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TRAUMA IN THE VERTEBRAL SPINE: DETERMINING FACTORS IN THE TIME FOR THE SURGERY

TRAUMATISMO NA COLUNA VERTEBRAL: FATORES DETERMINANTES NO TEMPO PARA REALIZAÇÃO DA CIRURGIA

LESIONES EN LA COLUMNA VERTEBRAL: FACTORES DETERMINANTES EN EL TIEMPO PARA LA CIRUGÍA

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ABSTRACT

Objective: Quantify the time elapsed between the arrival of the patient with surgical trauma in the spine at the emergency room and the completion of the surgical procedure, analyzing the factors that may have influenced this process. Methods: Retrospective study that included individuals of both sexes aged between 18 and 100 years who arrived at a tertiary trauma center with surgical fractures in the spine. Patients treated between March 2018 and March 2022 were included in the sample. All data to compose the study sample were collected from secondary data sources (medical records). Results: Medical records of 259 patients with spinal injuries were evaluated. Approximately one-third of the patients were operated on between 13h and 24h, and the other third over 72h. Only 6.6% were operated within 12 hours. The mean time to perform the surgical process was 84.3 ± 144.6 hours. Surgical intervention for most patients (59.1%) occurred within the first 48 hours. Patients with systemic arterial hypertension and patients with at least one comorbidity had a statistically longer mean waiting time for the surgical procedure than patients who did not have these characteristics. Conclusion: Most surgical interventions occurred in the first 48 hours, which is considered early. In addition, some factors, such as the existence of comorbidities, are directly associated with the time it takes to perform the surgical procedure. ***Level of Evidence II; Retrospective Prognostic.***

Keywords: Spinal Injuries; Spine; Surgical Procedures, Operative; Time.

RESUMO

Objetivo: Quantificar o tempo decorrido entre a chegada do paciente com trauma cirúrgico na coluna vertebral ao pronto-socorro e a realização da intervenção cirúrgica, analisando os fatores que podem ter influenciado neste tempo. Métodos: Estudo retrospectivo que incluiu indivíduos de ambos os sexos com faixa etária de 18 a 100 anos que deram entrada em um pronto-socorro terciário referência em trauma, apresentando fraturas cirúrgicas na coluna vertebral. Foram incluídos na amostra os pacientes atendidos entre março de 2018 até março de 2022. Todos os dados para compor a amostra do estudo foram coletados a partir de fontes secundárias de dados (prontuário médico). Resultados: Foram avaliados prontuários de 259 pacientes com lesões na coluna. Aproximadamente um terço dos pacientes realizaram cirurgia entre 13hs e 24hs e outro terço acima de 72hs. Somente 6,6% foram operados em até de 12hs. A média de tempo para realização da intervenção cirúrgica foi de 84,3 ± 144,6 horas sendo que para a maioria dos pacientes (59,1%) a intervenção ocorreu nas primeiras 48 horas. Os pacientes com hipertensão arterial sistêmica e pacientes com pelo menos uma comorbidade tiveram um tempo médio de espera até a intervenção cirúrgica estatisticamente maior do que os pacientes que não possuíam essas características. Conclusão: Conclui-se que a maioria das intervenções cirúrgicas ocorreram nas primeiras 48h, dentro do que se considera precoce. Além disso, alguns fatores como existência de comorbidades estão diretamente associados ao tempo que se leva para a realização do procedimento cirúrgico. ***Nível de Evidência II; Prognóstico Retrospectivo.***

Descritores: *Traumatismos Da Coluna Vertebral; Coluna Vertebral; Procedimento Cirúrgico; Tempo.*

RESUMEN

Objetivo: Cuantificar el tiempo transcurrido entre la llegada del paciente con traumatismo quirúrgico en la columna a urgencias y la del procedimiento quirúrgico, analizando los factores que pueden haber influido en finalización este proceso. Métodos: Estudio retrospectivo que incluyó individuos de ambos sexos con edades entre 18 y 100 años que llegaron a un centro traumatológico de tercer nivel con fracturas quirúrgicas en la columna vertebral. Se incluyeron en la muestra los pacientes atendidos entre marzo de 2018 y marzo de 2022. Todos los datos para componer la muestra del estudio fueron recolectados de fuentes de datos secundarias (historias clínicas). Resultados: Se evaluaron las historias clínicas de 259 pacientes con lesiones medulares. Aproximadamente un tercio de los pacientes fueron operados entre las 13 y las 24 horas y el otro tercio sobre las 72 horas. Solo el 6,6% fueron operados dentro de las 12 horas. El tiempo medio para realizar

