

Profile of pediatric patients from a trauma center in Brazil: a cross-sectional study

Perfil de pacientes pediátricos de um centro de trauma no Brasil: um estudo transversal

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ABSTRACT

Purpose: To describe the epidemiology of pediatric patients admitted to a trauma center in Minas Gerais, Brazil, as well as to characterize the care received since; characterize the data from hospital admission to the propaedeutics. **Methods:** This is a retrospective study whose data collection took place between October 2017 and March 2018 at Hospital João XXIII. Data were collected in all children under 14 years of age who were classified as victims of trauma of “very urgent” or “emergency” according to the Manchester protocol. Descriptive analysis was performed, including the following variables: age, gender, trauma mechanism, medical specialty of the first assessment provider, need for surgical procedures, propaedeutics and death. **Results:** The mean age of patients was 6.9 years. The main trauma mechanism identified was mechanical fall injury (104; 37.9%). Head trauma was the most frequent type of trauma observed, affecting 174 (65.4% of patients). In total, 44 (16.1%) children were operated. Five children (1.8%) died during the period of this epidemiological assessment. **Conclusion:** The most frequent pediatric trauma mechanism was mechanical fall, the most common injury was traumatic brain injury, male children were more affected than females. And the physician who performed the first assessment most frequently was general surgeons. The focused evaluation with ultrasonography in trauma proved to be a safe exam for the screening of traumatic injuries. This study revealed important information to inform future updates on pediatric trauma primary assessment protocols.

Keywords: Pediatric Injuries; Trauma; Epidemiology.

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RESUMO

Objetivos: Descrever a epidemiologia dos pacientes pediátricos internados em um centro de trauma em Minas Gerais, Brasil; caracterizar os dados desde admissão hospitalar até a propedêutica. **Métodos:** Trata-se de estudo retrospectivo cuja coleta de dados aconteceu entre outubro de 2017 e março de 2018 no Hospital João XXIII. Foram incluídas crianças menores de 14 anos que foram classificadas como vítimas de trauma de “muito urgência” ou “emergência” pelo protocolo de Manchester. Foi realizada análise descritiva, que incluiu as seguintes variáveis: idade, sexo, mecanismo de trauma, especialidade médica do provedor de primeira avaliação, necessidade de procedimentos cirúrgicos, propedêutica e óbito. **Resultados:** A média de idade os pacientes foi 6,9 anos. O principal mecanismo de trauma identificado foi a lesão por queda mecânica (104; 37,9%). O traumatismo cranioencefálico foi o tipo de trauma mais frequente observado, acometendo 174 (65,4% dos pacientes). No total, 44 (16,1%) crianças foram operadas. Cinco crianças (1,8%) morreram durante o período desta avaliação epidemiológica. **Conclusão:** O mecanismo de trauma pediátrico mais frequente foi a queda mecânica, a lesão mais comum foi o traumatismo cranioencefálico, as crianças do sexo masculino foram mais afetadas do que as do sexo feminino. A avaliação focada com ultrassonografia no trauma demonstrou ser um exame seguro para triagem de lesão traumática. Este estudo revelou informações importantes para futuras atualizações em protocolos de trauma pediátrico.

Palavras-chave: Lesões Pediátricas; Trauma; Epidemiologia.

INTRODUCTION

Trauma is considered the leading cause of death in the first four decades of life¹. Globally, trauma is responsible for 950,000 deaths annually among patients under 18 years². Approximately 95% of trauma deaths in this population occur in developing countries. In Brazil, 375 children are hospitalized daily due to traumatic injuries^{2,3}. In Minas Gerais alone, pediatric trauma mortality rates are higher than those in Argentina and Chile together^{1,3-5}.

According to the few previously published Brazilian epidemiological studies⁶⁻⁸, the most common trauma mechanisms are: fall injury; accidents with motor vehicles/pedestrians, drowning, burns, sports and violence⁶. We did not find any Brazilian study that assessed the quality of care for pediatric trauma in a trauma center or that proposed interventions to improve it, reinforcing society's disregard for an important pediatric health problem. These studies are out of date and mainly focus on a single organ system in the body - for example, traumatic brain injury⁶⁻¹⁰.

Although the approach to treating trauma cases differs between children and adults, only 10% of traumas involving children are treated in trauma centers trained to deal with pediatric trauma¹¹. If these patients were treated in trauma centers with adequate training, there would be a reduction in mortality, length of stay and an improvement in the prognosis¹².

