ARDS syndrome (acute respiratory distress syndrome).

Polytrauma is still a major challenge for emergency departments, both in the complexity of injuries and in the often vital consequences of tissue damage.

Continue efforts to decrease adverse developments in the emergency by applying for each treatment .

A feature of polytrauma is the possibility of rapid aggravation of the state of traumatized ness which justifies rapid evaluation and immediately applied resuscitation therapies.

Experience has demonstrated the importance of applying synchronized therapeutic protocols with scores and types of multidisciplinary team trauma scales, following well-established algorithms.

The purpose of trauma therapy is, among other things, to reduce the preventable morbidity and mortality in All Traumatized persons, identifying small, occult lesions in unpredictable developments.

Posttrauma, the major causes of deaths in the first 3 days are hemorrhagic shock and severe acute CBT (36).

Our retrospective study from the study period revealed an overall mortality rate of 46% in PT.

In the category of PT with uncertain diagnoses, mortality was between 19.8% and 33%.

In our statistics 60% of deaths in PTT were recorded in the first 24 hours, of which 19% were caused by uncontrollable bleeding, and 81% data from CBT.

Secondary deaths accounted for 25% of the number of Pts surviving above 24 h, the cause of death being the progression of CBT as well as septic and MSOF complications during long-term therapy in ATI.

1. Our study confirms the presence of severe multiple lesions in polytraumatized patients, lesions observed in the initial post-traumatic evolution.

2. In order to ensure adequate therapy in the PT, three conditions shall be indicated:

a)Consensual strategy as a priority

b) Coordination of emergency assistance

c)Multidisciplinary completed team

3. One of the circumstances for the indication of thoracotomy in hemotorax is the reduction of the duration of hospitalization, the prevention/reduction of late complications and the complete pulmonary review.

4. Intensive therapy and pleural drainage provide adequate therapy in most TT

5. Surgical procedures in TT depend on the type and extent of associated chest and general lesions as well as the general condition of traumatized patients.

6. In selected cases emergency thoracotomy is a life-saving process.

7. In polytrauma acute comorbidities and associated lesions increase the mortality and evolution of these patients.

8. Early mechanical ventilation in emergency and adequate hemodynamic stabilization are crucial for avoiding and preventing severe complications.

9. In the first 24 hours after the trauma, the most important causes of death are hemorrhages of central neurological lesions, but not the interval between the occurrence of trauma and the first emergency examination.

The abdominal U.S. is the initial diagnostic investigation. In recent decades the increase in US accuracy through modern technical equipment has diminished CT and PLP investigations during the initial observation of cases with abdominal trauma in line with careful, repeated clinical evaluation.

At PT where the presence of a ct retroperitoneal lesion is suspected is the method indicated for investigation.

10. In pleural empire fusion fever, pleural thickness and delayed operation increase the indication for conversion to thoracotomy.

In the fibrinopurulent stage, VATS and thoracotomy are a safe effective procedure. Immediate results of surgical treatment in pleural empiema is good. In stage III thoracic empiem will be required a complete decoration.

11. The thoracoscopic evacuation of the retained hemothorax is safe and effective. Success is ensured by early intervention based on the indication of CT thorax.

Proposed investigation and emergency attitude algorithm for the polytrauma emergency department

Table 17a. Patient investigation algorithm with PT I

<table>
<tr><th colspan="4">Patient with PT I</th></tr>
<tr><td colspan="2">Patient with cardio respiratory arrest</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>Penetrant</td><td></td></tr>
<tr><td>No vital sign
LINEAR EKG
Deceased patient</td><td>Shows vital signs EKG sinus rhythm
Thoracotomy and open heart massage
transfusion
Haematoma
Determination of intrathoracic lesion</td></tr>
<tr><td colspan="2">Shows intrathoracic lesion</td><td colspan="2">No intrathoracic lesion
Rebalance the patient in liquid, cardiac support</td></tr>
<tr><td>Pericardiotomy
Hil pensing
Cardiac massage
Resolve source
If abdominal lesion laparotomy and damage control is associated</td><td></td><td>Do not restore cardiac function/ death</td><td>Restoring organic cardiac activity
Definitive resolution of lesions
Definitive hemostasis
Damage control laparotomy</td></tr>
</table>