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Cart Related Trauma in Paediatrics: Revision of 54 Injured Child in Central, Sudan

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Abstract:

Background: Many children are admitted to the National Centre of Paediatric Surgery (NCPS), Gezira State- Sudan because of Cart-related trauma(CRT), those children reside in informal settlements, where there is lack of water supply, so they use a donkey- drawn water cart .Worldwide 78% of lethally injured children die before hospital arrival , demonstrating the need for effective injury prevention.

Objectives: To describe the mechanism of injury, demonstrate the epidemiological parameters of injury and to suggest preventive measures.

Design: hospital –based descriptive cross sectional prospective study involved all children admitted to the NCPS because of CRT Between June 2011 and June 2013.

Results: Between (June 2011 - June 2013), 54 paediatric patients admitted to the NCPS with CRT, the median age was 9.6 yrs, 92% were males, 97% from rural areas and 3% from suburbs , the most frequent injury diagnosed was Abdominal injuries in 44 patients (81.4%), followed by chest injury(n=6) 11.1%, extremities injury n=3 (5.5%) and the least was head injury 1 patient (1.85%) and the overall mortality was 1.8%(n= 1) died on arrival to hospital because of severe head injury. The mechanism of trauma was demonstrated, the cart of class- I leaver system and the force causing the injury was calculated.

Conclusion: The study highlights the morbidity and mortality of Cart-related trauma in central Sudan, it also documents the usefulness of institutional trauma data base in identifying common traumatic injuries in paediatric, which is required for identifying appropriate public health measures and directing resources towards the prevention and management of trauma.

Introduction:

Pediatric trauma has long been neglected and has become a major cause of morbidity and mortality, disability, and socioeconomic burden throughout the world and it is predicted by the World Health Organization (WHO) that by 2020, it will be the number one disease globally [(2)]. Childhood injuries continue to be underappreciated in sub-Saharan Africa. It is estimated that children under 18 years constitute approximately 50% of the population in Africa (as opposed to only 18% in the rest of the world) and, therefore, are taking the brunt of trauma in the African continent[(3)]. Most injuries occur in children who lack adequate supervision in their homes or outdoors, particularly in many African settings where there are large families with multiple siblings and low socioeconomic status, leading to child labor and abuse.

For instance, falls that were previously known to be the leading cause of injury and deaths in children have now been overtaken by motor vehicle accidents, children are particularly vulnerable as pedestrians in poorly planned traffic environments and are often not appropriately restrained when they are passengers.There is an ongoing misperception that injuries are just

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due to random chance and that little can be done to prevent them. However, the present commonly accepted scientific approach warns against this attitude and maintains that these false beliefs may perpetuate this myth and deem.

Preventive efforts for injury prevention appears to be the most cost effective method for addressing the problem of pediatric trauma. The most effective injury prevention measure in Africa is an evidence-based community injury prevention model having a shared ownership of the injury problem and its solution by experts and community members, and joint responsibility for determining appropriate priorities and interventions [(4)].

Situation in Sudan:

Cause-specific data on pediatric trauma are lacking in many parts of Sudan because of the nonexistence of trauma registries. Wars and conflicts have exposed the community and children to risk factors of injury and have changed many mechanisms of injury, reshaping the pattern and prevalence of trauma. Wars and displacement forced people to settle randomly or in camps around towns and villages, where there are no services, so they use a donkey-drawn water cart (Figure 1), this water cart is a kind of lever system tool, which is locally made, so we can apply rules of physics to understand the mechanism of trauma and to calculate the force causing this kind of trauma, It is of class

I lever system (Figure 2).