Considering that the first step in strengthening a pediatric trauma system in Minas Gerais is to understand the types of trauma and the characteristics of children who arrive at the referral hospital, here we gather the epidemiological information of pediatric trauma patients at Hospital João XXIII (HJXXIII). We believe that these data will be of fundamental importance for the formulation of public health policies, such as pediatric trauma prevention campaigns and improvements in the care provided to these patients.

METHODS

This is a retrospective study carried out at Hospital João XXIII located in Belo Horizonte, state of Minas Gerais, Brazil. Data were collected from medical records by locally trained researchers. This study was approved by the Research Ethics Committee under number 094B/2017.

STUDY SCENARIO

Hospital João XXIII is the reference hospital in the state of Minas Gerais for trauma victims, with 8,300 medical consultations per month, 540 surgeries and 980 admissions. In the municipal network, the HJXXIII is responsible for caring for all pediatric patients with burns, moderate to severe traumatic brain injury (TBI), multiple trauma with TBI, in addition to being a reference for 5 of the 9

macro-regions of Belo Horizonte. The hospital is responsible for all cases of pediatric trauma in the state when the most equipped hospital in the macro-region exceeds its capacity to provide care, whether due to an excess of patients or lack of resources.

Twenty percent of HJXXIII visits are for children and adolescents aged 0 to 14 years, resulting in approximately 55 pediatric patients per day. Cases of blunt trauma, perforating wounds, animal accidents, burns, small sutures, ingestion of foreign bodies and other clinical cases are treated¹³. Given the relevance of the HJXXIII as a reference center for trauma and its scope of action in the state, the hospital was chosen as the ideal setting for the study of pediatric trauma epidemiology in Minas Gerais.

DATA COLLECTION

Data were collected from the medical records of all pediatric trauma patients under the age of 14 considered to be severe according to the Manchester protocol¹⁴, who were referred to the emergency room between October 2017 and March 2018. All patients with a final diagnosis of trauma according to Chapter XIX or XX of the International Code of Diseases were defined as trauma victims. The severity of the case was established according to the Manchester Protocol¹⁴, and patients classified as emergency (red) or very urgent (orange) were included.

Exclusion criteria: patients aged 15 years or older; trauma cases classified as non-urgent (blue), not very urgent (green) or urgent (yellow) by the Manchester Protocol¹⁴ and any non-traumatic emergencies.

ANALYSIS

Descriptive analysis was performed, which included the following variables: age, gender, trauma mechanism, surgical procedures performed, imaging diagnosis used, trauma diagnosis, severity of cases, medical specialty that provided initial care, and death. The results were described with absolute and relative numbers.

RESULTS

Between October 2017 and March 2018, there were 274 hospitalizations for trauma in children under 14 years of age. The mean age of patients was 6.9 years and the median 6.5 years. The 25th percentile was equivalent to 3.0 years and the 75th percentile at 10.7 years. Graph 1 shows the distribution of data by age. Male children were more victims of trauma, representing 177 (64.7%) of the patients. 96 (35.2%) patients were women,

The main trauma mechanism was mechanical fall injury (104; 37.9%), followed by being run over by vehicle (50; 18.2%) and collision between vehicles (41; 15.0%), of which 6 (2.2%) involved motorcycles. Other trauma mechanisms observed were bicycle accidents (30; 10.9%), burns (22; 8.0%), firearm injuries (3; 1.1%), interpersonal violence (2; 0.7%), drowning (1; 0.4%) and stab wounds (1; 0.4%). In total, 20 patients were victims of unidentified trauma, of which 15 (5.5%) were blunt trauma. The most common mechanisms of pediatric trauma are shown in Graph 2.

At Hospital João XXIII, 151 (55.1%) pediatric trauma patients were initially evaluated by a general surgeon, 53 (19.3%) by a pediatrician, and 48 (17.5%) by a surgical resident. The remaining patients (22; 8.0%)

were first evaluated by other health professionals, such as neurosurgeons or maxillofacial surgeons. In HJXXIII, there are no pediatric surgeons available to perform the first assessment.

In total, 44 (16.1%) children were operated. The most common type of surgical procedure was orthopedic surgery, which represented 55.2% of the procedures, followed by neurosurgical, which represented 20.7% of the cases. Combined thoracotomy and laparotomies constituted 17.2% of surgical interventions.

The final diagnosis of trauma based on the affected body part was made in 266 cases, as shown in Graph 3. The most prevalent was traumatic brain injury, observed in 174 (65.4%) of the patients. 76 (28.6%) children had injuries in the upper and/or lower limbs and 67 (25.2%) had facial trauma. In addition, less common diagnoses for pediatric trauma patients included chest trauma (29; 10.9%), abdominal trauma (23; 8.6%), burns (21; 7.9%), neck trauma (19; 7.1%); pelvic trauma (15; 5.6%) and spinal cord injury (3; 1.1%).

