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Comparative study on clinical and evolutionary aspects of children with abdominal trauma in intensive therapy unity

Estudo comparativo de aspectos clínicos e evolutivos de crianças com trauma abdominal em unidade de terapia intensiva.

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Abstract

Abdominal trauma by accidents may induce life risk, because of the bleeding of solid organs or the development of sepsis due to perforation of empty viscera. Spleen and liver lesions in children are more frequent. The aim was to describe the epidemiological and clinical characteristics of children with abdominal trauma. A retrospective study was conducted in a general hospital in Salvador, Bahia, Brazil. This retrospective profile study with collected data describes the epidemiological and clinical characteristics of children with serious abdominal trauma, admitted in one Pediatric Intensive Care Unit (PICU) during 5 years and it compares the results with those of other patients with trauma without abdominal lesion. During this period 29 children were admitted with abdominal trauma; 125 children had trauma without abdominal lesion and represented the group in comparison. Abdominal trauma was more frequent in boys (p = 0.01) with an average age of 8.7 years. The main cause of abdominal trauma was car accident. The most affected organs were: spleen (51.7%) and liver (24.1%). Children with abdominal lesion presented more paleness (p = 0.002) and tachycardia (p = 0.007). At the PICU, hemodynamic, hematological and electrolytic dysfunctions were more common for children with abdominal trauma (p < 0.05). Children with abdominal trauma were treated with hemoderivatives, invasive hemodynamic monitoring and infusion of vasoactive drugs (p < 0.05). It was concluded that intensive therapy care must be necessary for a better evolution of the cases.

Keywords: abdominal trauma – children – intensive therapy care; children – abdominal trauma – liver and spleen lesions.

Resumo

Trauma abdominal por acidentes pode provocar risco de vida, devido ao sangramento de órgãos sólidos ou ao desenvolvimento de sepse, devido à perfuração de vísceras ocas. Lesões de baço e fígado são mais frequentes em crianças. O objetivo foi descrever as características epidemiológicas e clínicas da criança com trauma abdominal. Foi realizado um estudo retrospectivo em um hospital geral em Salvador, Bahia, Brasil, descrevendo-se as características clínicas e epidemiológicas de crianças com trauma abdominal grave e comparando-se os resultados com os de outros pacientes com trauma, sem lesão abdominal, em uma Unidade de Terapia Intensiva Pediátrica (UTIP), durante cinco anos. Durante esse período, 29 crianças foram internadas com traumatismo abdominal, 125 crianças tiveram trauma sem lesão abdominal e representaram o grupo de controle. O trauma abdominal foi mais freqüente em meninos (p = 0,01) com média de idade de 8,7 anos. A principal causa de trauma abdominal foi o acidente de carro. Os órgãos mais afetados foram: baço (51,7%) e fígado (24,1%). Crianças com lesão abdominal apresentaram mais frequentemente palidez (p = 0,002) e taquicardia (p = 0,007). Na UTI, distúrbios hemodinâmicos, hematológicos e eletrolíticos foram mais comuns em crianças com trauma abdominal (p <0,05), sendo utilizados, mais frequentemente, hemoderivados, monitoração hemodinâmica invasiva e infusão de drogas vasoativas (p <0,05). Concluiu-se que o tratamento em unidade de terapia intensiva deve ser necessário para uma melhor evolução dos casos.

***Palavras-chave**: trauma abdominal – crianças – cuidados intensivos; crianças – trauma abdominal – lesões de fígado e baço.*

INTRODUCTION

External origin of organic lesions ("accidents") is the main cause of mortality for individuals from 1 to 35 years old all over the world.[1] Since last century, after institutional control over epidemic outbreaks and life habit changes, the importance of aggressions and violence has been modifying the morbidity and mortality rates.[1] Due to a certain number of risk factors which are peculiar to these populations, both children and youngsters represent one of the groups most exposed to these accidents. The reason for that seems to be the cognitive immaturity of the infants and young children, as well as the use of alcohol and other illicit drugs by adolescents. The most common lesions in children are traumas caused by car accidents and falls; burning, drowning, exogenous intoxication, aspiration of strange

