

The Outcome of the Surgical Treatment in the Patients with the Penetrating Chest Wounds

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ABSTRACT

The aim of this paper is to present the treatment evaluation of the chest penetrating wounds in our hospital during the Patriotic war in Croatia. Due to the war situation, all the patients were treated with the aggressive surgery- thoracotomy. We compared the treatment outcome of these patients with those treated after the war who were treated with the standard procedure, meaning that the thoracotomy was performed only if the indications were clear and most of the minor chest wounds were treated with the thoracic drain. The compared parameters were: age, gender, thoracotomy percentage in comparison to total number of wounded, incidence of multiple wounds needing surgery, total follow up period, infection incidence, period of hospital treatment, blood transfusions, spirometry finding minimum one year after the hospital treatment. None of the parameters showed any significant statistical difference suggesting that one treatment was better than the other.

Key words: thorax, trauma, thoracotomy, spirometry

Introduction

Every chest wound is a penetrating injury which requires parietal pleura opening. The wounds sustained in the war are caused by the gunshots and therefore they are clinically rather specific due to the potential consequences.

The penetrating wounds have the various symptoms, some of them are minor and do not endanger patient's life, but some causing the damage of the vital organs can have the fatal outcome.

Therefore the appropriate medical treatment with the exact indications for thoracotomy would be further discussed in the paper. In order to choose the right treatment, the penetrating wounds should be divided according to their chest location. Most of them are classified according to the topographic location of the chest organs in central and peripheral ones and these in upper and lower (thorax and abdominal).

The central chest wounds are localized inside on both medial clavicular lines. In the upper part there are clavicles and jugular incision and lower the ribs margins and xiphoid. The upper and lower regions are divided by the mamillary line. In the case of the central penetrating

wounds, the most endangered organs are: heart, big blood vessels, thorax, bronchi, esophagus, spine and other neighboring organs situated under the diaphragm: stomach, liver, pancreas and big blood vessels. Since the central wound imposes a life threat, it should be treated surgically. It must be point out that the surgery should be urgently performed; avoiding all unnecessary diagnostic or therapeutic procedures¹ and the patient should be rushed to the hospital².

The marginal chest wounds are localized laterally from medioclavicular line. The wound upper margin is axilla and shoulder and lower margin are ribs. The line going through VI intercostals cavity separates the upper and lower region. The lungs are most affected organ in the case of the chest penetrating wounds, accompanied with hematomneumothorax which can be tensional one. However in the lower wounds, the intra abdominal structures can be damaged. Most of the lung damages heal spontaneously and therefore they can not be an indication for the thoracotomy. The authors agreed that 80% of marginal penetrating wounds should be treated with the thorax drain^{3,4} in the peaceful times. It is well known

that the thoracotomy indication in the patients initially treated with the drain, is the bleeding of 1500 ml in 24 hours⁵ (according to some authors 1000 ml), or 100 ml every hour (some suggest 50 ml every hour) regardless of the wound type.

Our results are specific because all our patients with the penetrating chest wounds had thoracotomy during the war, opposing the common protocol applied in the treatment of these patients. Analyzing our data and thoracotomy indications, it must be taken in the consideration that the medical care was organized differently in the times of the war in the Clinical hospital Osijek.

The aim of this paper is to present the treatment evaluation in the case of chest penetrating wounds at the Surgical department in our hospital during the Patriotic war, with the special emphasis on the later consequences of the treatment. The treatment outcome of the war patients was compared to those treated during the peaceful time. The paper discusses the question if the patients treated during war would have any early or later treatment consequences and what would be their later functional status since the treatment in the war was significantly different from the standard treatment protocol.

Materials and Methods

The study was conducted retrospectively. The criteria for the patients' selection were the following data: age, dates of hospital admission and discharge, detailed description of the sustained injuries, exact number of transfusions, follow up period of minimum 6 months after the hospitalization, pulmonary check-up, and spirometry minimum a year after the surgery, and accurate spirometry finding.

The war patients were wounded in the period from 1991 till 1995 and other patients were wounded in the time of peace and form the second group.

Out of 139 patients with the complete medical history during the war period, 35 patients satisfied the criteria and were included in the study. The same criteria were applied for the patients in the time of peace and out of 33 patients, 28 were included in the study.

The quantity of the transfused blood was expressed in blood doses and the period of the hospitalization in days. The death rate was counted from the day of hospital admission till 30 days after the initial treatment, meaning till the hospital discharge, if the hospitalization lasted longer than 30 days. The infection incidence was also evaluated. The spirometry finding was obtained at the Pulmonary department in the Clinical hospital Osijek. In the study we evaluated the values of vital capacity (VC) as an indicator of restrictive changes in the lung functioning. The changes were classified according to the frame of reference from minor changes of 65–80% referential values, medium 50–60% till severe changes of 50% less than referential values. According to their spirometry finding, the patients were divided in two groups. The first group consisted of the patients with the normal

spirometry finding and the second had any kind of spirometry verified restrictive change. As the separating value between these two groups, 80% of the expected value was taken.

