

Associated factors to empyema in post-traumatic hemothorax

Fatores associados ao empiema em pacientes com hemotórax retido pós-traumático

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A B S T R A C T

Objective: to analyze the associated factors with empyema in patients with post-traumatic retained hemothorax. **Methods:** prospective observational study. Data were collected in patients undergoing PD during emergency duty. Variables analyzed were age, sex, mechanism of injury, side of the chest injury, intrathoracic complications of RH, laparotomy, specific injuries, rib fractures, trauma scores, days to diagnosis, diagnostic method of RH, primary indication of PD, initial volume drained, length of the first tube removal, surgical procedure. Cumulative incidence of empyema, pneumonia and pulmonary contusion and the proportion of patients with empyema or without empyema in each category of each variable analyzed were obtained. **Results:** the cumulative incidence of PD among trauma patients was 1.83% and the RH among those with PD was 10.63%. There were 20 cases of empyema (32.8%). Most were male in the age from 20 to 29, victims of injury by firearm on the left side of the thorax. The incidence of empyema in patients with injury by firearms was lower compared to those with stab wound or blunt trauma; higher among those with drained volume between 300 and 599 ml. The median hospital length of stay was higher among those with empyema. **Conclusion:** the incidence of PD was 1.83% and RH was 10.63%, these results are consistent with the low severity of the patients involved in this study and consistent with the literature. The incidence of empyema proved to be negatively associated with the occurrence of injury by firearms and positively associated with a drained volume between 300 and 599 ml, compared with lower or higher volumes.

Key words: Empyema. Thoracic Injuries. Thorax. Drainage. Hemothorax.

INTRODUCTION

Thoracic trauma is the main cause of mortality in all age groups. This type of trauma has increased around the world¹. Thoracic injuries are still the second leading cause of mortality due to trauma, corresponding to 20% to 25% of deaths^{2,3}. Blunt trauma due to automobile accidents corresponds to 70% to 80% of all thoracic injuries in the United States^{2,4} and deaths occur in 25% of the cases³. When the mechanism of injury is penetrating, only 40% of the cases are chest injuries²⁻⁴.

Most of the traumatic thoracic injuries are treated with pleural drainage (PD), a simple procedure performed by the physician during the initial care approach². When the diagnosis is hemothorax, 85% to 90% are satisfactorily treated by PD without complications⁵. The permanence of the drain is determined by lung expansion, which in ideal conditions of treatment, usually occurs in the early days after drainage⁵. Fluid accumulation in the pleural cavity, sometimes, can be identified on imaging, after removing the drain or even when the drain remains in place. This

finding has been recognized as residual or retained hemothorax (RH). However, this definition is still not uniform in the medical literature⁶.

Less invasive procedures have been early indicated for treatment of RH⁷⁻¹². The main goal of the early treatment is to avoid the RH progression to other complications, especially to empyema, one of the most severe complication which frequently requires a complex approach for treatment^{5,12,13}. The RH is the main predisposing factor for post-traumatic empyema and the incidence varies from 4% to 20%^{5,7,13,14}.

The phase of the empyema determines the treatment's modality. Less invasive treatments can be indicated for the earliest phase. The purulent phase is the most complicated and usually requires Eloesser's pleurostomy^{15,16}. Other recommended treatment modalities range from conservative treatment, involving only observation, to guided thoracic puncture, redrainage, intrapleural injection of fibrinolytic agents, thoracoscopy (VATS) and thoracotomy with pulmonary decortication^{5,8,17}. After these treatments the prognosis of the empyema tends

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to be better because they are performed in exudative and fibrinopurulent stage. However, in the purulent stage, thoracoscopy and open pulmonary decortication have less chance of success.

The literature also highlights selected factors associated with the presence of empyema such as age, mechanisms of trauma (blunt or penetrating), side of the thoracic injury, exploratory laparotomy, severity of the patient, time and the RH diagnostic method, primary indication for PD, drained volume, permanence of the drain, need of redrainage, length of stay and surgical procedures^{18,19}. It is generally agreed that aseptic techniques of PD and complete evacuation of RH are necessary to avoid complications. According to the clinical situation and appearance of the effusion on radiography or computed tomography, RH can be observed after drainage, depending of the pleural absorptive capacity^{8,17,20,21}.