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bodies through respiratory airways, venomous animal bites and physical abuses also seem to be relevant causes.[2]

Children who are victims of trauma present different characteristics from adults. Due to their smaller size, the child is attained as a "whole" by the lesions, and he is simultaneously attained in different organs and systems.[3] Trauma in the abdominal region is among the frequently reported stricken body segments; this could represent a life danger for the child, particularly due to blood losses from the lesions in solid organs. These organs are proportionally bigger as related to the body mass for the pediatric age group and are more exposed and less protected by the thorax still forming ossification and for the weakness of abdominal musculature.[4] The lesions of empty viscera are less common, but they can determine some important complications besides presenting a few difficulties for diagnosis initially.[5] Simultaneous injury of several organs is a determining factor of a number of complications such as: respiratory failure and coagulation problems, infections which demand diagnostic and therapeutic procedures that are only available at big tertiary centers such as a surgical center or an intensive care unity,[6] working places of the multidisciplinary group of practitioners, surgeons and other specialists in the field.

Organization and systematization for the attendance of trauma victim children can reduce these children's morbidity and mortality.[7] The knowledge of each population characteristics and their age groups is fundamental for elaborating these systems of attendance. The study of the children's epidemiological characteristics identifies the risk groups and is useful to elaborate prevention measures.[8] The results of the initial clinical presentation, as well as the aspects of evolution may supply some important data for these patient's treatment at the situation in the acutest stage.[9]

The objective of this study is to describe the epidemiological and clinical characteristics of children with abdominal trauma in a Pediatrics Intensive Care Unity (PICU), by comparing them to children with trauma without abdominal lesion.

METHOD

A retrospective profile study has been accomplished by revising reports during five years at a PICU that attends an average of 350 children per year in a general hospital in Salvador, Bahia, Brazil, a nuclear reference in trauma. During this period, 195 pediatric patients were admitted in this unit and diagnosed as victims of accidents. Children with abdominal trauma were included within the main study group; as for the comparison group we have studied children who were accident victims without abdominal trauma. The patients studied were evaluated according to clinical and therapeutic parameters, complications and evolution.[10] Accidents were precisely described according to the International Classification of Diseases (ICD 10)[11] as automobile accident, grouped under "vehicle occupants" or as crash, falls, firearm lesion or by "cold weapon" and "injuries". Children admitted under different diagnosis in (PICU) were excluded in the study. Patients presenting loss above 20% in data researched on the medical record were excluded.

We have observed the arrival of patients at the Emergency Service taking into consideration the level of conscience, cardiovascular and respiratory systems. The level of conscience was divided into lucid, torporific or in coma. Cardiovascular data employed were: blood pressure and cardiac rate according to the reference values[7] for each age group. Mucosas have been described as hypocromic or not hypocromic. When there was no cardiovascular abnormality, the patient was classified as stable. The definition for the respiratory system was apneustic, with respiratory insufficiency if the patient made use of some equipment of medication for respiratory support (mask, tube) or else if he was using ventilatory support through intubation.

At the moment of admission and discharge from PICU we employed the Glasgow scale[6] for evaluating the conscience. Cardiovascular system has been described as similar to data reported at emergency, as well as the respiratory system, plus report over the first oxygen saturation by the time of admission in the PICU. The types of trauma were defined according to the body segment in: cranial/maxillary/facial trauma, abdominal (hepatic, kidney, spleen, empty viscera), pelvic and orthopedic trauma. Dysfunction of organs evaluation followed the next classification: cardiovascular, respiratory, hematological, gastrointestinal, hepatic, renal and neurological.[12] Complications were defined as electrolytic or metabolical troubles according to the alterations of glycemia, infectious (respiratory, urinary, sanguineous or surgical wound) and high digestive hemorrhage. The therapeutic resources used at the PICU as reported were mechanical ventilation, hemodynamical invasive monitorization, use of vasoactive drugs and use of hemoderivates. Final evolution was defined as hospital discharge or death.