The statistical analysis was done with the program Statistica for Windows, release 7.1 (Stat-soft, Inc.,Tulsa, OK, USA). The statistical significance among numerical parameters was evaluated with Student t test for the quantity of the transfused blood and the period of hospitalization. Before applying Student t test, the homogeneity of the variances was tested, showing that there was no difference among the variances that might have affected the test accuracy. X² test was used to compare the spirometry findings. The differentiating significant value of 0.05 for all variables was used.

Results

Out of 35 patients wounded in the war, 3 were women and out of 28 patients wounded in the time of peace 4 were women (Table 1).

The mean age of the war patients was around 33 (31 for men and 51 for women) and of the patients in the peaceful time around 34 (33 for men and 40 for women) (Table 1).

In the patient group wounded during the war (out of 139 studied medical histories) 21 patients died (15, 11%) and in the second group out of 33 studied medical histories, 5 died (15, 15%) (Table 1). All war patients had thoracotomy and only 14 patients in the time of peace (50%) (Figure 1).

However, the number of the patients with the multiple injuries is significant in comparison to the patients with the isolated chest wound. There were 14 out of 35 patients in the war group who had other injuries besides the chest injury (3 patients had abdominal injury, 5 pa-

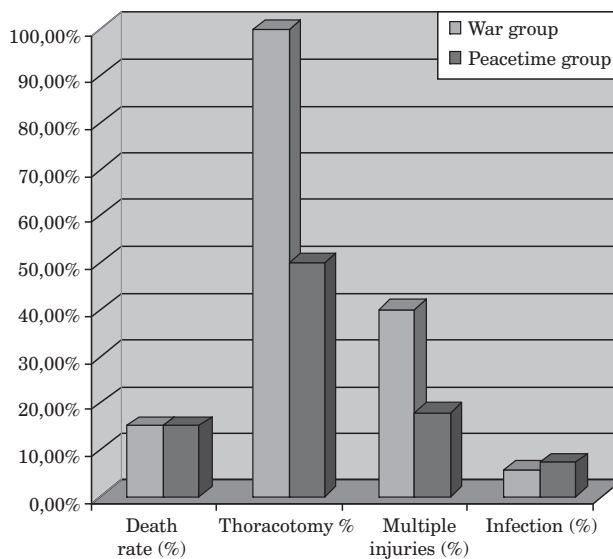


Fig. 1. Relationship of parameters in war and peacetime groups.

TABLE 1
PATIENT DEMOGRAPHIC CHARACTERISTICS

	War Group	Peacetime group
Gender		
Male	32	24
Female	3	4
Age (years)	33	34
Death rate (%)	15.11	15.15
Thoracotomy (%)	100	50
Multiple injuries (%)	40	18
Infection (%)	5.71	7.14
Hospitalisation (days)		
Total	20	16
Isolated chest wound	12	14
Transfusion doses		
Total	3.56	3.03
Isolated chest wound	2.51	2.73
»Bad« spirometry (%)	25.7	21.44

tients injured extremities, 2 head wounds, 2 patients had multiple injuries of abdomen and extremities and 2 patients had non-penetrating wounds out of chest). In the patient group in the peacetime, there were 23 patients out of 28 who had isolated chest wound (remaining 5 patients had an additional abdominal injury) (Table 1) (Figure 1).

The hospitalization period in the war group was mean period of 20 days (12 for the patients with isolated chest wounds) and in the second group the mean hospitalization period was 16 days (14 days for the patients with the isolated chest wound). Applying Student t test with the significant value of 0.05, t value of 1.30 was obtained. T value according to Student distribution for corresponding significant value (0.05) and degrees of freedom (61) was 1.99, proving that there was no statistically significant difference in the hospitalization period according to the determined significant value between these two groups (Table 2).

The quantity of the transfused blood was expressed in the doses and in the war group there were 3.56 (2.51 doses for the patients with the isolated thorax injury). The patients in the peaceful time got 3.03 of transfused blood (2.73 for patients with an isolated chest injury). Using Student t test with the significant value of 0.05, we got t value of 0.54. T value of 1.99 was determined according to Student distribution for the corresponding significant value of (0.05) and degrees of freedom (61), showing that there was no statistically significant difference in the transfused blood quantity between these two patient groups according to the determined significant value (Table 2).