Over a period of three years, this study analyzes the associated factors with empyema in patients with post-traumatic RH in one reference hospital for trauma in Belo Horizonte, Minas Gerais.

METHODS

This is an observational prospective study of patients admitted in the Risoleta Tolentino Neves (HRTN) Hospital. This work was approved by the Hospital Research Center's Board (Protocol number 01/2012).

Data were collected from 21 November 2009 to 07 March 2013 and stored in particular data collection form. All patients underwent to pleural drainage in the HRTN by the trauma team during emergency duty. The PD was held in water seal in the operating room or the emergency room, according to hospital protocol.

For the total number of trauma care in the period of the study an estimate was made based on the information generated by the MV2000®, management software and electronic registration records. For the number of PD, the Collector®, trauma registry software HRTN, deployed since 2009, provided information for the years 2011, 2012 and 2013. Further information about the Collector® are available in the literature²². It was considered that the average monthly drainage from January 2011 to March 2013 could be extrapolated for the months of November 2009 to December 2011.

The study included multiple patients victims of blunt or penetrating trauma diagnosed with RH; with hemodynamic stability at admission; Revised Trauma Score (RTS) greater than seven and Injury Severity Score (ISS) less than 25. Patients aged less than 15 years and those who died due to related injuries, without the possibility of monitoring were excluded. Patients submitted to PD who did not develop RH also did not take part of this study, as well as those with empyema not related to RH. The imaging methods were radiography and computed tomography scan.

To calculate the sample size, the percentage found in the literature equal to 26.8% was used as a starting point relative to patients with retained hemothorax that developed empyema¹⁷. Since August 2012 the use of antibiotics has been routinely used in all patients with hemothorax in our institution, then we decided to use a lower percentage (20%) of cases. Thus, there was obtained a sample of 61 patients, given a margin of error of 10% and 95% of confidence level.

The variables analyzed were: age (continuous in years and stratified in 15- 20; 20-29; 30-39; 40 and over 40); gender; mechanism of injury (blunt trauma, stab wound, injury by firearm); the side of the thoracic injury (right, left, right and left); intrathoracic complications associated with RH (empyema, pneumonia, other); laparotomy (yes, no); specific lesions (extrathoracic complications; diaphragm injury, other injuries); fracture of the ribs (number of fractures count); trauma indices (RTS, ISS; TRISS - Trauma and Injury Severity Score); time in days to diagnosis (continuous); diagnostic method of HR (radiography, computed tomography scan); primary indication for PD (hemopneumothorax; pneumothorax, hemothorax); drained initial volume (less than 300ml, 300-599 ml, 600ml or higher); days of the first tube removal (continuous); surgical procedure (yes/no, based on the following inclusion criteria: thoracotomy, thoracoscopy, pleurostomy and decortication).

The cumulative incidence of empyema, pneumonia and pulmonary contusion among patients with RH was obtained in the study period. Then it was calculated the proportion of patients who developed or not empyema in each category of each variable analyzed. Afterwards the association of each variable with empyema was evaluated.

Pearson's chi-square was used for comparison of categorical data and Fisher's exact when $n < 5$. The Mann-Whitney test (nonparametric test to compare median) was used to compare the count or continuous variables. Mean was not used in any of the count or continuous variables, once the distributions of these variables after been evaluated by Shapiro-Wilk test for skewness and kurtosis did not reveal normality in a level of significance of 5%. The significance level for analysis of associations and difference in medians was 5%.

RESULTS

Of 31.406 patients seen between November 2009 and March 2013 on HRTN, there were 574 thoracic drainages, of which 61 developed into HR.

The cumulative incidence of PD among patients victims of trauma was 1.83% (574/31.406) and the RH among those with pleural drainage was 10.63% (61/574). Thirty three infectious pleuropulmonary complications were observed in 24 patients. There were 20 cases of empyema,

ten cases of pneumonia, and three cases of infected lung injury, corresponding to 32.8%; 16.4% and 4.9% respectively, in the 61 patients with RH.

The median age of the patients was 30 years, most were male between 20 and 29 years old, victims of firearms injuries on the right side of the thorax. Laparotomy was performed in seven patients. Diaphragm injury occurred in 10 patients and extrathoracic complications in 32. The median for RTS was 7.84, ISS 9.0 and TRISS 0.99. The median time for the diagnosis of HR was four days, ranging from 1 to 38 days. Radiography was the most commonly diagnostic method and hemopneumothorax occurred in 39 patients. The initial volume drained ranged from 300ml to 599ml in 35 patients. The median time to remove the first thoracic drain was five days, ranging from zero to 19 days. The median hospital length of stay was 10 days, ranging from two to 42 days. Observation, without major surgical procedure (only the initial drainage), was performed in 38 patients (Table 1).