In order to analyze the data, we have used the chi-square test and Fisher exact test for continuous and categorical variables, by calculating means, medians and pattern deviation. The Z test was used to compare samples and considering the statistically significant value when $p < 0.05$.[13] We have evaluated the absolute and relative risk and the variables difference of risk according to the type of accident and for the evaluation of the relative frequencies we used the chi-square test. In order to evaluate three or more associations the Analysis of Variance (ANOVA) technique and then the Tuckey's test were used.[14] The program used was the Statistical Package for Social Science (SPSS).

RESULTS

During the period of research, 195 children diagnosed as presenting lesions of external origin were described. Among those 153 children (78.5%) had trauma. Abdominal trauma occurred to 29 children (19%) and 124 children suffered trauma without associated abdominal lesion. The age average of the patients with abdominal trauma was of 8.7 years and that of the control group was 6.8 (p = 0.03). The trauma score in the group of cases was of 6.4, and for the control group of 6.4. The children of masculine sex were more affected by abdominal trauma group than those of the control group, 79.3% and 55.6% respectively (p = 0.01). Car accidents were the most frequent causes (44.8%). Other causes were: falls (31.0%), lesions by impact (6.9%) and wounds by firearm (6.9%). There was no abdominal trauma caused by injury syndrome in this population. The most frequently affected abdominal organ was the spleen (51.7% of the cases), the liver (24.1%), kidneys (13.8%) and pancreas (10.3%). Six children (21%) presented trauma of empty viscera (stomach, intestines, urinary bladder). Other traumas were reported to be presented followed by abdomen lesion: cranial (31.0%), thoracic (20.7%), and orthopedic trauma (24.1%). Data related to the epidemiological characteristics, types of accident and organic segments involved are demonstrated in Table 1.

In the initial presentation at the Emergency we found significant difference in relation to the control group for the level of conscience (p = 0.01), tachycardia (p = 0.007) and cutaneous-mucosal paleness (p = 0.002). Only 37%[10] of children with abdominal trauma presented stable hemodynamics, with significant difference related to the control group (p = 0.0005). Table 2 presents data related to the results at the Emergency Service.

Organic dysfunction with significant difference between the groups was the cardiovascular (p = 0.02) and hematological system (p = 0.002) dysfunctions. The following electrolytic and metabolic alterations with significant statistical difference were found for children with abdominal trauma: hyponatremia (p = 0.008), hyperkalemia (p = 0.05), hypocalcemia (p = 0.02), hypomagnesemia (p < 0.001). The frequency of glycemia disturbances was similar between the groups (p = 0.28). There was no difference related to the site of infection. The frequency of high digestive hemorrhage was similar between the groups.

The therapeutic resources used with statistical difference between the groups were: use of vasoactive drugs (p = 0.008) and hemoderivate transfusion (p = 0.003). The use of mechanical ventilation, invasive monitorization (central vein pressure), and parenteral nutrition were similar for the groups. In 15 (52%) of the children with abdominal trauma we applied a maintenance treatment; 8 (28%) of the children presented lesion of the spleen, 4 (14%) lesion of the liver and 3 (10%) lesion of the kidney. 6 (21%) of the children who had laparotomy done, among 14 (48%) presented spleen lesion and 6 (21%) of them had a lesion of empty viscera. Only one child (3.4%) with abdominal trauma collapsed (TABLE 4).

DISCUSSION

Aggressions determined by agents of external origin (accidents) represent an important cause of morbidity

Table 1 - Clinical-epidemiological characteristics, type of accident and organic segment involved.