In conclusion we would like to point out that in the group of the war patients, 26 had a normal spirometry finding, 8 had mild restrictive changes and 1 had me-

dium restrictive changes. In the patient group treated in the time of peace, 22 patients had a normal spirometry finding, 5 had mild changes and 1 patient had medium restrictive changes. X² test determined the value of $\chi^2=0.16$ and together with differentiating value of 0.05 (table value X² is 3,841) resulted in $P>0.05$, meaning that there was no statistically differentiating value for even minor restrictive changes among the two patient groups (Table 2).

Discussion

If we closely observe the patient distribution according to the age, it is obvious that the patients were of almost identical age and the mean age of the women was higher than of the men. These data corresponds with the literature³. It can be explained with the fact that most wounded men were younger since only they join the military and most of the women were civilians who sustained their injuries as the consequence of targeting civilians with the grenades. During the time of peace, most of the patients were wounded in shooting, again most affected age were younger men.

It can be seen also that more wounded patients in the war had multiple injuries, almost 40% of them, whereas only 18% of peacetime patients. We can explain it with the fact that the war patients sustained their injuries in severe shelling (grenades) and consequently had the multiple injuries. During the peacetime, the patients sustained their injuries in gun shooting and mostly it was only one shot.

In spite of the multiple injuries in both patient groups, the death rate is not significantly different between these two, because most of the war patients who had the multiple injuries were wounded with grenade splinters which have lower kinetic energy and therefore are less tissue damaging. It should be mentioned that not only the lower kinetic energy affects the tissue damage, but also

TABLE 2
TABLE OF STATISTICAL SIGNIFICANCE

Hospitalisation	
t value	1,3
T value*	1,99
confidence interval	95%
Trasfusions	
t value	0,54
T value.	1,99
confidence interval	95%
Sprometry	
x ² value	0,16
X ² value**	3,84
confidence interval	95%

*T value - from Student distribution with 61 df, **X² value - from x² distribution with 1 df

the projectile shape (the irregular one causes more tissue damage). Nevertheless we think that the proper medical treatment of the wounded in the Clinical hospital Osijek during the war with its results proved that the treatment protocol was well chosen.

The infection incidence was slightly higher (Table 1) than in the other studies⁶. All the patients had three-some antibiotic prophylaxis, although in the case of isolated chest wounds it is controversial⁷. Since the infection incidence was higher in spite of the antibiotic prophylaxis, it can be concluded, that the antibiotic administration in the case of penetrating chest wounds is controversial.

The main problem discussed in this paper is thoracotomy indications. The lung injuries are widely not known as the thoracotomy indication and we mentioned previously that in the peacetime almost 80% of penetrating margin wounds are treated with thoracotomy drain. Some papers suggest higher thoracotomy incidence even in the peacetime⁸. However, the papers discussing war injuries, report some other treatment data. There are papers showing a rather high thoracotomy incidence of 75%⁹, especially in the case of penetrating wounds sustained with the high initial speed projectiles, but there are some other papers presenting the different data on peacetime wounds and other treatment experience in the war^{3,4}. Therefore, the real question is what the indications are for the urgent thoracotomy. It is in our opinion continuous bleeding through already inserted thoracotomy drains and it is bigger than 1500 ml in 24 hours. We should also mention the injury of the lower chest region, regardless whether the injuries are central or marginal, the abdominal organs might be damaged and the laparocentesis is recommended or in the case of any doubt also laparotomy. Recently the laparoscopic exploration of the abdomen is advised. The current reports suggest that this method should be used only in specific cases and is rather sensitive when it is used to diagnose other intra-abdominal injuries¹⁰. Furthermore, the unnecessary laparotomy, being a far aggressive treatment, can impose a higher risk.

The risk might not be only a damage of intraabdominal structures, but also the damage of diaphragm that later can cause further complications¹¹.

Discussing our results, the medical care provided in the Clinical hospital, in the time of the war should be taken in consideration, since it was the hospital on the front line and it was impossible to predict the admission of the wounded on daily basis. We could not organize and plan an evacuation of the wounded due to the war situation 2km around the hospital, the city of Osijek was besieged and we had a dramatic lack of trained staff that