When the stratification of the sample was made by the presence of empyema, there was a higher incidence for: age above 39 years; men; stab wound; injury on the left side of the thorax; patients with extrathoracic complications; patients who did radiography; hemothorax as primary indication for drainage; initial volume drained from 300 to 599 ml and those submitted to surgical procedure (Table 2).

The incidence of empyema in patients with injury by firearm was significantly lower compared to those with stab wound or blunt trauma ($p=0.008$); it was higher among those with volume drained between 300 and 599 ml compared to those with lower or higher volume ($p=0.030$). The median hospital length of stay was significantly higher among those with empyema compared to those without empyema ($p=0.001$).

DISCUSSION

This study addressed the evolution of post-traumatic RH in 61 patients among the 574 patients with PD between 2009 and 2013. The cumulative 10.5% incidence of RH was consistent with other reports in the literature, where the incidence ranges from 4% to 20%^{7,9,17}.

The trauma indices were consistent with low severity of the patients. Twenty-four patients had intrathoracic infectious pleuropulmonary complications resulting from RH - empyema, pneumonia and infected lung injury. Previous studies indicate incidences ranging from 3% to 27% for these complications^{11,14,23,24}. In this work the incidence was 32.8%, 16.4%, and 4.9% for empyema, pneumonia and infected pulmonary contusion, respectively. Empyema demands surgical treatment in some cases, being one intrathoracic complication with serious damage for patients¹⁹.

Patients with penetrating trauma by firearms had significantly lower risk of empyema compared to those with

penetrating trauma with knives and blunt trauma. The literature tends to high quote the penetrating mechanism as a risk factor for empyema, but this is controversial and the reasons are not objectively clarified^{3,4,12,16}. Another study in Brazil has found similar results to this work regarding the incidence of empyema according to the mechanism of trauma¹⁹. In this work, the finding may be explained by the patient's age effect, once among the 33 patients with penetrating trauma by firearms, only two were older than 40 years (6%), as opposed to 13 among the remaining 28 with penetrating trauma by knife or blunt trauma (46.4%) (data not shown). This fact means that, in the present study, patients with different trauma of those by firearms were older, with higher incidence of empyema (compared to the other age groups) among those over 40 years. Age is a risk factor in post-traumatic pleural empyema, because elderly patients have less cardiovascular and respiratory physiological reserves and more associated chronic diseases with propensity to retain pulmonary secretions¹⁹. There was a higher incidence of empyema when the injury was on the left side of the thorax, but without statistical significance. Evidence indicates that the rib fractures on the left side would be more associated with empyema^{8,12,17}, corroborating with the findings of this study.

The diagnostic method most used for RH was radiography, performed in 53 patients (86.9% of total), held on the occasion of the chest tube removal. Perhaps this is the reason for underestimated diagnosis of RH and empyema, considering that CT scan was used to study the characteristics of the collection only after this one be seen on radiography, or during the initial phase of the trauma care. Another interesting factor is that chest radiography, in some cases of trauma, consists only of the anteroposterior position, a fact that reduces the possibility of diagnosis of small amounts of liquid which is better seen in the lateral view. If the CT scan had been used in all patients, certainly the amount of fluid in the pleural cavity would be higher, since it is known that CT is an excellent imaging method for rapid diagnosis, especially for evaluation of hemodynamically stable patients with blunt abdominal trauma²⁵. However, even if the number of complications due to the RH had been underestimated in this study, the routinely use of CT scan would be unthinkable due to financial cost and the radiation risk. Another form of reasoning would be think that, if there is no presentation on plain thoracic radiography, there is no clinical manifestation and, consequently, no complication.

The primary indication for drainage was hemopneumothorax in 39 patients (65.0%) corroborating previous findings¹². Patients with hemothorax had a higher incidence of empyema (38.9%) than those with isolated pneumothorax (33.3%) or hemopneumothorax (30.8%), which is quite reasonable since, in the former case, the risk to develop empyema is increased when blood accumulates in the pleural cavity, working as a culture medium for bacteria.