Regarding the type of imaging exam requested by the assistant physicians (Graph 4), it was observed that 50.5%, 31.3% and 15.7% of pediatric trauma patients received chest, limb and pelvic radiographs, respectively. Cranial computed tomography was the most common type of requested computed tomography (58.8%), followed by spinal cord computed tomography (24.6%) and chest computed tomography (9.5%). Focused Sonography Assessment for Trauma (FAST) exams were performed in 20.4% of patients. Of the 56 FAST exams performed, 4 (7%) had positive results, while of the 16 abdominal CT scans, only 7 (43.75%) were able to identify considerable injury, that is, injury that altered the medical team's condition. course of action, revealed the need for surgery or hospitalization, or established the need for consultation with another medical specialty.

According to previously established severity criteria (such as a Glasgow Coma Scale score less than 15, need for hospitalization, CT scan, surgery, mechanical ventilation or blood transfusion, as well as circulatory shock and death), 59.4% of patients were considered critical 15, 16. Five children (1.8%) died during the period of this epidemiological evaluation.

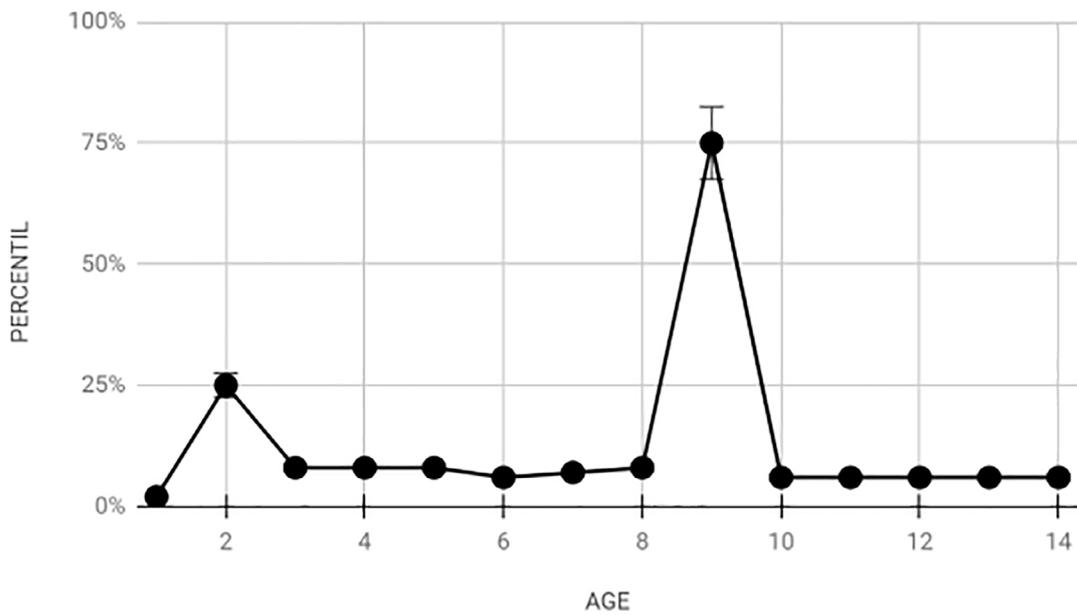
DISCUSSION

Traumatic injuries are among the leading causes of death in pediatric patients, along with those accompanying infectious, pulmonary, and neoplastic diseases. In Brazil, around 117,000 children under the age of 14 are hospitalized in the public health system for external causes each year and, unfortunately, 4,000 (3.4%) of these children die as a result of trauma. of his injuries⁶. Every day, in Brazil, 375 children under the age of 14 are hospitalized for trauma.

