Fatal trauma injuries in a brazilian big metropolis: a study of autopsies

Lesões fatais em trauma numa grande metrópole brasileira: um estudo de autópsias

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A B S T R A C T

Objective: This study aims to review a series of deaths by trauma in a large metropolis. The intention is to identify preventable causes of death. **Methods**: We prospectively studied 500 unselected and consecutive cases of death associated with trauma. The study variables were: mechanism of injury, etiology, site of injury, surgical intervention, medical malpractice, damaged organs and the prevention of mortality. The cases were grouped according to the mechanism of injury in: penetrating trauma, blunt trauma, poisoning, drowning, burns and suffocation. **Results**: We examined 418 (83.6%) males and 82 (16.4%) females (mean age 39 ± 19.6 years, ranging from three to 91 years). Penetrating trauma accounted for 217 (43%) cases, while blunt trauma accounted for 40% of cases. The most common mechanism of injury in death by penetrating trauma was gunshot, representing 41% of cases. Within the set of blunt trauma, the most common mechanism was traffic accident, which represented 22% of total deaths. There were 71 (14%) cases of preventable deaths: thromboembolism in 35 (7%), infectious complications in 25 (5%), medical malpractice in seven (1%) and treatable lesions in outpatients in five (1%). **Conclusion**: This study shows that traumatic death in the city of São Paulo is associated with serious and complex injuries. Prevention of these types of death would be related to the control of violence.

Key words: Wounds and injuries. Mortality. Autopsy. Prevention and control

INTRODUCTION

Trauma is one of the leading causes of death worldwide, especially in large cities. São Paulo is the largest city of Latin America and the fourth most populous city in the world according to the estimate of *United Nations World Urbanization Prospects*. It is inhabited by 11,000,000 citizens living in 1525 km^2 and driving 5,300,000 cars; it also has the same problems encountered in large urban areas, that is, heavy traffic and violence. Trauma was responsible for 7,603 deaths in 2005, of which 3,209 were caused by homicides and 1,579 by transport accidents. The first approach to traumatized patients is provided by the São Paulo paramedic service, created 15 years ago. It is a branch of the fire department and is composed of 265 emergency vehicles (one for each 41,500 people and 5.7 km^2), a helicopter and four special ambulances with trauma doctors and nurses. The number of occurrences (trauma care and clinical emergencies) per year surpasses 59,000 (161/day), with an average time of 13 minutes to reach the site.

Trauma care is administered from trauma and regional systems that integrate primary, secondary and tertiary care centers. Centers with secondary and tertiary services are formed mostly by public teaching hospitals. Hospital care to traumatized patients is usually carried out by a surgical team and not by groups of emergency medicine, as usual in other countries.

Brazilian Law requires autopsy of all cases of suspected or unnatural death. The Legal Medical Institute (IML) is a Department of the State Police and is responsible for all the city's forensic autopsies. The IML in São Paulo is composed of three morgues, divided according to regions of the city. In 2001, 6,200 autopsies were performed at its Headquarters[1].

This study aims to review a series of deaths due to trauma in a major metropolis in addition to identifying preventable causes of death.

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METHODS

A total of 500 not selected and consecutive cases of death related to trauma were prospectively studied between 2008 and 2009. All the corpses were autopsied in the IML Headquarters by the same coroner. The variables studied were: mechanism of trauma, etiology, place of death (at the scene or hospital), surgical intervention, medical error, injured organs and preventable death.

The cases were grouped according to the mechanism of trauma: penetrating trauma, blunt trauma, poisoning, drowning, burns and asphyxiation. Penetrating Trauma was ranked based on etiology of firearm or stab. Blunt Trauma was classified based on the etiologies related to transport accidents, fall and assault. The surgical procedure was defined as any surgical procedure, regardless of complexity, including vascular dissections and chest tubes.

Therapeutic errors or improperly diagnosed lesions were defined as medical errors.

