

Original article

Clinical assessment of pediatric patients with Waddell's triad

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ABSTRACT. *Introduction:* Waddell's triad represents an emergency for pediatric patients due to the high incidence of injuries associated with the femur fracture. *Objective:* To clinically assess, upon presentation, the femur fracture associated with the head trauma, chest and/or abdominal trauma in the pediatric patients and its course during the hospital stay. *Material and Methods:* Prospective, observational study analyzing the cases that had clinical, imaging and picture records to assess the presence of associated injuries as well as their course during the hospital stay. *Results:* A total of 21 patients were included; 13 boys and 8 girls, ages 3-14 years; weight upon admission was 12-30 kg, the Pediatric Trauma Score range was 1-9 points; 9.6% sustained open fractures; 15 cases had femoral fracture associated with musculoskeletal injuries; the most frequent finding related with head trauma was brain edema. Sixty-two percent of those with thoracic or abdominal trauma warranted a surgical procedure; 18 patients required mechanical ventilation; several methods were used to treat the femur fractures. *Conclusions:* The polytraumatized patients need multidisciplinary care. There is a high percentage of musculoskeletal and non-orthopedic associated injuries in Waddell's triad. The Pediatric Trauma Score is a good indicator of the severity of the patient's condition.

Key words: fracture, femur, child, trauma, abbreviated injury scale.

RESUMEN. *Introducción:* La tríada de Waddell es una condición de urgencia para el paciente pediátrico debido a la alta incidencia con lesiones asociadas a la fractura de fémur. *Objetivo:* Evaluar clínicamente la presentación de la fractura de fémur asociada a trauma craneal, trauma torácico y/o abdominal en el paciente pediátrico y evolución durante su estancia intrahospitalaria. *Material y métodos:* Estudio prospectivo, observacional, analizando casos que contaban con expediente clínico, imagenológico y fotográfico, evaluando la presencia de lesiones asociadas así como su evolución durante su estancia hospitalaria. *Resultados:* Se incluyeron 21 pacientes, 13 niños y 8 niñas, edades de 3-14 años, peso al ingreso fue de 12-30 kg, rango Pediatric Trauma Score de 1-9 puntos, 9.6% fueron fracturas expuestas, se asociaron con lesiones musculoesqueléticas a la fractura femoral en 15 casos, en relación al trauma craneal el hallazgo más frecuente fue edema cerebral. En el trauma torácico u abdominal 62% ameritaron algún procedimiento quirúrgico, 18 pacientes requirieron apoyo ventilatorio mecánico, el tratamiento de la fractura de fémur se realizó por varios métodos. *Conclusiones:* El paciente politraumatizado debe tener una atención multidisciplinaria. En la tríada de Waddell es alto el porcentaje de asociación de lesiones musculoesqueléticas y no ortopédicas. La escala de Pediatric Trauma Score es un buen indicador de la gravedad del paciente.

Palabras clave: fractura, fémur, niños, trauma, escala resumida de traumatismo.

Level of evidence: IV (Act Ortop Mex, 2010)

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Introduction

Waddel's triad is defined as the presence of an intra-abdominal or intrathoracic lesion, head trauma and femoral shaft fractures in a pediatric patient.¹ The injuries sustained by pediatric pedestrians due to trauma caused by a motor vehicle in motion, similar to being run over, are the main cause of death in children ages 5-14 years.² Reports state that during the mechanism of injury the pedestrian absorbs all the energy; children and elderly people sustain more serious injuries than the rest of the population, and the severity of the injuries depends on the speed of the vehicle, the body weight of the pedestrian and the frontal structure of the vehicle.²

Waddel's triad occurs as a result of a high energy mechanism, so initially the physical exam should try to rule out associated injuries and treat all those requiring emergency care, as the patient's life is at risk.² The injury and death rates have increased dramatically due to motor vehicle accidents (MVA) of the run over type.³ Between 1982 and 1988 the United States Consumer Product Safety Commission reported a 738% increase in injuries and an 862% increase in the deaths resulting from being run over by a motor vehicle; 40% of them occurred in children.³ When energy is associated with velocity, the mortality rate due to being run over is exponential; another important factor is the characteristics of the injured tissue.⁴