AGE AND GENDER GROUP ASSESSED IN THE STUDY

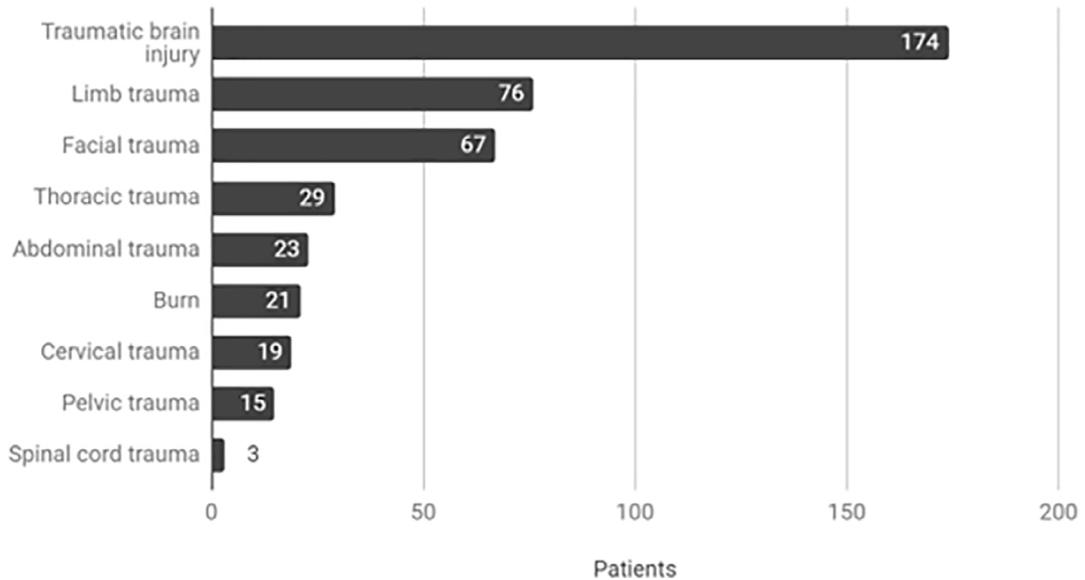
Despite the high mortality of pediatric trauma patients, few studies have assessed the epidemiology, quality of medical services, and the mechanism of trauma. Therefore, we emphasize the need for more studies on the topic and for greater awareness of pediatric trauma to create better prevention programs. In this analysis, patients older than 14

AGE DISTRIBUTION

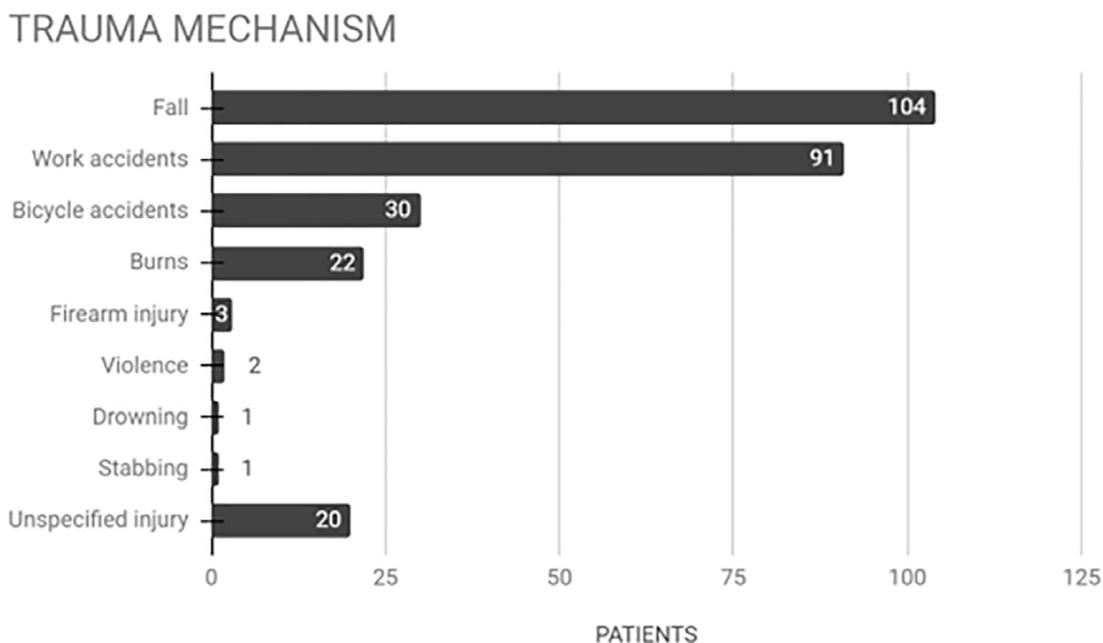


Graph 1. Age distribution of trauma patients treated at Hospital João XXIII. In the 75% percentile, the age group is 9 years old. In the 25% percentile, patients at 2 years of age.