Deaths were considered preventable when individuals who suffered treatable injuries (trauma in the absence of affection of large blood vessels, heart or spinal cord, serious brain damage, or asphyxiation), but were not hospitalized, with associated medical error; death due to infectious complications and death due to thromboembolic events (Figure 1).

RESULTS

There were 418 (83.6%) cases of males and 82 (16.4%) females. The average age was 39 ± 19.6, median 35, ranging from three to 91 years. The distribution of cases in accordance with the mechanisms of trauma, etiology, place of death, surgical intervention, injured organs and the number of preventable deaths is described in table 1. The average number of shots per victim of firearm injury was 4.24 (871 shots/205 cases). A total of 386 (77.2%) patients were hospitalized and 114 (22.8%) died on the scene.

Surgical interventions were conducted in 167 (43.3%) of the hospitalized individuals. There were 71 (14%) cases of preventable deaths (Table 2). Medical error has been identified in seven cases, all due to lack of proper diagnosis: five hemothoraxes and two epidural hematomas. Treatable injuries on victims who had not been hospitalized presented as one case of stabbing reaching the lung and three cases of firearms: 1) one projectile in the liver, 2) two projectiles, lesion in the small intestine) and (3) four projectiles injuring lung and small intestine.

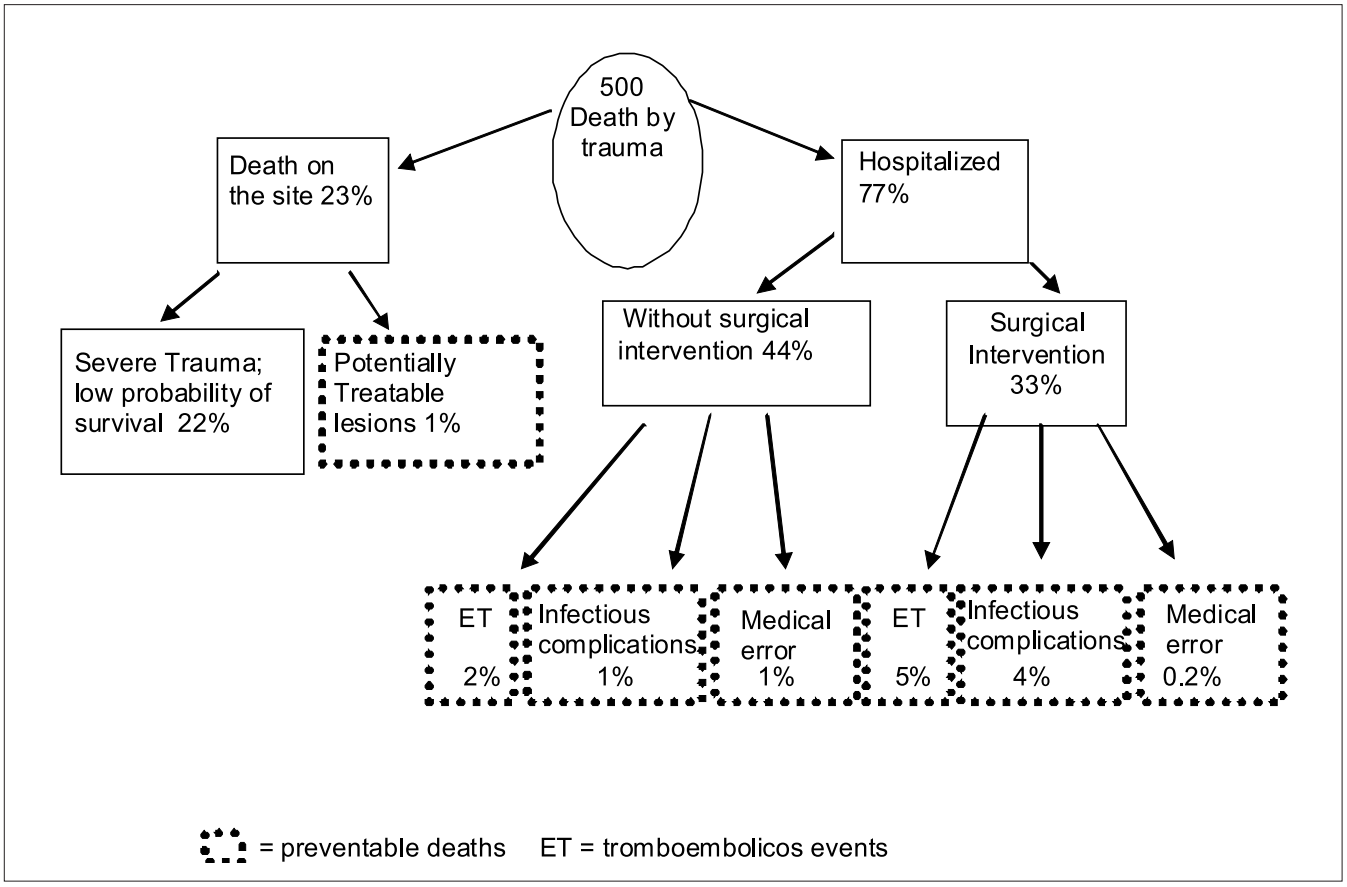

Figure 1- *Flowchart indicating prevention of trauma-related mortality.*

Table 1 - Distribution of cases according to the mechanism of trauma (n = 500).

Mechanism*	Cause*	Death on the scene**	Surgical procedure**	Injuried organs	Preventable*