Study conducted by the Hospital do Trabalhador, Av. Rep. Argentina, 4406 - Novo Mundo, Curitiba – PR, Brazil.
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el proceso quirúrgico fue de 84,3 ± 144,6 horas. La intervención quirúrgica para la mayoría de los pacientes (59,1%) ocurrió dentro de las primeras 48 horas. Los pacientes con hipertensión arterial sistémica y pacientes con al menos una comorbilidad tuvieron un tiempo medio de espera para el procedimiento quirúrgico estadísticamente mayor que los pacientes que no presentaban estas características. Conclusión: Se concluye que la mayoría de las intervenciones quirúrgicas ocurrieron en las primeras 48 horas, dentro de lo que se considera precoz. Además, algunos factores como la existencia de comorbilidades están directamente asociados al tiempo de realización del procedimiento quirúrgico. ***Nivel de Evidencia II; pronóstico retrospectivo.***

Descriptores: *Traumatismos Vertebrales; Columna Vertebral; Procedimientos Quirúrgicos Operativos; Tiempo.*

INTRODUCTION

The spinal column, like all other parts of the body, is subject to trauma. As spinal traumas are more common in patients between 15 and 35 years of age, this situation is detrimental to society as a whole since this age group is usually in full economic activity and needs to take time off work.[1]

The causes of spinal trauma are diverse and can be related to traffic accidents, falls from a height, injuries due to violence (physical aggression), sports trauma, firearm injuries, and diving in shallow waters, among others.[2]

Worldwide, the annual incidence of spinal trauma is between 15 and 40 cases per million inhabitants. In Brazil, this data is still obscure since this type of trauma is not subject to notification, so the data is scarce and uncertain and comes from the few epidemiological studies that exist.[3,4]

The time between the occurrence of an injury and the surgical procedure has long been the subject of debate. In the case of patients with spinal cord injuries, it is recommended that the surgical procedure be carried out within 24 hours so that there is a greater neurological benefit.[5] In addition, faster interventions prevent complications since they entail a lower risk of acquiring pneumonia and less time on mechanical ventilation, among others.[6,7] It has also been reported that patients who wait two weeks for surgery are more likely to develop arachnoiditis and spinal abscess.[8]

Delays in referring patients with spinal trauma for surgery can result in neurological damage, chronic pain, and deformities. Thus, early interventions can be beneficial and have neuroprotective effects.[5,9]

Therefore, knowing how long patients take between arriving at the emergency room and undergoing surgical intervention and understanding the factors responsible for this time is fundamental to correcting flaws and improving the care provided in trauma centers.

Given the above, this study aims to quantify the time elapsed between the arrival of a patient with surgical trauma to the spine in the emergency room and the surgical intervention, analyzing the factors that may have influenced this time.

MATERIAL AND METHOD

A retrospective analysis of medical records and examinations was carried out in a tertiary emergency department that is a reference in the care of polytraumatized patients at the Hospital do Trabalhador in Curitiba, Paraná. The ethics and research committee approved this study under number CAAE 52990421.7.0000.5225. The signing of the Informed Consent Form was waived.

The study included patients of both sexes, aged between 18 and 100, diagnosed with fractures, dislocations, and fracture-dislocations of the spine and treated surgically. The sample consisted of patients seen between March 2018 and March 2022. The exclusion criteria were conservative lesion treatment and medical records with incomplete data.

To establish the diagnosis, all patients admitted to the emergency department with a suspected spinal fracture were carefully assessed, and the anteroposterior and lateral radiographs of the spine were taken. If fractures were suspected, the patients underwent CT scans with SCOUT to verify the existence and extent of the injury. The following data was assessed by reviewing the medical records: age, comorbidities, trauma mechanism, type of spinal injury (fractures, dislocations, and fracture-dislocations), vertebral level, time between arrival at the emergency room and surgery, and neurological status using the Frankel scale on arrival at the emergency room.

To determine the time from when the patient entered the emergency room until the surgical intervention was performed, the first time the patient was seen was collected from the medical records, the time the nursing team triaged the patient, and when the patient entered the operating room. The waiting time was divided into groups: <12 hours, 12 to 24 hours, >24 to 36 hours, >36 to 48 hours, >48 to 72 hours, and more than 72 hours.