Table 1 – Description of the patients with RH.

Variables	Total (n=61; 100.0%)	
Age		
Median (IIQ)	30	(22; 38)
(Min-Max)		(15; 73)
Age (groups) (n; %)		
< 20	11	(18.0)
20-29	19	(31.0)
30-39	16	(26.2)
≥ 40	15	(24.6)
Gender (n; %)		
Male	57	(93.4)
Female	4	(6.6)
Mechanism of trauma		
Blunt	17	(27.9)
Stab wound	11	(18.0)
Injury by firearm	33	(54.1)
Side of the injury (n; %)		
Right	32	(52.5)
Left	26	(42.6)
Right and Left	3	(4.9)
Laparotomy (n; %)		
Yes	7	(11.5)
No	54	(88.5)
Specific injuries (n; %)		
Extrathoracic complications	18	(29.5)
Diaphragm injury	10	(16.4)
Other injuries	25	(41.0)
Rib fractures		
Median (IIQ)	0	(0;2)
(min-Max)		(0; 11)
Index of trauma		
<i>RTS</i>		
Median (IIQ)	7.84	(7.84-7.84)
(Min-Max)		(4.09-7.85)
<i>ISS</i>		
Median (IIQ)	9	(9-16)
(Min-Max)		(4-32)
<i>TRISS</i>		
Median (IIQ)	0.99	(0.98-0.99)
(Min-Max)		(0.72-0.998)
Time until the HR diagnosis (days)		
Median (IIQ)	4	(2; 6)
Min-Max		(1; 38)
Method of diagnosis (n; %)		
Radiography	53	(86.9)
ComputedTomography Scan	8	(13.1)
Diagnosis (n; %)		
Hemopneumothorax	39	(57.4)
Pneumothorax	3	(4.9)
Hemothorax	18	(29.5)
Initial drained volume (n; %)		
<300 ml	7	(11.5)
300 ml to 599 ml	35	(57.4)
≥ 600 ml	12	(19.7)
Length of the first drain (days) (n; %)		
Median (IIQ)	5	(4; 7)
Min-Max		(0; 19)
Hospital Length of stay (n; %)		
Median (IIQ)	10	(6; 19)
Min-Max		(2; 42)
Surgical Treatment (n; %)		
Yes	16	(26.2)
No. with redrainage	7	(11.5)
No. only observation	38	(62.3)

Source: HRTN (2009-2013)

Table 2 - Empyema incidence in patients with RH.