Penetrating 217 (43.4)	Firearm 205 (41.0)	49(23.9)	47(22.9)	Brain - 103 Lung - 107 Members - 70 Heart - 60 Liver - 48 Intestines - 28 Stomach - 21 Spleen - 9	11 (2.2): 4 medical errors 3 infectious complications 3 treatable lesions 1 thromboembolism
	Weapon white 12 (2.4)	4(33.3)	5(41.6)	Lung - 5 Heart - 2 Liver - 2 Spleen - 1 Stomach - 1	2 (0.4): 1 treatable lesions 1 infectious complications
Blunt 199 (39.8)	Transport 112 (22.4)	16(14.2)	63(56.2)	Brain - 83 Members - 46 Liver - 40 Lung - 27 Spleen - 27 Heart - 9 Intestines - 5	17 (3.4): 12 thromboembolism 5 infectious complications
	Fall 76 (15.2)	7(9.2)	41(53.9)	Brain - 53 Members - 19 Liver - 5 Lung - 4 Spleen - 3	25 (5.0): 15 Thromboembolism 7 infectious complications 3 medical errors
	Assault 11 (2.2)	2(18.1)	2(18.1)	Brain - 9 Spleen - 2 Liver - 1	——
Other 84 (16.8)	Burn 11 (2.2)	1(9.0)	5(45.4)	——	8 (1.6): 5 thromboembolism 3 infectious complications
	Intoxication 15 (3.0%)	1(6.6%)	0	——	2 (0.4): 2 infectious complications
	Asphyxiation 8 (1.6)	6(75.0)	1(12.5)	——	1 (0.2): 1 infectious complications
	Drowning 4 (0.8)	2(50.0)	0	——	——
	Other 46 (9.2)				5 (1.0): 2 thromboembolism 3 infectious complications

Values represented in (%)
**% compared to the whole population (n = 500)*
***% compared the cause*

DISCUSSION

Autopsy as a tool for evaluation of trauma

Studies of trauma cases through autopsy represent a valuable tool for a noble review, quality control and, finally, a better clinical management of these patients[2,3]. Woks have shown that a significant number of lesions not initially localized is detected only at autopsy, with data ranging from 11 to 22%[4,5]. Not only the diagnosed lesions, but also the severity of trauma, evaluated by the *Injury Severity Scale* (ISS), are different when the autopsy data are compared with clinical findings[3,6].