Data was analyzed using JMP® Pro version 13 - SAS 1989-2019 software (Institute Inc., Cary, NC, USA). Numerical data was analyzed using tables and graphs. Descriptive statistics were used to describe the general data. The Wilcoxon non-parametric test was used to compare the times until surgery between the groups. A 95% confidence level was set for all analyses.

RESULTS

The present study evaluated 600 records of patients diagnosed with fractures, fracture-dislocations, and spine dislocations treated by surgery at the Hospital do Trabalhador in Curitiba-PR. Of these, 259 met the inclusion criteria. The patients' ages ranged from 18 to 92. (Table 1)

Less than half of the patients had comorbidities (29.6%). Among these, systemic arterial hypertension was the most common (19.5%), followed by diabetes mellitus (7.8%), other diseases (4.3%), rheumatic disease (2.3%), cardiovascular disease (3.5%), chronic obstructive pulmonary disease (1.9%), dyslipidemia (1.9%) and chronic kidney disease (0.8%). Assessing the patients' habits, 4.7% reported being smokers and 1.9% alcoholics. (Table 2)

The three main trauma mechanisms found were falls from another level (38.4%), followed by motorcycle accidents (20.2%) and car accidents (12.4%). Concerning diagnosis, 93.4% had a fracture, 1.9% a dislocation, and 4.6% had a fracture and dislocation. (Table 3)

The highest incidences of injury were in the lumbar (35.1%), thoracic (34.0%) and cervical spine (23.9%). (Table 3)

Regarding the existence of injuries associated with the spine, 64.1% of the patients had no other injuries, and when they did, the most prevalent were appendicular injuries (10.4%) and chest injuries (9.2%). (Table 3)

Table 4 shows the neurological status of the patients on admission to the emergency room. 63.9% of the patients were classified as Frankel E, while 23.1% were classified as Frankel A.

Figure 1 shows the time between the patient's arrival at the emergency room and the surgical intervention. Approximately one-third of the patients underwent surgery between 12 and 24 hours (33.2%), and another third over 72 hours (32.4%).

Seventeen (6.6%) patients were operated on within 12 hours, 103 (39.7%) patients within 24 hours, 153 (59%) patients within 48 hours, and 175 (67%.6) patients before 72 hours. Therefore, these data show that more than half of the patients underwent surgery before 72 hours, a time considered early by some studies. (Figure 1)

Table 1. Distribution of the age group of the patients included in the study.

Features	Group	N (%)
Age group	18 to 29 years old	79 (30.6%)
	30 to 39 years old	42 (16.3%)
	40 to 49 years old	46 (17.8%)
	50 to 59 years old	46 (17.8%)
	60 and over	45 (17.4%)

Table 2. Distribution of comorbidities present in the patients.

Features	Group	N (%)
SAH	Yes	50 (19.5%)
	No	207 (80.5%)
DM	Yes	20 (7.8%)
	No	237 (92.2%)
COPD	Yes	5 (1.9%)
	No	252 (98.1%)
CKD	Yes	2 (0.8%)
	No	255 (99.2%)
Dyslipidemia	Yes	5 (1.9%)
	No	252 (98.1%)
Alcoholism	Yes	5 (1.9%)
	No	252 (98.1%)
Smoking	Yes	12 (4.7%)
	No	245 (95.3%)
Cardiovascular disease	Yes	9 (3.5%)
	No	248 (96.5%)
Rheumatic disease	Yes	6 (2.3%)
	No	251 (97.7%)
Other	Yes	11 (4.3%)
	No	246 (95.7%)
Presence of comorbidity	Yes	76 (29.6%)
	No	181 (70.4%)

SAH - Systemic Arterial Hypertension; DM - Diabetes Mellitus; COPD - Chronic Obstructive Pulmonary Disease; CKD - Chronic Kidney Disease.

Table 3. Distribution of characteristics related to patient diagnosis.