Variable	Total (n=61; 100%)		Empyema (+) (n=20; 32,8%)		Empyema (-) (n=41; 67,2%)		p
Age							
Median (IIQ) (Min-Max)	30	(22; 38) (15; 73)	30	(21; 43) (15; 59)	30	(22; 38) (15; 73)	0.994 ^(*)
Age groups							
< 20	100.0%	(11/11)	36.4%	(4/11)	63.6%	(7/11)	0.999 ^(b)
20-29	100.0%	(19/19)	31.6%	(6/19)	68.4%	(13/19)	0.568 ^(c)
30-39	100.0%	(16/16)	18.8%	(3/16)	81.3%	(13/16)	0.222 ^(b)
≥ 40	100.0%	(15/15)	46.7%	(7/15)	53.3%	(8/15)	0.187 ^(c)
Gender							
Male	100.0%	(57/57)	33.3%	(19/57)	66.7%	(38/57)	0.999 ^(b)
Female	100.0%	(4/4)	25.0%	(1/4)	75.0%	(3/4)	
Mechanism of trauma							
Blunt	100.0%	(17/17)	47.1%	(8/17)	52.9%	(9/17)	0.140 ^(c)
Stab wound	100.0%	(11/11)	54.5%	(6/11)	45.5%	(5/11)	0.090 ^(c)
Injury by firearm	100.0%	(33/33)	18.2%	(6/33)	81.8%	(27/33)	0.008 ^(c)
Side of the injury							
Right	100.0%	(32/32)	31.3%	(10/32)	68.7%	(22/32)	0.788 ^(b)
Left	100.0%	(26/26)	38.5%	(10/26)	61.5%	(16/26)	0.416 ^(b)
Right and Left	100.0%	(3/3)	0.0%	(0/3)	100.0%	(3/3)	0.544 ^(c)
Laparotomy							
Yes	100.0%	(7/7)	28.6%	(2/7)	71.4%	(5/7)	0.999 ^(c)
No	100.0%	(54/54)					
Specific injuries							
Extrathoracic complications	100.0%	(18/18)	27.8%	(5/18)	72.2%	(13/18)	0.590 ^(b)
Diaphragm Injury	100.0%	(10/10)	10.0%	(2/10)	80.0%	(8/10)	0.355 ^(c)
Other injuries	100.0%	(25/25)	24.0%	(6/25)	76.0%	(19/25)	0.223 ^(b)
Rib fractures							
Median (IIQ) (min-Max)	0	(0;2) (0; 11)	0	(0;4) (0; 11)	0	(0;1) (0; 9)	0.223 ^(*)
Index of trauma							
RTS							
Median (IIQ) (Min-Max)	7.84	(7.84-7.84) (4.09-7.85)	7.84	(7.84-7.84) (7.55-7.85)	7.84	(7.55-7.84) (4.09-7.85)	0.999 ^(*)
ISS							
Mediana (IIQ) (Min-Max)	9	(9-16) (4-32)	9	(9-17) (4-32)	9	(9-16) (9-29)	0.586 ^(*)
TRISS							
Median (IIQ) (Min-Max)	0.99	(0.98-0.99) (0.72-0.998)	0.99	(0.98-0.99) (0.95-0.998)	0.99	(0.98-0.99) (0.72-0.998)	0.570 ^(*)
Days until the diagnosis of RH							
Median (IIQ) Min-Max	4	(2; 6) (1; 38)	5	(2;6) (1; 10)	4	(2;6) (1; 38)	0.478 ^(*)
Methods of diagnosis							
Radiography	100.0%	(53/53)	34.0%	(18/53)	66.0%	(35/53)	0.622 ^(c)
Computed Tomography	100.0%	(8/53)	25.0%	(2/8)	75.0%	(6/8)	
Diagnosis							
Hemopneumothorax	100.0%	(39/39)	30.8%	(12/39)	69.2%	(27/39)	0.655 ^(b)
Pneumothorax	100.0%	(3/3)	33.3%	(1/3)	66.7%	(2/3)	0.999 ^(c)
Hemothorax	100.0%	(18/18)	38.9%	(7/18)	61.1%	(11/18)	0.515 ^(b)
Inicial drained volume							
<300 ml	100.0%	(7/7)	14.3%	(1/7)	85.7%	(6/7)	0.660 ^(c)
300 ml a 599 ml	100.0%	(35/35)	40.0%	(14/35)	60.0%	(21/35)	0.030 ^(b)
≥ 600 ml	100.0%	(12/12)	8.3%	(1/12)	91.7%	(11/12)	0.084 ^(c)
Length of the first drain (days)							
Median (IIQ) Min-Max	5	(4; 7) (0; 19)	6	(4;8) (4; 19)	5	(4;7) (0; 10)	0.563 ^(*)
Hospital length of stay (days)							
Median (IIQ) Min-Max	10	(6; 19) (2; 42)	19	(12;23) (5; 35)	8	(6;12) (2; 42)	0.001 ^(*)
Surgical treatment							
Yes	100.0%	(16/16)	43.8%	(7/16)	56.3%	(9/16)	0.277 ^(b)
No. with redrainage	100.0%	(7/7)	42.8%	(3/7)	57.2%	(4/7)	0.416 ^(c)
No. only observation	100.0%	(38/38)	26.3%	(10/38)	73.6%	(28/38)	0.166 ^(b)

Source:HRTN (2009-2013)

Notes: (*) Mann-Whitney test,(ã) Fisher's exact test, (l) Pearson Chi-Square test.

Regarding the initial volume drained, it seems reasonable and believable that the amount of blood at the first pleural drainage leads to the complications of RH and empyema, because liquid in high quantity in the pleural cavity can accumulate instead to be drained. On the other hand, the increased liquid volume in the pleural cavity could also increase the drainage rate and thereby dragging the entire fluid to the drain, decreasing the amount of blood. Furthermore, the high drained volume may mean more severe trauma, meaning in fact, a greater number of associated lesions and increased risk of complications. The finding in this study is that the higher incidence of empyema occurred when the drained volumes ranged from 300-599 mL, in addition of being the most commonly drained volume. It seems that this volume can be key reference for predicting complications such as empyema.