Classically, there are three phases in the injuries sustained by pediatric patients: the impact of the bumper, the impact of the windshield and hood and, finally, the impact on the floor. The injuries of the pelvic limbs are due to the impact of the bumper; the thoracic or abdominal trauma results from the impact of the hood and windshield and, fi-

nally, the head or cervical spine trauma results from hitting the ground.⁴

Given that the healing of this kind of fractures is considered as appropriate, conservative treatment represents a good choice. It consists of an initial period of traction, followed by the placement of a pelvipodal cast until healing. Other treatments have been described with Kirschner nails plus a cast, open reduction and bone fixation with plate and screws, medullary nailing and, recently, external fixation.^{1,5} Overall, there is no systematic treatment for these fractures in children. However, other factors should be considered, like the age, the soft tissue injuries, the type and location of the fracture, the head, thoracic and abdominal trauma, the presence of fractures in the same limb or in the contralateral limb, the surgeon's expertise and the family's psychosocial situation.⁶

The trauma scores provide an objective description of the patient's conditions and help to properly select and recognize the individuals who sustained the most severe injuries.^{7,8} Moreover, these scores have been used for the quality control of the treatment methods as well as to develop new protocols.⁹

The Pediatric Trauma Score (PTS) can be easily applied for the pre- and in-hospital triage (patient classification according to severity) and has multiple applications that include the prediction of survival, the correlation with other standard predictors of injury severity and central nervous system impairment.^{10,11}

The purpose of the study was to clinically assess Waddel's triad in the pediatric patient and its course during the hospital stay. The rationale for conducting this study is that there is very little information on the clinical impact, the association with other musculoskeletal injuries, non-orthopedic injuries, and the course of patients with Waddel's triad.

Material and methods

A prospective, observational trial was conducted to analyze all the cases of pediatric patients with a diagnosis of Waddel's triad at «Dr. Eduardo Vázquez Navarro» General Hospital in Puebla, SSEP, from 2005 to 2009. The cases with a complete clinical, imaging and photographic record were included. All patients were admitted at the Pediatric Emergency Service, at the shock area, where the following information was collected: sex, age, mechanism of injury, Pediatric Trauma Score, associated musculoskeletal injuries, treatment provided by general surgery and neurosurgery, requirement of mechanical ventilation upon admission, number of days elapsed before the treatment of fractures, the treatment method, and the length of stay (LOS).

A statistical analysis of the following data was carried out with the chi² test: comparison among age groups divided into </- 6 years and >/- 7 years using the PTS, the patient's weight divided into < 15 kg and > 15 kg associated with the PTS, PTS associated with the LOS divided into two groups, < 30 days and > 30 days; p < 0.05 was considered as a significant value.

Table 1. Musculoskeletal injuries associated with the femoral fracture included in Waddel's triad.

Cases	Associated injury
Case 1 (3a)	Femoral fracture
Case 2 (3a)	Humeral fracture
Case 3 (3a)	Humeral fracture
Case 4 (4a)	Femoral fracture
Case 5 (4a)	Humeral and femoral fracture
Case 6 (5a)	Humeral fracture
Case 7 (5a)	Clavicle fracture
Case 8 (6a)	None
Case 9 (6a)	Clavicle and femoral fracture
Case 10 (6a)	Humerus
Case 11 (6a)	None
Case 12 (7a)	Coxofemoral dislocation + femoral fracture
Case 13 (8a)	Bilateral radius and ulnar fracture
Case 14 (8a)	Humeral and femoral fracture
Case 15 (9a)	None
Case 16 (10a)	Humeral and femoral fracture
Case 17 (10a)	None
Case 18 (10a)	Humeral fracture
Case 19 (11a)	None
Case 20 (11a)	Radius fracture
Case 21 (14a)	Clavicle fracture

Table 2. Head trauma and its treatment at the Neurosurgery Service.

Cases	Condition	Treatment
7	Subarachnoid hemorrhage	Decompressive craniotomy
1	Right parietal fracture	Medical
13	Moderate to severe brain edema	Medical

Table 3. Thoracic or abdominal trauma and its treatment at the Emergency Service.