Features	Group	N (%)
Mechanism	Motorsport	32 (12.4%)
	Motorcycling	52 (20.2%)
	FAI	20 (7.8%)
	Fall from the same level	20 (7.8%)
	Fall from another level	99 (38.4%)
	Shallow water diving	4 (1.6%)
	Others	31 (12.0%)
Diagnosis	FX	242 (93.4%)
	LX	5 (1.9%)
	FX LX	12 (4.6%)
Level of injury	Cervical	62 (23.9%)
	Thoracic	88 (34.0%)
	Lumbar	91 (35.1%)
	Sacral	1 (0.4%)
	Cervicothoracic	3 (1.2%)
	Thoracolumbar	6 (2.3%)
	Lumbosacral	7 (2.7%)
	Multiple	1 (0.4%)
Associated injuries	Cardiovascular Injury	1 (0.4%)
	Head injury	6 (2.3%)
	Visceral injury	8 (3.1%)
	Injury to the locomotor system	27 (10.4%)
	Thoracic Injury	24 (9.3%)
	Multiple Minor Injuries	13 (5.0%)
	Multiple Serious Injuries	12 (4.6%)
	Other	2 (0.8%)
	None	166 (64.1%)

FAI - Firearm Injury; FX - fracture; LX - dislocation; FX LX - fracture and dislocation.

The average time taken to perform the surgical procedure was 84.3±144.6 hours. The fastest patient was referred for the procedure in 5 hours, while the patient who waited the longest for surgery waited 1440 hours, or two months (Table 5). The patient who underwent surgery within 5 hours arrived at the emergency room hemodynamically stable and with a progressive neurological deficit. The patient, who took 1,440 hours to undergo the surgical procedure, arrived at the emergency room hemodynamically unstable with poor general condition and multiple injuries to other organs and, therefore, remained in the intensive care unit for two months for more specialized care to reduce the risks associated with safe spinal surgery.

As shown in the histogram graph in Figure 2, surgical intervention for the majority of patients took place within the first 48 hours.

The analysis of the association between the average waiting time for surgery and patient characteristics (Table 6) showed that patients with at least one comorbidity had a significantly longer average waiting time for surgery than patients who did not have these characteristics. Within the comorbidities, hypertension was the most significant for the longest waiting time (0.0078 and p=0.0277, respectively).

The longest times until surgery were found for the group aged 60 or over, patients with dislocations, patients with lumbar and thoracolumbar injuries, and patients with multiple injuries. Despite the longer

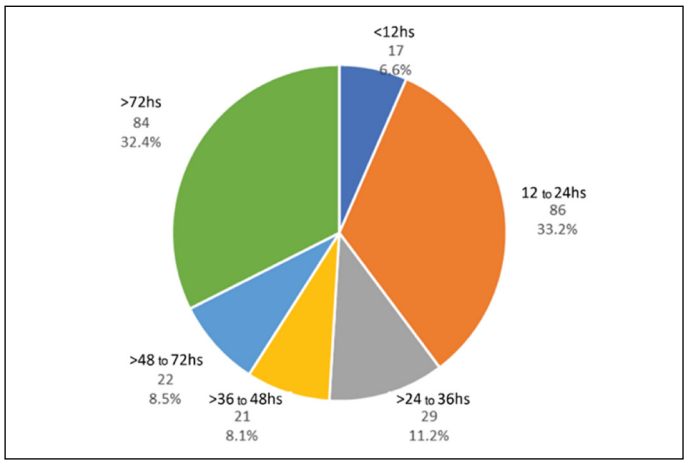

Figure 1. Distribution of patients about the time until surgical intervention.

Table 4. Distribution of patients' neurological status on admission to the emergency room.

Features	Group	N (%)
Frankel	Frankel A	59 (23.1%)
	Frankel B	8 (3.1%)
	Frankel C	11 (4.3%)
	Frankel D	14 (5.5%)
	Frankel E	163 (63.9%)

Table 5. Summary measures for the times up to surgery.

Measures	Values
Average	84.3 hours
Standard Deviation	144.6 hours
Minimum	5.0 hours
Q1	20.0 hours
Median	35.0 hours
Q3	96.0 hours
Maximum	1440.0 hours

Figure 2. Histogram and boxplot for time until surgery.

Table 6. Association analysis between mean time to surgery and patient characteristics.