Variable	Group with abdominal trauma % (n)	Control group % (n)	p value
Age	8.7 (29) SD = 3.4	6.8 (124) SD = 4.2	0.03*
Sex	Male: 79.3 (23)	Male 55.6 (69)	0.019*
Trauma score	6.4 SD = 2.9	5.7 SD = 2.8	0.19
Car accident	44.8 (13)	47.6 (59)	0.78
Fall accident	31.0 (20)	41.1 (51)	0.31
Fire arm	6.9 (2)	3.2 (4)	0.31
Injuries	0 (0)	3.2 (4)	---
Organ attained			
Spleen	51.7 (15)	---	---
Liver	24.1 (7)	---	---
Kidney	13.8 (40)	---	---
Pancreas	10.3 (3)	---	---
Empty viscera	21.0 (6)	---	---
Trauma of other segment presenting abdominal lesion			
Cranial	31.0 (9)	91.9 (114)	< 0.001*
Thoracic	20.7 (6)	8.9 (11)	0.09
Orthopedic	24.1 (7)	21.0 (26)	0.7

Note: *p value significant if < 0.05; SD = standard deviation.

Table 2 - Parameters for the initial presentation of the patients when arriving in the Emergency Service

Variable	Group with abdominal trauma % (n)	Control group % (n)	p value
Tachycardia	29.6 (8)	8.4 (9)	0.007*
Hypotension	7.4 (2)	0.9 (1)	0.10
Bradycardia	3.7 (1)	0.9 (1)	0.36
Paleness	48.1 (13)	18.7 (20)	0.002*
Polymerase chain reaction	3.7 (1)	1.9 (2)	0.49
Normal Hemodynamics	37.0 (10)	72.9 (78)	0.0005*
Normal level of conscience	57.7 (15)	23.1 (28)	0.01*
Normal respiratory pattern	65.4 (17)	56.4 (62)	0.07

Note: *p value significant if < 0.05.

Table 3 - Clinical Complications of the patients during admission in Pediatric Intensive Care Unit

Note: *p value significant if < 0.05.

Variable	Group with abdominal trauma % (n)	Control group % (n)	p value
Organic Dysfunction			
Respiratory	27.6% (8)	37.1% (46)	0.33
Cardiovascular	31.0% (9)	12.9% (16)	0.02*
Hematologic	20.7% (6)	3 (2.4%)	0.002*
Kidney	0 (0)	0.85 (1)	---
Neurological	6.9% (2)	8.1% (10)	1.00
Gastro enteric	10.3% (3)	0 (0)	0.006*
Hepatic	10.3% (3)	1.6% (2)	0.04*
Electrolytic / metabolic disturbance			
Hyponatremia	58.65 (17)	32.35 (40)	0.008*
Hypernatremia	6.9% (2)	2.4% (3)	0.24
Hypopotassemia	27.6% (8)	20.2% (25)	0.38
Hyperpotassemia	17.2% (5)	5.6% (7)	0.05
Hypocalcemia	13.8% (4)	2.4% (3)	0.02*
Hypercalcemia	3.4% (1)	0.8% (1)	0.34
Hypomagnesemia	31.0% (9)	5.6% (7)	< 0.001*
Hypermagnesemia	6.9% (2)	2.4% (3)	0.24
Hypocloremia	10.3% (3)	8.9% (11)	0.73
Hyperglycemia	41.4% (12)	52.4% (65)	0.28

Note: *p value significant if < 0.05.

Table 4 - Therapeutic Resources used in Pediatric Intensive Care Unit and evolution of the patients.