The median times, minimum and maximum stay of the drain were higher among patients with empyema, although not statistically significant. Empyema associated to longer time is expected, once the incidence of infection is increased after 72 hours of the drain insertion in the pleural cavity¹⁹. But the length of hospital stay was significantly higher among patients who developed empyema, which is predictable because, in the presence of complication, the patients have more suffering, besides an extended hospital staying and also, more costs to the patients, hospital and society itself.

Nearly two-thirds of the patients did not undergo any surgical procedure. Previous findings indicate success around 80% for observation of the RH^{8,12,17,20}. In this study the lowest incidence of empyema was associated with observation (26.3% versus 42.8% for redrainage and 43.8% for surgical approach).

Among those without empyema, the difference among the three groups occurred in the mean of the hospital length of stay, having been progressively greater for those with surgery, followed by patients with redrainage, and finally to those without operation (results not shown). This could be explained by the attempt of frustrated nonoperative approach, plus the postoperative period.

These features with hospitalized patients could be allocated to other situations if prevention of RH had been done, and consequently reduction of empyema.

The small number of patients who developed empyema, irregular use of prophylaxis for other associated injuries, antibiotic treatment for other conditions may have influenced our results. Perhaps in the last one lies the biggest limitation of this study, which is the inability to evaluate the effect of antibiotic prophylaxis, once this one started to be routinely used after the start of the present study. Still, it draws attention to the high incidence of empyema, which could even be underestimated. Ultrasound was also not evaluated. Another interesting aspect would have been assessed the incidence of different complications for drainage in the operating room or in the emergency room. There was one single patient drained in the emergency room and this one had pneumonia and empyema. However, because only one case was done in this situation, it was not possible to establish the existence of any association between the occurrence of empyema and pleuropulmonary complication.

Little is known about the RH. Not long time ago, the rule for treatment of RH was conservative approach, and surgery was the exception. Lately, with the incorporation of new technologies, with low morbidity, it seems that the craving for surgical approach have been raised only to sort out problems in short time. Regarding the treatment of the diseases, morbidity and mortality must be considered according the risks to the patients. A proper recognition of the entity RH can clarify the need or not of surgical approach. Thus, future studies still need to be done.

The conclusions of this study are: the incidence of PD was 1.83% and RH was 10.63%, these results are consistent with the low severity of the patients involved in this study and consistent with the literature. The incidence of empyema proved to be negatively associated with the occurrence of injury by firearms and positively associated with a drained volume between 300 and 599 ml, compared with lower or higher volumes.

R E S U M O

Objetivo: analisar os fatores associados ao empiema em pacientes com hemotórax retido pós-traumático. **Métodos:** estudo prospectivo observacional. Os dados foram coletados de pacientes submetidos à drenagem pleural de emergência. Foram analisadas: idade, sexo, mecanismo de trauma, lado da lesão torácica, complicações intratorácicas decorrentes do hemotórax retido, laparotomia, lesões específicas, fratura de arcos costais, índices de trauma, dias até o diagnóstico, método diagnóstico do HR, indicação primária da drenagem pleural, volume inicial drenado, dias de permanência do primeiro dreno, procedimento cirúrgico. Obteve-se a incidência acumulada de empiema, pneumonia e contusão pulmonar e a incidência de empiema em cada categoria das variáveis analisadas. **Resultados:** a incidência acumulada de drenagem pleural por trauma foi 1,83% e a de hemotórax retido entre aqueles com derrame pleural foi de 10,63%. Houve 20 casos de empiema (32,8%). A maioria tinha entre 20 e 29 anos, era do sexo masculino e sofreu ferimento por arma de fogo. A incidência de empiema entre pacientes com ferimento por arma de fogo foi inferior aos demais mecanismos; superior entre aqueles com volume drenado entre 300 e 599 ml. O tempo mediano de permanência hospitalar foi maior nos pacientes com empiema. **Conclusão:** as incidências de derrame pleural e hemotórax retido entre aqueles com DP nessa amostra de baixa gravidade dos pacientes foram, respectivamente, 1,83% e 10,63%. A incidência de empiema revelou-se negativamente associada à ocorrência de ferimento por arma de fogo e positivamente associada a volume drenado entre 300 e 599 ml, bem como, ao tempo mediano de permanência hospitalar.

Descritores: Empiema. Traumatismos Torácicos. Tórax. Drenagens. Hemotórax.

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