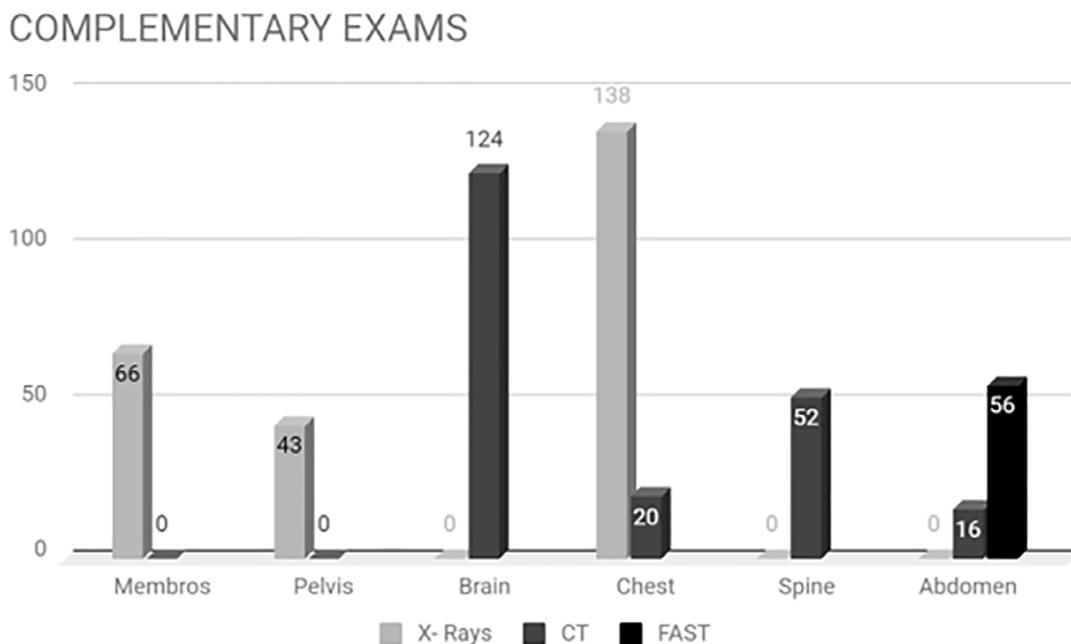
BODY SEGMENT



Graph 2. Location of trauma in relation to the affected body part in pediatric trauma patients at Hospital João XXIII. Head trauma was the most affected body part, followed by limbs and face.



Graph 3. Mechanism of trauma in pediatric trauma patients admitted to Hospital João XXIII. Falls were the most frequent mechanism, followed by work accidents and bicycle accidents.



Graph 4. Complementary exams performed in pediatric trauma patients at Hospital João XXIII. Most patients underwent an X-ray and CT. Most patients with abdominal trauma underwent FAST.

years were not included, as their needs were similar to those of adults¹³.

Most trauma cases involve children over 4 years of age. Accidents can be associated with the fact that both parents have to work and leave the child in the care of guardians who have limited knowledge about accidents and how to avoid them. These circumstances may explain the increase in the high incidence of trauma in this age group.

Regarding the distribution by gender of patients in this study, the ratio between boys and girls was 1.8:1. This data is similar to data found in other countries, which reported a ratio of 1.5:1^{7,8}.

TRAUMA MECHANISM

The most common injury mechanisms found in this study were mechanical falls and car accidents, as reported in other studies. When compared to other studies, mechanical falls also prevail over other causes of trauma⁷⁻⁹. This increase in mechanical falls and car accidents can be explained by the psychomotor maturation process and the introduction of leisure/sports activities in this age group^{8,9}. In addition, as mentioned above, these children are often placed in day care centers that sometimes lack adequate infrastructure and safety measures, contributing to the risk of mechanical falls². However, a limitation of this study was to group mechanical falls from small and large heights, which could, in fact, involve different mechanisms and lead to injuries at different levels of severity.

The incidence of car accidents or serious pedestrian accidents is significantly high in developing countries. Children are exposed to numerous risk factors, such as high circulation of vehicles and low socioeconomic conditions, associated with the lack of adequate education in traffic safety and the lack of available safety equipment^{7,17-19}.

CHARACTERISTICS OF MEDICAL CARE

Hospital João XXIII is a first-line trauma center capable of treating severely injured and highly complex patients, offering them the possibility of definitive treatment of traumatic injuries²⁰. A feature that enables this trauma center to efficiently and effectively treat patients is the presence and availability of multidisciplinary teams in this hospital, comprising a general surgeon, pediatrician, anesthesiologist, nurse and nursing technician.