should have monitored the wounded with the thorax drains. Consequently, all patients with the penetrating chest wound had the thoracotomy. This treatment protocol enabled us to take a proper care of the wounded, good monitoring of bleeding and an easier follow up. Since this treatment protocol of the penetrating chest wound is different from the well established one, it was needed to be evaluated. We would like to add that in most of our cases anterolateral or lateral thoracotomy was performed, what corresponds with other study reports¹². The following five parameters were used for the statistical evaluation: death rate (parameter for treatment efficiency), infection incidence (parameter for the occurrence of early infections), doses number of blood transfusions (parameter for the initial patient status and an indicator for later blood volume supply during the hospitalization, suggesting how well and fast would patient recover), hospitalization period (parameter for primary treatment efficiency), spirometry finding (parameter for permanent respiratory function damage as a consequence of certain treatment). If the vital capacity (VC) is decreased, there are for sure some restrictive changes (occurring in the case of respiratory surface shrinking or decreased expansion and shrinking of lung tissue). Based on the conducted testing, we did not detect for any parameters any statistically significant difference which would prefer one treatment to the other (Table 2). It can be explained in two ways. Firstly, the widely used treatment of the penetrating chest wounds with thorax drain (without indications for other treatment) is an excellent choice, since it is less aggressive and invasive and promises a good outcome, suggesting that more aggressive treatment is not needed. Furthermore, choosing thoracotomy treatment in the case of penetrating chest wounds would not induce any other outcome.

Conclusion

We can conclude that the widely used treatment with the thorax drain in the case of lateral penetrating chest wound (if there are no other medical indications) is a good choice. It is less aggressive and invasive, has a good outcome, implying that other treatment would be a poor choice. It is obvious that thoracotomy should not be performed in case of every penetrating chest injury and would not have any better early or later outcome. It is to be addressed whether thoracotomy (as an aggressive and invasive treatment) was a good treatment choice in our case, but due to the organizational problems in the time of war, we believe that it was the right and the only choice.

REFERENCES

1. FELICIANO DV, BITONDO CG, CRUSE PA, MATTOX KL, BURCH JM, BEALL AC Jr, JORDAN GL Jr, *Am J Surg*, 152 (1986) 654.
- 2. BLEETHMAN A, CRAWFORD K, CRAWFORD R, *Injury*, 27 (1996) 129.
- 3. OPARAH SS, MANDAL AK, *J Thorac Cardiovasc Surg*, 77 (1979) 162.
- 4. ROBINSON PD, HARMAN PK, GROVER FL, *J Thorac*

- Cardiovasc Surg*, 95 (1988) 184.
- 5. KARMIY-JONES R, JURKOVICH GJ, NATHENS AB, SHATZ DV, BRUNDAGE S, WALL MJ, ENGELHARDT S, HOYT DB, HOLCROFT J, KNUDSON MM, *Arch Surg*, 136 (2001) 513.
- 6. AGUILAR MM, BATISTELLA FD, OWINGS JT, SU T, *Arch Surg*, 132 (1997) 647.
- 7. LANG-LAZDUNSKI L, PONS F, JAN-

COVICI R, Curr Op Crit Care, 5 (1999) 488. — 8. LEPPANIEMI A, CEDERBERG A, TIKKA S, J Trauma, 40 (1996) 217. — 9. ZAKHARIA AT, Ann Thorac Surg, 40 (1985) 209. — 10. ERTEKIN C, ONARAN Y, GULOGLU R, GUNAY K, TAVILOGLU K, Surg Laparosc Endosc, 8 (1998) 26. — 11. DEGIANNIS E, LEVY RD, SOFIANOS C, POTOKAR T, FLO-

RIZOONE MGC, SAADIA R, Brit J Surg, 83 (1996) 88. — 12. KARMY-JONES R, NATHENS A, JURKOVICH GJ, SHATZ DV, BRUNDAGE S, WALL MJ, ENGELHARDT S, HOYT DB, HOLCROFT J, KNUDSON MM, MICHAELS A, LONG W, J Trauma, 56 (2004) 664.

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REZULTATI KIRURŠKOG LIJEČENJA BOLESNIKA S PENETRANTNIM OZLJEDAMA PRSNOG KOŠA

S A Ž E T A K

Cilj ove studije je evaluacija liječenja penetrantnih ozljeda prsnog koša u našoj ustanovi tijekom Domovinskog rata. Specifičnost liječenja u ratnim uvjetima je ta da su gotovo svi bolesnici tada bili zbrinjavani agresivnim kirurškim pristupom – torakotomijom. Kao usporedbu smo uzeli bolesnike liječene nakon završetka rata. Ta je grupa bolesnika liječena standardno, tj. torakotomije su rađene samo bolesnicima s jasnim indikacijama, a većina perifernih ozljeda prsnog koša je zbrinjavana torakalnom drenažom. Parametri koje smo uspoređivali su dob, spol, postotak torakotomija u odnosu na ukupan broj ozlijeđenih, prisutnost udruženih ozljeda koje su zahtijevale operacijsko liječenje, ukupno vrijeme praćenja, prisutnost infekcija, trajanje hospitalizacije, potreba za primjenom krvi, spirometrski nalazi nakon minimalno godinu dana od završetka bolničkog liječenja. Niti jedan parametar nije pokazao statistički značajnu razliku koja bi govorila u prilog jednog od načina liječenja