Variable	Group with abdominal trauma % (n)	Control group % (n)	p value
Mechanical ventilation	24.1 (7)	37.9 (47)	0.16
Vesselactive drug	31.0 (9)	10.5 (13)	0.008*
Invasive monitorization (central vein pressure)	34.5 (10)	16.9 (21)	0.03*
Hemoderivates	48.3 (14)	21.0 (26)	0.003*
Parenteral nutrition	13.8 (4)	4.8 (6)	0.09
Sedation/analgesia	75.9 (22)	64.5 (80)	0.24
Abdominal surgery	14 (48%)	---	---
Evolution			
Decease	3.4 (1)	4.8 (6)	1,00

Note: *p value significant if < 0.05.

and mortality in pediatric age group.[2] Several studies have demonstrated the negative impact of the cases, as well as relating to the patient and family, as concerning the large social and financial costs to the whole community.[1] Every effort must be employed by the prevention policies through identification of groups and risk factors, besides the optimization of the organizational processes and the systematization of attendance to the victims in different moments after the event.[15]

Among the external causes of organic lesions in children, we point out the force of physical impact due to trauma of different origins; the child's peculiar physical structure besides the absence of perception of danger; the impulsive behaviour in adolescents associated to ingestion of substances. It is possible to indicate some risks: car accidents, injuries and wounds from firearms, which are the most frequent etiological agents in these lesions.[1] In children, the simultaneous injury on several body segments is more frequent.[16] Abdominal organs are particularly vulnerable and may determine immediate life risk, due to excessive bleeding or perforation of empty viscera.[17]

Approaching the child with abdominal trauma presents peculiar characteristics, as well as for the difficulties in diagnosis and complications related to the lesions.[9] Diagnosis may not be evident at the initial presentation in the Emergency Service.[18] Infants do not inform adequately what they feel and other details of history and physical examination must be used. The mechanism of trauma such as falls from high places or the impact on the abdominal and the inferior thoracic regions may suggest the presence of abdominal lesion. Signs and symptoms such as localized pain, hematomas and contusions, abdominal distensions, cutaneous-mucosal paleness and tachycardia, hematuria and vomit or bilious rests inside the gastric catheter suggest the presence of aggressions to the organs in the abdominal cavity.[19]

The diagnosis evaluation by image, through X-ray, ultrasound and computerized tomography can be useful.[20] Eventually peritoneal wash may be necessary.[21] None of these parameters is 100% sensitive or specific. It is always important to have a joint discussion about individual cases among clinical and surgical physicians.

The use of resources from the pediatric intensive care units is basic to the follow-up and recovering of the children with abdominal trauma.[22] Almost all organic systems may present complications, such as cardiovascular collapse, due to bleeding, electrolytic and metabolic troubles, as well as a systemic inflammatory response and sepsis.[23] Nutritional support through parenteral nutrition must be instituted in cases of long fasting.[24] Continuous monitorship of the cardiovascular system has permitted the maintenance behaviour in cases of trauma of parenchymatous viscera (spleen, liver, kidneys) therefore preserving these organs.[25]

After splenectomy, the incidence of sepsis in some related series reaches 50%.[26] Excessive transfusion of hemoderivatives (> 40 ml/kg) and the use of vasoactive amines in order to maintain the hemodynamic stability, points to the need of exploratory laparotomy.[27] Other resources of intensive therapy are also used such as powerful sedative and analgesic drugs under continuous infusion, invasive hemodynamic monitorization (central vein pressure and invasive arterial procedures), as well as mechanical pulmonary ventilation in cases of serious respiratory insufficiency; dialytic method in cases of renal insufficiency and intensive neuromonitorization for cranial trauma.[23]

This study has described the children admitted in a pediatric PICU during a period of five years, with diagnosis of abdominal trauma compared to those traumatized without lesion in the abdominal structures. Although the study is retrospective and some of the characteristics has not been previously controlled, as all children were followed in a same and unique hospital service we have used the same treatment protocols and data in the medical record, as for the children with abdominal trauma and for the children from the control group, in order to favor the uniformity of collected data. Abdominal trauma was more frequent in children of male sex and in school age, as related in literature.[17] Boys are described as children with more aggressive attitudes and who get involved in activities that place them in greater risk of external aggressions, especially in school age, when they are move about independently. The cases present a particular season, mainly during summertime, on school vacations when children are more exposed to environment and less supervised. Bad socioeconomic conditions, in the middle of human agglomerations and poor living conditions favour the occurrence of accidents, whether at home or on the streets.[1] The most common causes for abdominal trauma were car accidents and falls, just as in other series[8] Inadequate transportation for children not provided in cars with restriction appliances (seat belt and transportation seat) increases the chances for the lesions of abdominal organs.[28] When the child is projected to the front, their abdominal structures may be compressed, which causes bleeding or empty viscera ruptures. Streets or avenues with little or inexistent protection for pedestrian circulation make it easy for the occurrence of hitting. In big cities they run the risk of falling from high places, frequently because of inadequate domiciles[8] or due to collision with handlebars or falls.