Despite the importance of autopsy for evaluation of trauma, the international literature shows that no more than 50% of patients deceased due to trauma are autopsied[5,7]. In Brazil, autopsy is mandatory in all cases of unnatural death.

Table 2 - Preventable causes of death.

Causes	n	% of total (n=500)
Thromboembolism	35	7.0
Infectious complications	25	5.0
Medical malpractice	7	1.4
Treatable lesions in patients not hospitalized	4	0.8
Total	**71**	**14.2**

Our results demonstrate the importance of necroscopic examinations; 71 out of 500 death cases were potentially preventable.

Epidemiology of trauma in São Paulo

We observed that trauma has affected especially young males, corroborating international series.

A balance between penetrating (43.4%) and blunt traumas (39.8%) was observed, with injuries by firearms (41%) and transport accidents (22%) as the main mechanisms of trauma. Different distributions of mechanisms of trauma were found in different cities around the world on the basis of local social problems. For example, in a Norwegian study[8], which assessed 260 autopsies of trauma and showed an incidence of 87% of blunt trauma, 31% due to transport means and 25% falls; only 13% of cases accounted for penetrating trauma. In Auckland, New Zealand, the leading cause of traumatic death was hanging (36%), followed by accidents with means of transportation (32%) and falls (10%)[9].

In Brazil, Fraga *et al.*[10] analyzed nearly 2000 autopsies by trauma in the city of Campinas. The authors show an even younger average age than in our case (28 years), also with preponderance of complex injuries, thoracic trauma being present in half the cases.

The complexity of the lesions found in our study is notable. The majority of cases presented with severe head trauma and multiple organs lesions. A quarter of cases died on the scene and more than half of victims who had hospital assistance were not operated. Most cases of trauma are treated with surgery due to the following facts: 1) surgical vascular access is often necessary, 2) thoracic trauma is treated with pleural drainage or thoracotomy in most times and 3) abdominal trauma is, in most cases, handled with laparotomy. We believe that patients in hospitals were not operated due to the daunting prospect of survival upon arrival in most cases.

Prevention of mortality

As stated earlier, death by trauma in São Paulo city is represented by complex and serious events. The percentage of potentially avoidable deaths is apparently higher when compared with other studies[2,11]. However, a direct comparison cannot be made since most of the studies are based solely on inpatients[2]. Furthermore, the definition of preventable death is variable, adapted to local realities and available data. Bok Yoo *et al.*[12], through a large restrospective study with more than 5000 autopsies, revealed that fatal pulmonary thromboembolism is associated with the trauma.

The deficiency of our study is the lack of clinical information due to the limitations of the Medical Legal Institute. In addition, a comparison with non-lethal trauma has not been made.

This study shows that death by trauma in São Paulo is associated with serious and complex injuries. The most preventable causes of death were thromboembolism and infectious complications; however, the number of deaths preventable by medical treatment is small. These facts suggest that prevention of deaths must be achieved by controlling violence.

R E S U M O

***Objetivo**: Este estudo tem o objetivo revisar uma série de mortes por trauma em uma grande metrópole. A intenção é identificar as causas evitáveis de morte. **Métodos:** Foram estudados prospectivamente 500 casos não selecionados e consecutivos de morte associada ao trauma. As variáveis do estudo foram as seguintes: mecanismo do trauma, etiologia, local da morte, a intervenção cirúrgica, imperícia médica, órgãos lesados e prevenção da mortalidade. Os casos foram agrupados, segundo o mecanismo de trauma, em: trauma penetrante, trauma contuso, intoxicação, afogamento, queimadura e asfixia. **Resultados:** Foram abordados 418 (83,6%) casos do sexo masculino e 82 (16,4%) do sexo feminino (média de idade 39 ± 19,6 anos, variando de três a 91 anos). O trauma penetrante correspondeu a 217 (43%) casos; já o trauma contuso representou 40% dos casos. O mecanismo de trauma mais comum de morte entre o trauma penetrante foi lesão por arma de fogo, representando 41% do total de casos. Dentro do conjunto dos traumas contusos, o mecanismo mais comum foi o de acidentes de transporte, o que representou 22% do total de óbitos. Aconteceram 71 (14%) casos de mortes evitáveis: tromboembolismo em 35 (7%); complicações infecciosas em 25 (5%), imperícia médica em sete (1%) e lesões tratáveis em pacientes não hospitalizados cinco (1%). **Conclusão:** Este estudo mostra que a morte traumática, na cidade de São Paulo, está associada à lesões graves e complexas. Prevenção da morte está relacionada ao controle da violência.*