Health professionals from other medical specialties, such as orthopedists, neurosurgeons and vascular surgeons, are added to the team, as needed, such as orthopedists, neurosurgeons and vascular surgeons¹⁶. In general, the initial care for pediatric trauma can be performed by any trained medical professional, regardless of specialty, with no qualitative difference in the outcome of the case¹². Having available However, having pediatric surgeons to manage hospitalized and more complex cases in children it would be beneficial for the care of the child, the patient, however, this specialty is still not available at Hospital João XXIII. In general, the initial care for pediatric trauma can be performed by any trained medical professional, regardless of specialty, with no qualitative difference in the outcome of the case¹².

PROPEDEUTICS

The lack of standardization of medical care has led to excessive requests for CT scans, exposing children to the risks of intense radiation. When analyzing the complementary workup of the 274 patients, it was possible to observe the

evaluation of the use of FAST as a screening method for important injuries of abdominal organs, instead of the need for computed tomography. Of the 56 children (20.4% of the total study sample) who underwent the FAST, 4 tests (7%) had positive results. Subsequent analysis showed that of the positive FAST tests, 3 corresponded to solid organ damage on abdominal CT and 1 was a false negative result. Fifty-two FAST tests were negative and no additional abdominal injuries were found in case management. The FAST in the HJXXIII is performed by a radiologist on duty, which increases the precision and accuracy of the examination.

Of the 16 patients (6% of the total study sample) who underwent abdominal computed tomography, 6 of them (37.5%) had solid organ damage and 1 patient had pneumoperitoneum, undergoing surgery. The remaining 10 patients did not present tomographic alterations, but only 1 had been previously submitted to FAST.

Requesting unnecessary medical imaging tests is a known cause of delay in transfers and definitive treatment in trauma centers equipped with the necessary resources²¹.

In addition, there is also a greater concern in performing CT scans due to the increased risk of exposure to radiation. With patients experiencing unnecessary additional CT scans (with large doses of radiation) increases, the risk of neoplasia or damage to the developing nervous system increases^{21,22}.

TRAUMA DIAGNOSIS

Risk factors inherent to the pediatric age group influence the pattern and type of traumatic injuries. The anatomical differences between children and adults make children more susceptible to trauma, with greater exposure to important structures and less protection from accidents²³. Head trauma (TBI) is frequently seen in the trauma center in this study²⁴. This increase in frequency can be explained by the fact that the child's head is proportionally larger than the rest of the body, containing a higher center of gravity and a weaker skull base^{24,25}.

Despite the higher incidence of TBI, most are considered mild and only a few head injuries result in brain damage or sequelae. The mean TBI severity stratification, according to the Glasgow Coma Scale, was 14.31, with more than 90% of cases scoring above 14. More severe complications occur in only 10% of cases¹⁰. Therefore, it is important to highlight the indiscriminate use of cranial tomography in mild TBI.

SURGERIES PERFORMED

In total, only 16.1% of children were operated. The surgical procedures performed, in order of frequency, were: orthopedic, neurosurgical, thoracotomy and laparotomy. Considering the small number of pediatric trauma cases that required surgery, the data demonstrate the importance of conservative treatment and trauma management. Non-operative management of parenchymal viscera with lesions of different severities has been more successful in children than in the adult population. This conservative treatment method for visceral injury can be used if treatment guidelines are strictly followed and if the patient is adequately monitored throughout hospitalization¹³.

PATIENT GRAVITY AND MORTALITY

Across Brazil, most hospitals use the Manchester screening protocol for screening¹⁴. This protocol has more than 50 classification flowcharts for various patient injuries.

In the flowchart for severe trauma patients, patients are classified into several severity categories. Patients with compromised airway, altered consciousness, dyspnea, shock, severe pain (greater than or equal to 6 on the pain scale) or significant trauma mechanism are classified as emergency cases (red) or very urgent (orange)¹³. This categorization system is subjective and highly dependent on the health professional responsible for patient care. Compared to Canadian scales, Emergency Severity Index (ESI) and a Dutch screening protocol²⁶⁻²⁸, the Manchester protocol imprecisely increases the priority level of less urgent patients, which demonstrates that it is less effective in screening cases of lesser urgency. Therefore, despite the protocol's ability to identify critically ill trauma patients, it can lead to an increase in patients classified as less urgent trauma, which could, in turn, increase the demand for emergency services and contribute to the overcrowding²⁹. Using established severity criteria in this protocol, such as - ECG<15, use of tomography, need for surgery, death, hospitalization, use of blood or mechanical ventilation and shock -, it is estimated that 59.4% of the patients treated were severe, therefore, more, evidencing that the Manchester Protocol The city is examining more children have been taken to emergency rooms than necessary³⁰. This can lead to overcrowding of emergency units and excessive interventions, raising the question whether this would be the best method to be used in pediatric trauma.