The most offended abdominal organs were the spleen and the liver.[9] Despite the fact that the lesion of these organs can be a cause of life risk because of abundant bleeding, needing urgent exploratory laparotomy, the non-surgical maintenance behaviour was performed

successfully in 15 (52%) of the children. Since the study was retrospective and non-controlled, this population presented a good evolution in these cases: 9 (21%) children presented trauma of empty viscera (intestines, stomach, and bladder). This kind of trauma may represent certain difficulty for the initial diagnosis.[17]. Abdominal distension, gastric stasis, paralyzed ileum and signs of sepsis may indicate the existence of lesion. The delay of diagnosis doesn't seem to compromise the clinical evolution of the patients as occur with the bleedings.[29]

The most associated body segment to abdominal trauma was the cranial segment (31%). Cranial trauma is fundamentally important in relation to the prognosis of children victims of other traumas and instability factors caused by abdominal lesion, due to the bleeding and hypotension that may particularly aggravate the brain lesion.[30]

Although the score of severity has been similar for the researched groups, paleness and tachycardia at initial presentation were found more frequently in cases of abdominal trauma. The presence of hypotension is described as a late finding at the presentation of the child with blood loss,[31] so the identification of other signs of hemodynamic decompensation of earlier appearing may be fundamental for the choice of adequate procedure. There lies the importance of continuous observation of the child in serious conditions to identify early the compensate shock to prevent evolution in cases with internal bleeding.

Gastrointestinal, cardiovascular and hematological systems were the most frequently affected in this population. The definition of the organ dysfunction classifies gastrointestinal alteration when there are alterations of hepatic enzymes and need of hemotransfusion due to digestive hemorrhage, a frequent situation in abdominal trauma. Cardiovascular dysfunction happened due to the need of hemodynamic support and the hematological dysfunction because of coagulation pathology. Those systems should be carefully monitorized for poly traumatized patients.[6] In spite of the risk of renal lesion due to the trauma itself, or from the other complications, renal insufficiency was not frequent in this series.

Hyponatremia was the most common electrolytic alteration, perhaps related to the use of hypotonic solutions and due to the inappropriate secretion of Antidiuretic hormone.[32] In some patients with associated cranial trauma, the presence of hyponatremia can be harmful in case of cerebral edema.

The presence of hypomagnesemia and hypocalcemia could be explained due to bone lesions and the development of transitory hypoparathyroidism.[33] However, the form of study presented does not allow any conclusion in this sense. Besides, as there was a greater use of hemoderivates for the children with abdominal trauma, these alterations can be due to the use of citrates for the hemoderivate conservation (calcium chelating).[34]

A more important incidence of high digestive hemorrhage did not occur in abdominal trauma. Some studies have demonstrated that the significant risk of digestive hemorrhage happens only in specific groups of patients and does not justify the use of indiscriminate prophylaxis.[35]

Mortality found in children with abdominal trauma was lower than in control group. Several descriptions in literature have demonstrated that one of the main factors of prognosis is related to the presence of cranial traumatism,[9] absent in the majority of children studied with abdominal trauma, what may explain the low lethality of these cases.