Cases	Treatment	Surgical finding
8	Medical	Thoracic or abdominal contusion
5	Pleurostomy tube	Hemopneumothorax
4	Exploratory laparotomy	Hollow viscus injury
3	Exploratory laparotomy	Liver injury
1	Exploratory laparotomy	Spleen injury

Results

Twenty-one patients were included; 13 (61.9%) were males and 8 (38%) were females. One patient had a basicervical fracture of the femur, instead of a shaft fracture, and was considered as a variant of Waddel's triad. The age range was 3-14 years, with a mean age of 7.09 years; weight upon admission was 12 to 30 kg, with a mean of 19.8 kg. The PTS range was 1-9, with a mean of 5. Open fractures represented 9.6%. Skeletal injuries associated with the femur fractures were found in 15 cases, which accounted for 71.4% (*Table 1*). No deaths were reported in our series. The following findings were observed in the 21 cases that sustained head trauma: 13 cases had moderate-to-severe brain edema (62%), 7 had subarachnoid hemorrhage (33.3%), and one had right parietal fracture (4.8%) (*Table 2*). In the case of thoracic or abdominal trauma, 8 were found to have thoracic or abdominal contusion (38%), 5 had hemopneumothorax (23.8%), 4 had injury of a hollow viscus (19%), 3 liver injury (14.3%), and one had splenic injury (4.8%) (*Table 3*). An endotracheal tube was placed in 18 patients (85%) for mechanical ventilation support upon admission to the Pediatric Emergency Room (*Figures 1 and 2*). After their hemodynamic stabilization or emergency surgery, all patients had to be admitted to the Intensive Care Unit (*Figures 3 and 4*). The treatment of the femur fracture is described in *table 4*. The LOS range was 10 to 43 days, with a mean of 31.38 days. There was no statistically significant difference, $p = 0.25$, when the patient's age was related with a lower PTS. When we compared the PTS with the patients' weight at the time of the injury considering as a reference ≥ 15 kg and ≤ 15 kg, we found a statistically significant difference with $p = 0.045$. A significant difference was also found when the PTS was related with the LOS with $p = 0.04$. All patients ≤ 15 kg had associated musculoskeletal injuries; among them, 7 of the 8 patients who underwent decompressive craniotomy also underwent exploratory laparotomy or placement of a pleurostomy tube.

Table 4.

Number of cases	Treatment
5	Locking endomedullary nail
3	Flexible endomedullary nails
2	External fixator
10	Steinman crossed nails + pelvipodal cast
1	Canulated screws

Discussion

The results shown for sex and the age group are similar to those published in the literature,^{2,3,11} without any difference in the mechanism of injury, which was being run over by a motor vehicle.^{1-3,11} It is important to note that the lower the age, weight and body mass index, the greater the magnitude of the trauma, as Kellum et al. have already shown.³ Our study, like other articles, shows that femur fracture is the most frequent injury in motor vehicle accidents (MVA). Non-orthopedic injuries occurred frequently, 24% of the patients in the series had head trauma and 59% had intrathoracic or intraabdominal injuries.

The patients with non-orthopedic injuries associated with the femur fracture represented 66.7% of the patients in the series, similar to the studies by Kirkpatrick et al. (63%); however, he found that the thoracic limb fracture was the most frequent one among patients run over by a motor vehicle.¹²

No significant difference was found in older patients regarding the location of the fracture, unlike what other studies show.¹³⁻¹⁷ The incidence of ventilatory support upon admission into the emergency room was 85%, and a higher morbidity rate was associated with a lower PTS.

All patients weighing < 15 kg sustained associated musculoskeletal injuries. Various treatment modalities were used to treat the femoral fracture, but it was found that the external fixator facilitated the handling of patients by the nursing staff.⁵



Figure 1.



Figure 2.

Figures 1 and 2. Patient with Waddel's triad upon admission into the Pediatric Emergency Room with multidisciplinary treatment.



Figure 3. Patient at the Pediatric Intensive Care Unit with a drain secondary to decompressive craniotomy.



Figure 4. Three-year-old patient with hemopneumothorax and a pleurotomy tube.

It is important to consider that a polytraumatized patient with Waddel's triad may have sustained fatal injuries, so the latter have to be ruled out and considered as a priority.

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