The pediatric trauma score (PTS) is a specific tool originally used as a pre-hospital screening guide for pediatric trauma and later validated for hospital screening and prognostic evaluation²⁸. PTS incorporates weight, airway, systolic pressure, level of consciousness, presence of fractures and penetrating injuries. One of the limitations of the PTS, however, is that it depends on the observer's assessment of the patient's vital signs and their level of consciousness, both of which are particularly difficult to assess in the pediatric age group. Therefore, well-trained medical professionals are needed for the accurate implementation of this screening guide²⁹.

Although traumatic accidents are the most common cause of death in the first four decades of life¹, the mortality rate observed in this study in HJXXIII was relatively low. As approximately 60% of trauma deaths occur before the patient arrives at the hospital, their lower than expected mortality rate may be due to the patient dying at the scene of the accident or during transport to the hospital³.

PREVENTION

Prevention is the best strategy to reduce mortality associated with traumatic accidents that affect children and adolescents in Brazil⁶.

Prevention programs are especially important in this era of the contemporary and globalized world, where job opportunities are concentrated in crowded cities, which require daily commuting and increase the risk of traumatic accidents. Particularly in Minas Gerais, with the increasing prevalence of traumatic accidents, programs that promote traffic safety education, teach the correct use of traffic safety equipment and encourage other risk reduction strategies are imperative³⁰.

CONCLUSION

This epidemiologic assessment at João XXIII Hospital showed that school-aged male children were most affected by pediatric trauma. The most frequent pediatric trauma mechanism is mechanical fall, followed by traffic accidents. The first assessment of a pediatric trauma case was performed most often by a general surgeon. FAST, when used, was able to accurately identify all cases of significant intra-abdominal injury. The most common injury that pediatric trauma cases presented with was head trauma. Only a small number of cases required surgery and the mortality rate was extremely low. The results highlighted by this research reveals important information for adapting the flow of care and, thus, optimizing services for patients. Through the results described, solutions can be developed to improve the quality of pediatric trauma care at HJXXIII. Some possible solutions include: 1) the development of a new screening tool that could be used to improve the existing triage classification system; 2) redesigning the staffing of the emergency room medical provider teams to ensure an appropriate distribution of medical knowledge and skill; 3) encouraging the use of effective and safe diagnostic tools such as FAST and X-ray imaging to avoid unnecessary radiation; and 4) the establishment of robust community prevention programs that target mechanical falls, car accidents, and traumatic brain injury.

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REFERENCES

1. World Health Organization (WHO). Global health estimates: life expectancy and leading causes of death and disability [Internet]. Geneva: WHO; 2020; [cited 2019 Dec 09]. Available from: https://www.who.int/healthinfo/mortality_data/en/
2. Peden MM, Oyegbite K, Ozanne-Smith J, Hyder AA, Branche C, Rahman AF, et al. World report on child injury prevention. New York: World Health Organization (WHO)/ United Nations Children's Fund (UNICEF); 2008.
3. Ministério da Saúde (BR). DATASUS. Mortalidade - Brasil [Internet]. Brasília (DF): Ministério da Saúde; 2020; [cited 2019 Dec 09]. Available from: <http://tabnet.datasus.gov.br/cgi/defohtm.exe?sim/cnv/obt10uf.def>
4. World Health Organization (WHO). Argentina [Internet]. Geneva: WHO; 2020; [cited 2019 Dec 09]. Available from: <https://www.who.int/countries/arg/en/>
5. World Health Organization (WHO). Chile [Internet]. Geneva: WHO; 2020; [cited 2019 Dec 09]. Available from: <https://www.who.int/countries/chl/en/>