CONCLUSION

Children with abdominal trauma may present distinct clinical and epidemiological aspects, and the therapeutic approach and strategies of prevention should be related to these aspects. On the series hereby presented the school age boys formed the most affected group, mainly because of car accidents and falls. The presence of cutaneous-mucosal paleness and tachycardia were more prevalent in these children as well as electrolytic, cardiovascular and hematological. A better knowledge of the specific characteristics of children with abdominal trauma, concerning the epidemiological aspects and clinical presentation are fundamental for the improvement of prevention policies, systematization of attendance in all stages after the trauma, continuous prevention educational schedules and the reduction of morbidity and mortality.

REFERENCES

1. SMITH, G.S.; BARSS, P. Unintentional injuries in developing countries: the epidemiology of a neglected problem. **Epidemiol. Rev**., Baltimore, v.13, p.228-266, 1991.
2. KRUG, E. (Ed.) **Injury**: a leading cause of the global burden of disease. Geneva: World Health Organization; 1999.
3. SANCHEZ, J.L.; PAIDAS, C.N. Childhood trauma: now and the new millenium. **Surg. Clin. North Am.**, Philadelphia, v.79, n.6, p.1503-1535, 1999.
4. AMERICAN HEART ASSOCIATION. **Pediatric advanced life support provider manual**: trauma resuscitation and spinal immobilization. Dallas, 2002. chapt. 10, p.253-286.
5. RAMENOFSKY, M.L. Pediatric abdominal trauma. **Pediatr. Ann.**, Thorofare,v.16, n.4, p.318-321, 324326, 1987.
6. WHITE, J.R.; DALTON, H.J. Pediatric trauma: postinjury care in the intensive care unit. **Crit. Care Med.**, Philadelphia, v.30, n.11, p.S478-488, 2002. Suppl.
7. POTOKA, D.A.; SCHALL, L.C.; FORD, H.R. Improved functional outcome for severely injured children treated at pediatric trauma centers. **J. Trauma**, Baltimore, v.51, n.5, p.824-832, 2001.
8. FONSECA, S.S. et al. Fatores de risco para injúrias acidentais em pré-escolares. **J.Pediatr. (Rio J.),** Porto Alegre, v.78, n.2, p.97-104, 2002.

9. STAFFORD, P.W.; BLINMAN, T.A.; NANCE, M.L. Practical points in evaluation and resuscitation of the injured child. **Surg. Clin. North Am.**, Philadelphia, v.82, n.2, p.273-301, 2002.

10. KAUFMANN, C.R. et al. Evaluation of the Pediatric Trauma Score. **JAMA**, Chicago, v.263, n.1, p.69-72, 1990.

11. ORGANIZAÇÃO MUNDIAL DA SAÚDE. **CID 10 - Classificação Internacional de Doenças**. São Paulo, 2002.

12. WILKINSON, J.D. et al. Mortality associated with multiple organ system failure and sepsis in pediatric intensive care unit. **J. Pediatr.**, St. Louis, v.111, n.3, p.324-328, 1987.

13. MARCILIO, C. **Dicionário de pesquisa clínica**. Salvador: Ed. Artes Gráficas, 1995.

14. NIELD, M.; GOCKA I. To correlate or not to correlate: what is the question? **Nurs. Res.**, Philadelphia, v.42, n.5, p.294-296, 1993.

15. RIVARA, F.P. Pediatric injury control in 1999: where do we go from here? **Pediatrics, Elk Grove Village, v.**103, n.4, pt. 2, p.883-888, 1999.

16. ABRAMOVICI, S.; SOUZA, R.L. Abordagem em criança politraumatizada. **J.Pediatr. (Rio J.),** Porto Alegre, v.75, p.S268-278, 1999. Supl. 2.

17. CANTY Sr, T.G.; CANTY Jr, T.G.; BROWN, C. Injuries of the gastrointestinal tract from blunt trauma in children: a 12-year experience at a designated pediatric trauma center. **J. Trauma**, Baltimore, v.46, n.2, p.234-240, 1999.