Features	Group	Mean ± SD (hours)	Median (Q1-Q3)	p-value
Age group	17 to 29 years old	84.3 ± 128.9	27.0 (18.0–96.0)	0.2901
	30 to 39 years old	74.0 ± 113.1	29.0 (18.0–72.0)	
	40 to 49 years old	69.0 ± 134.1	29.5 (18.8–95.3)	
	50 to 59 years old	64.2 ± 61.6	37.5 (23.7–96.0)	
	60 and over	118.7 ± 225.8	72.0 (21.5–108.0)	
Mechanism	Motorsport	136.4 ± 290.1	33.0 (19.0–114.0)	0.2969
	Motorcycling	104.1 ± 142.1	48.0 (20.0–120.0)	
	FAI	139.5 ± 199.9	57.5 (16.5–144.0)	
	Same level drop	61.2 ± 51.4	44.0 (19.2–96.0)	
	Fall to another level	61.4 ± 73.4	30.0 (20.0–96.0)	
	Shallow water diving	64.5 ± 29.1	69.0 (35.3–89.3)	
	Others	54.7 ± 71.6	24.0 (16.0–72.0)	
Diagnosis	FX	84.6 ± 147.3	36.0 (20.0–96.0)	0.2458
	LX	127.0 ± 132.7	96.0 (17.5–252.0)	
	FX LX	61.1 ± 84.9	20.0 (13.2–72.0)	
Frankel	Frankel A	74.5 ± 113.1	24.0 (18.0–94.0)	0.6402
	Frankel B	52.5 ± 36.8	60.0 (13.8–90.0)	
	Frankel C	103.1 ± 206.8	32.0 (21.0–96.0)	
	Frankel D	54.3 ± 50.5	25.5 (18.0–102.0)	
	Frankel E	86.4 ± 155.4	40.0 (20.0–96.0)	
Frankel	Frankel A	74.5 ± 113.1	24.0 (18.0–94.0)	0.3140
	Frankel B-C-D	70.1 ± 123.5	32.0 (19.0–96.0)	
	Frankel E	86.4 ± 155.4	40.0 (20.0–96.0)	
Region	Cervical	68.4 ± 58.2	49.0 (21.0–120.0)	0.2465
	Thoracic	71.7 ± 107.4	29.0 (19.0–96.0)	
	Lumbar	103.9 ± 202.6	40.0 (20.0–96.0)	
	Sacral	480.0 ± −	480.0 (480.0–480.0)	
	Cervicothoracic	23.0 ± 15.4	19.0 (10.0–40.0)	
	Thoracolumbar	103.0 ± 186.1	21.5 (14.7–174.0)	
	Lumbosacral	80.1 ± 118.8	24.0 (16.0–120.0)	
	Multiple	96.0 ± −	96.0 (96.0–96.0)	
Associated injuries	Cardiovascular	16.0 ± −	16.0 (16.0–16.0)	0.5355
	Head	111.2 ± 108.4	77.0 (17.7–216.0)	
	Visceral	71.9 ± 108.2	31.5 (21.0–64.5)	
	Locomotor system	50.0 ± 42.8	36.0 (19.0–96.0)	
	Thoracic	71.7 ± 105.1	28.5 (18.5–96.0)	
	Multiple Minor Injuries	132.8 ± 240.3	50.0 (21.0–120.0)	
	Multiple Serious Injuries	198.3 ± 222.3	84.0 (20.3–456.0)	
	Other	21.5 ± 4.9	21.5 (18.0–25.0)	
	None	80.5 ± 145.1	35.0 (19.0–96.0)	
SAH	Yes	106.8 ± 211.1	72.0 (24.0–96.0)	0.0277
	No	79.5 ± 124.1	32.0 (19.0–96.0)	
DM	Yes	142.1 ± 313.9	63.0 (25.2–96.0)	0.2440
	No	80.0 ± 120.8	34.0 (19.5–96.0)	
COPD	Yes	56.4 ± 38.0	48.0 (21.0–96.0)	0.8695
	No	85.4 ± 146.4	35.5 (20.0–96.0)	
CKD	Yes	81.5 ± 88.4	81.5 (19.0–144.0)	0.8037
	No	84.8 ± 145.5	36.0 (20.0–96.0)	
Dyslipidemia	Yes	44.6 ± 26.4	40.0 (19.5–72.0)	0.7819
	No	85.6 ± 146.4	35.5 (20.0–96.0)	
Alcoholism	Yes	64.6 ± 59.4	40.0 (28.5–113.0)	0.6243
	No	85.2 ± 146.3	35.0 (19.2–96.0)	
Smoking	Yes	82.8 ± 58.3	70.0 (35.5–120.0)	0.1009
	No	84.9 ± 148.1	35.0 (19.0–96.0)	
Cardiovascular	Yes	116.0 ± 160.2	72.0 (24.5–120.0)	0.2589
	No	83.7 ± 144.7	35.0 (19.2–96.0)	
Rheumatic	Yes	38.2 ± 26.3	23.5 (19.0–72.0)	0.4230
	No	85.9 ± 146.6	36.0 (20.0–96.0)	
Other	Yes	38.8 ± 37.2	25.0 (17.0–41.0)	0.2563
	No	86.8 ± 147.8	37.5 (20.0–96.0)	
Presence of Comorbidity	Yes	103.7 ± 183.3	51.0 (24.0–114.0)	0.0078
	No	76.9 ± 125.4	29.0 (19.0–96.0)	