***Descritores:** Ferimentos e lesões. Mortalidade. Autópsia. Prevenção e controle.*

REFERENCES

1. Herbella FA, Fernandes PH, Delmonte C, Del Grande JC. Forensic autopsy costs in the city of São Paulo. São Paulo Med J 2003; 121(3):139-42.
2. Gruen RL, Jurkovich GJ, McIntyre LK, Foy HM, Maier RV. Patterns of errors contributing to trauma mortality: lessons learned from 2,594 deaths. Ann Surg 2006; 244(3):371-80.
3. Martin BT, Fallon WF Jr, Palmieri PA, Tomas ER, Breedlove L. Autopsy data in the peer review process improves outcomes analysis. J Trauma 2007; 62(1):69-73.
4. Sharma BR, Gupta M, Bangar S, Singh VP. Forensic considerations of missed diagnoses in trauma deaths. J Forensic Leg Med 2007; 14(4):195-202.
5. Sharma BR, Gupta M, Harish D, Singh VP. Missed diagnoses in trauma patients vis-à-vis significance of autopsy. Injury 2005; 36(8):976-83.
6. Marx WH, Simon HM, Jumbelic M, Sposato E, Nieman G. Severity of injury is underestimated in the absence of autopsy verification. J Trauma 2004; 57(1):46-9.
7. Mushtaq F, Ritchie D. Do we know what people die of in the emergency department ? Emerg Med J 2005; 22(10):718-21.
8. Søreide K, Krüger AJ, Várdal AL, Ellingsen CL, Søreide E, Lossius HM. Epidemiology and contemporary patterns of trauma deaths: changing place, similar pace, older face. World J Surg 2007; 31(11):2092-103.
9. Pang JM, Civil I, Ng A, Adams D, Koelmeyer T. Is the trimodal pattern of death after trauma a dated concept in the 21st century ? Trauma deaths in Auckland 2004. Injury 2008; 39(1):102-6.
10. Fraga GP, Heinzl LR, Longhi BS, Silva DC; Fernandes Neto FA, Mantovani M. Trauma cardíaco: estudo de necropsias. Rev Col Bras Cir 2004; 31(6):386-90.
11. Davis JW, Hoyt DB, McArdle MS, Mackersie RC, Eastman AB, Virgilio RW, Cooper G, Hammill F, Lynch FP. An analysis of errors causing morbidity and mortality in a trauma system: a guide for quality improvement. J Trauma 1992; 32(5):660-5; discussion 665-6.
12. Bok Yoo HH, Mendes FG, Alem CER, Fabro AT, Corrente JE, Queluz TT. Achados clinicopatológicos na tromboembolia pulmonar: estudo de 24 anos de autópsias. J Bras Pneumol 2004; 30(5):426-32 .

Received on: 19/02/2010
Accepted for publication: 22/04/2010
Conflict of interest: none
Funding source: none

How to cite this article:
Wilson JL, Herbella FAM, Takassi GF, Moreno DG, Tineli AC. Fatal trauma injuries in a brazilian grand metropolis: a study of autopsies. Rev Col Bras Cir. [periódico na Internet] 2011; 38(2). Disponível em URL: http://www.scielo.br/rcbc

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