18. BUDUHAN, G.; McRITCHIE, D.I. Missed injuries in patients with multiple trauma. **J. Trauma**, Baltimore, v.49, n.4, p.600-605, 2000.

19. TAYLOR, G.A.; EICHELBERGER, M.R.; POTTER, B.M. Hematuria: a marker of abdominal injury in children after blunt trauma. **Ann. Surg.,** Philadelphia, v.208, n.6, p.688-693, 1988.

20. CANTOR, R.M.; LEAMING, J.M. Evaluation and management of pediatric major trauma. **Emerg. Med. Clin. North Am**., Philadelphia, v.16, n.1, p.229-256, 1998.

21. ROTHENBERG, S. et al. Selective management of blunt abdominal trauma in children: the triage role of peritoneal lavage. **J. Trauma**, Baltimore, v.27, n.10, p.1101-1106, 1987.

22. HULKA, F. Pediatric trauma systems: critical distinctions. **J. Trauma**, Baltimore, v.47, n.3, p.S85-89, 1999. Suppl.

23. McRITCHIE, D.I.; MATTHEWS, J.G.; FINK, M.P. Pneumonia in patients with multiple trauma. **Clin. Chest Med**., Philadelphia, v.16, n.1, p.135-146, 1995.

24. JAKSIC, T. Effective and efficient nutritional support for the injured child. **Surg. Clin. North Am.**, Philadelphia, v.82, n.2, p.379-391, 2002.

25. PEARL, R.H. et al. Splenic injury: a 5-year update with improved results and changing criteria for conservative management. **J. Pediatr. Surg.,** Philadelphia,v.24, n.5, p.428-431, 1989.

26. BISHARAT, N. et al. Risk of infection and death among post-splenectomy patients. **J. Infect**., Kent, v.43, n.3, p.182-186, 2001.

27. HOLMES, J.F. et al. Identification of children with intra-abdominal injuries after blunt trauma. **Ann. Emerg. Med**., St. Louis, v.39, n.5, p.500-509, 2002.

28. JOHNSTON, C.; RIVARA, F.P.; SODERBERG, B.S. Children in car crashes: analysis of data for injury and use of restraints. **Pediatrics, Elk Grove Village, v.**93,n.6, p.960-965, 1994.

29. FURNIVAL, R.A.; WOODWARD, G.A.; SCHUNK, J.E. Delayed diagnosis of injury in pediatric trauma. **Pediatrics, Elk Grove Village, v.**98, n.1, p.56-62, 1996.

30. THE BRAIN TRAUMA FOUDATION; THE AMERICAN ASSOCIATION OF NEUROLOGICAL SURGEONS; THE JOINT SECTION ON NEUROTRAUMA AND CRITICAL CARE. Resuscitation of blood pressure and oxygenation. **J. Neurotrauma**, Larchmont, v.17, n.6/7, p.471-478, 2000.

31. SCHWAITZBERG, S.D.; BERGMAN, K.S.; HARRIS, B.H. A pediatric trauma model of continuous haemorrhage. **J. Pediatr. Surg.,** Philadelphia, v.23, n.7, p.605-609, 1988.

32. Oh, M.S.; CARROLL, H. Disorders of sodium metabolism: hypernatremia and hyponatremia. **Crit. Care Med.**, Philadelphia, v.20, n.1, p.94-103, 1992.

33. BORELLI, A.; LEITE, M.R.; CORREA, P.H.S. Paratireóides e doenças ósseas metabólicas. In: WAJCHENBERG, B.L. **Tratado de endocrinologia**. São Paulo: Roca, 1992. p.845-910.

34. LYNCH, R.E. Ionized calcium: pediatric perspective. **Pediatr. Clin. North Am**., Philadelphia, v.37, n.2, p.373-389, 1990.

35. LACROIX, J. et al. Frequency of upper gastrointestinal bleeding in a pediatric intensive care unit. **Crit. Care Med.**, Philadelphia, v.20, n.1, p.35-42, 1992.