Wilcoxon non-parametric test with significance level $p<0.05$. SAH: Systemic Arterial Hypertension; DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary Disease; CKD: Chronic Kidney Disease; FAI: Firearm wound; FX: fracture; LX: dislocation; FX LX: fracture and dislocation.

times, no statistically significant difference was found for any cases (p=0.2901, 0.2458, 0.2465, and 0.5355, respectively). In addition, longer waiting times were found for patients with injuries from car accidents, motorcycle accidents, and firearm injuries. Again, there were no statistically significant differences (p=0.2969). (Table 6)

Regarding surgical waiting time and the patient's neurological status, there was no significant difference between surgical waiting time and the five types of neurological impairment (p= 0.6402). (Table 6)

When categorizing neurological status into complete neurological damage (Frankel A), incomplete damage (Frankel B, C, and D), and no damage (Frankel E), no statistically significant difference was found in the waiting time for surgical intervention (p= 0.3140). (Table 6)

DISCUSSION

The waiting time for surgery is classified in most studies as early up to 72 hours and late after 72 hours.[10] Some factors that can prevent surgery from taking place early, such as the presence of associated lesions, comorbidities, and conflicting schedules between surgeons and operating rooms.[10] In fact, our study confirmed that patients with comorbidities had a significantly longer average waiting time for surgery and were operated on later, with an average of over 72 hours.

Vaccaro et al.[11] found in a prospective, randomized study in which 20 of 62 patients were followed up and "early" surgery was defined as occurring within 72 hours of the spinal cord injury that associated injuries were a determining delay factor for the timing of the intervention. Although not statistically significant, our study showed a tendency for patients with multiple lesions to have a longer average intervention time than patients without associated lesions.

One study showed that patients with fracture dislocations of the spine required a longer waiting time for the surgical procedure because they were more serious and more complex to assess.[12] In our study, patients with associated dislocations tended to have a longer waiting time for surgical intervention. This increase in waiting times for the procedure is because the associated injuries are more serious and complex.

Age is also a variant related to a longer time to surgery, with patients over 60 often suffering from multiple comorbidities.[13] This study also found a trend towards longer mean times to surgery in the group aged 60 or over and statistically longer in patients with at least one comorbidity.

Among the comorbidities present in the study, patients with systemic arterial hypertension (SAH) had the longest average waiting time for surgical statistically higher than patients who did not have this characteristic. The reason for this increase may be related to the fact that SAH is a cardiovascular risk factor and, consequently, a preoperative contraindication for anesthesiologists.[14] Therefore, surgical intervention only begins when the patient is hemodynamically stable, i.e., with normotension. In addition, for the team of spinal surgeons, SAH increases intrasurgical bleeding, making intervention more difficult.

Fehlings and Perrin,[5] analyzed 66 articles published in the last ten years, emphasizing the effect of decompression on neurological outcome after spinal cord injury. The authors showed that several prospective studies suggest that early decompression after spinal cord injury (<72 hours) can be performed safely and can improve neurological outcomes. Given this, it can be said that the spinal surgery team at the hospital where our study was carried outperforms the surgical procedures within the time considered safe since most surgeries took place within the first 48 hours.

The results of this study should be evaluated with caution, as the number of patients evaluated is limited. However, this study has shown the importance of identifying the time it takes patients to arrive at the emergency room and undergo surgical intervention and understanding the factors responsible for this time. Knowing this information is fundamental to correcting flaws and improving the care provided in trauma centers.

CONCLUSION

This study made it possible to quantify the average time elapsed between the arrival of a patient with surgical trauma to the spine at the emergency room and the completion of the surgical procedure, which was 84.3 hours.

In addition, the factor that statistically increased the waiting time for the surgical procedure was the presence of comorbidities, especially hypertension. Finally, there was a trend towards longer waiting times for patients aged over 60 with fractures with associated injuries and dislocations.

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