6. Waksman RD, Freitas GG. Panorama da mortalidade por acidentes em crianças e adolescentes no Brasil. *Boletim SPSP*. 2017 Nov;6:4-6.
7. Filócomo FRE, Harada MJCS, Silva CV, Pedreira MLG. Estudo dos acidentes na infância e na adolescência em um pronto-socorro pediátrico. *Rev Latinoam Enferm*. 2002 Jan;10(1):41-7.
8. Martins CBG. Acidentes na infância e adolescência: uma revisão bibliográfica. *Rev Bras Enferm*. 2006 Mai/Jun;59(3):344-8.
9. Bem MAM. Aspectos epidemiológicos dos pequenos traumas em crianças atendidas no Hospital Infantil Joana Gusmão [dissertation]. Florianópolis: Universidade Federal de Santa Catarina (UFSC); 2005.
10. Zeitel RS, Flintz RA, Nogueiras CC. Traumatismo craniano em pediatria. *Rev Ped SOPERJ*. 2017 Dec;17(Suppl 1):S63-S71.
11. Athey J, Dean M, Ball JM, Wiebe R, Melese-d'Hospital I. Ability of hospitals to care for pediatric emergency patients. *Pediatr Emerg Care*. 2001 Jun;17(3):170-4.
12. Potoka DA, Schall LC, Gardner MJ, Stafford PW, Peitzman AB, Ford HR. Impact of pediatric trauma centers on mortality in a statewide system. *J Trauma*. 2000 Ago;49(2):237-45.
13. Botelho Filho FM. Adesão a protocolo de atendimento do trauma pediátrico em um centro de trauma brasileiro [dissertation]. São Paulo: Universidade Federal de São Paulo (UNIFESP); 2020.
14. Mackway-Jones K, Marsden J, Windle J; Manchester Triage Group. *Emergency triage*. 3rd ed. Chichester: John Wiley & Sons Limited; 2014.
15. Abib SCV, Françóia AM, Waksman R, Dolci MI, Guimarães HP, Moreira F, et al. Unintentional pediatric injuries in São Paulo. How often is it severe? *Acta Cir Bras*. 2017 Jul;32(7):587-98.
16. Silveira ES, O'Dwyer G. Centro de trauma: modelo alternativo de atendimento às causas externas no estado do Rio de Janeiro. *Saúde Debate*. 2017 Jan/Mar;41(112):243-54.
17. Fonseca SS, Vitoria CG, Halpern R, Barros AJD, Lima RC, Monteiro LA, et al. Fatores de risco para injúrias acidentais em pré-escolares. *J Pediatr*. 2002;78(2):97-104.
18. World Health Organization (WHO). Global status report on road safety 2018 [Internet]. Geneva: WHO; 2018; [cited 2019 Dec 09]. Available from: <https://www.who.int/publications/i/item/9789241565684>
19. Organisation for Economic Cooperation and Development (OECD). DAC Guidelines and Reference Series. Supporting state building in situations of conflict and fragility: policy guidance [Internet]. Paris: OECD; 2011; [cited 2019 Dec 18]. Available from: https://www.oecd-ilibrary.org/development/supporting-statebuilding-in-situations-of-conflict-and-fragility_9789264074989-en
20. American College of Surgeons (ACS). Committee on Trauma. Resources for optimal care of the injured patient. Chicago: ACS; 2014.
21. Jung R, Atallah AN. Tomografia computadorizada e risco de neoplasias. *Diagn Tratamento*. 2017;22(2):57-62.
22. Parente DB. O risco da radiação no uso indiscriminado da tomografia computadorizada. *Radiol Bras*. 2013 Mar/Apr;46(2):5-6.
23. American College of Surgeons (ACS). Committee on Trauma. Advanced trauma life support: student course manual. Chicago: ACS; 2018.
24. Imamura JH. Epidemiologia dos traumas em países desenvolvidos e em desenvolvimento [dissertação]. São Paulo: Universidade de São Paulo (USP); 2012.
25. Pereira Júnior GA, Andreghetto AC, Basile-Filho A, Andrade JI. Trauma no paciente pediátrico Simpósio: Trauma I. 1999 Jul/Sep;32(3):262-81.
26. Storm-Versloot MN, Ubbink DT, Kappelhof J, Luitse JS. Comparison of an informally structured triage system, the emergency severity index, and the manchester triage system to distinguish patient priority in the emergency department. *Acad Emerg Med*. 2011 Aug;18(8):822-9.
27. Souza CC, Araújo FA, Chianca TCM. Produção científica sobre a validade e confiabilidade do Protocolo de Manchester: revisão integrativa da literatura. *Rev Esc Enferm*. 2015;49(1):144-51.
28. Fieber J. Use of the pediatric trauma score to triage severity of childhood injury [thesis]. New Haven: Yale University School of Medicine; 2014.
29. Kauffman CR, Maier RV, Carrico CJ. Evaluation of the pediatric trauma score. *JAMA*. 1990 Jan;263(1):69-72.
30. Franciozi CES, Tamaoki MJS, Araújo EFA, Dobashi ET, Utumi CE, Pinto JA, et al. Trauma na infância e adolescência: epidemiologia, tratamento e aspectos econômicos em um hospital público. *Acta Ortop Bras*. 2008;16(5):261-5.