Figure 1: water cart

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- First Class Lever

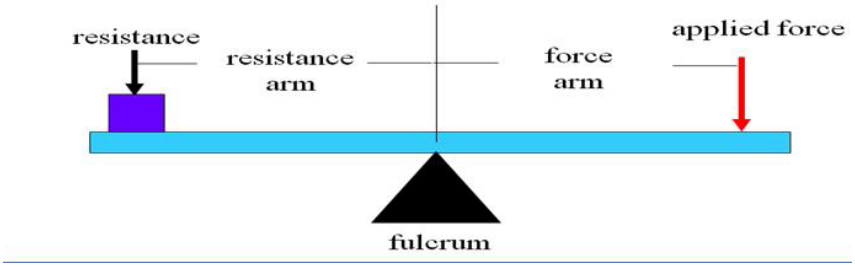

Figure 2: Class -I Lever system

Lever System

Levers are one of the basic tools that were probably used in prehistoric times. Levers were first described about 260 BC by the ancient Greek mathematician Archimedes (287-212 BC). A lever is a simple machine that makes work easier for use; it involves moving a load around a pivot using a force. Many of our basic tools use levers , including scissors (2 class 1 levers), pliers (2 class 1 levers), hammer claws (a single class 2 lever), nut crackers (2 class 2 levers), and tongs (2 class 3 levers). First Class – The applied force and the resistance are on opposite sides of the fulcrum, Second Class – The resistance is between the applied force and the fulcrum, Third Class – The applied force is between the resistance and the fulcrum.

Results:

Between June 2011 and June 2013, 54 patients (under age of 16 years) presented at the NCPS –Medani with CRT trauma, the mean age was 9.6 (range,). 92% of them were males. 97% came from rural settings. Fig.4 shows that the most frequent injury diagnosed was abdominal injury in 81.4% (n=44), and the most frequent abdominal injury was the splenic injury in 40.9% (Figure 5), the overall mortality was 1.8 % (n= 1).

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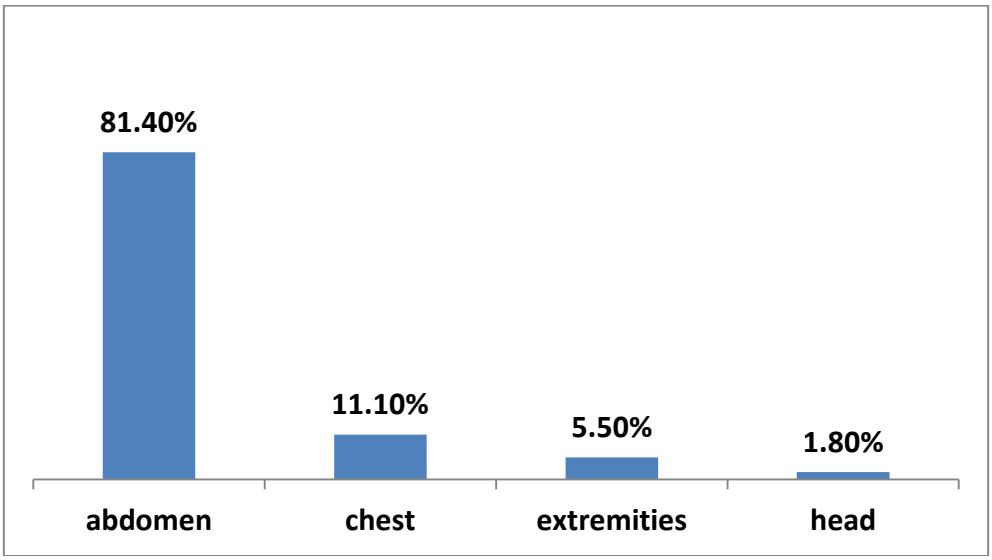

Figure (4): Sites of Trauma

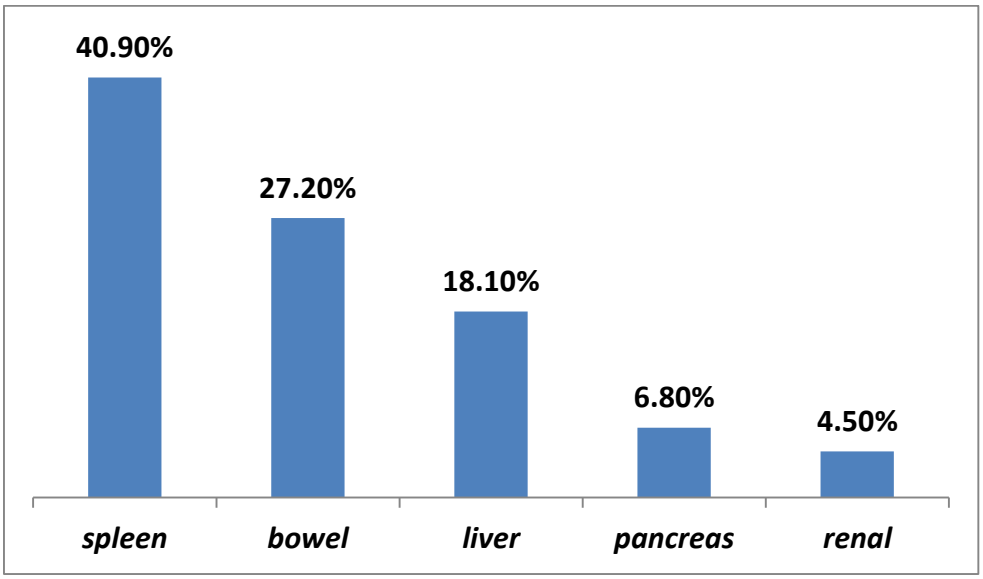

Figure (5): Sites of abdominal trauma

Discussion:

During the study it was noticed that the majority of injuries occured at home, when the donkey was released; so this will disturb the balance of the lever system, children use to hang at the resistance side as a sawyer (Fig.5 and Fig.6).

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Figure (5): simulation

Figure (6): simulation

The force applied was calculated, when the weight of two barrels – full capacity -fell on the child:

The capacity of one barrel is 44 Gallons, in liters 44 x 4.5 = 198 L, in ml 198.000

Weight of one empty barrel is 30 Kg and so the total force applied is (198 x 10-3 + 60)9.8= 589. 9404 n, Two barrels is: 1180

Dynamic energy = mass x vlosity²/ 2 = 5782

Kinetic Energy

K.E. = MV^2 / g^2

M: mass in pounds

V: velocity (F/S)

g: acceleration of gravity = 32 ft

*the object (metal bar)

The full expression of the potential destructive force of any given collision is expressed in terms of foot – pounds / S / seq. inch of application.

One foot is the amount of work required to raise 1 pound 1 foot against the force of the gravity. Dissipation of kinetic energy can cause displacement of gas or liquidds within the victim, with the resulting injury being due to hydrostatic or pneumo–forces. Differences in the plasticity of various structures lying in the path of dissipated waves of kinetic energy. Injuries are associated with many predictable features such as age, sex, geographic location and socioeconomic status [(5)]. The demographic data and the studied population revealed that the median age was 9.6 yrs, 92% being males and 97% reside in the rural communities. Most injuries occured in children who lack adequate supervision, as in many African settings where there are large families with multiple children and low socioeconomic status leading to children labor.

In a study done in Ethiopia by Dan Poenaru, between February 2011 and April 2014, the most frequent injury diagnosed was lower limb fracture (32%), followed by upper limb fracture (13%), multiple trauma patients (9%), skull fracture (7%), and concussion (5%). Less frequent injuries included abdominal, thoracic, lacerations and dislocations.

The most frequent mechanism of injury was pedestrian injured on the road (31%), followed by pedestrian beside the road (12%), passenger in vehicle (4.3%), passenger on top of vehicle (4%), and motorcycle passenger (3%).Less frequent mechanisms included motorcycle and vehicle driver, bicycle, and horse-drawn cart passenger. This study confirmed that, injury

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mechanism is the main predictor of injury pattern, and so the body regions most frequently injured in major childhood trauma are the lower extremities, head and neck, and abdomen. In minor childhood injury, soft tissue and upper extremity injuries predominate. Motor vehicle versus pedestrian trauma results in the Waddell triad of injuries to the head, torso, and lower extremity (pelvis, femur or tibia). Motor vehicle injuries may cause head, face, and neck injuries in unrestrained passengers. Cervical spine injuries, bowel disruption or haematoma, and chance fractures occur in restrained passengers. Bicycle trauma results in head injury in the unhelmeted riders as well as upper extremity and upper abdominal injuries , the later results of contact with handle bar[(6)] . Direct impact from a bicycle handle bar remains highly predictive of the need for operation.

The most common site of injury in CRT is abdominal injury, unlike the results found in other trauma centers, because of other mechanisms of injury, in which serious bdominal injury accounts for approximately 8% of admissions to paediatric trauma centers and abdominal trauma is the third leading cause of paediatric traumatic death after head and thoracic injuries worldwide, this is due to the mechanism of injury. It is a focused trauma that will produce an injury in a particular part of the body as the child hangs over the bar of the cart, so the fall of the weight most likely will be on the abdomen and because of the anatomical differences in children, they are more vulnerable to major abdominal injuries even with very minor forces and in cart related injury significant force will be applied to a relatively small area hence it is less well protected by the pliable rib cage and underdeveloped anterior abdominal wall muscles.

The most frequent injured abdominal organ is the spleen (n=18) 40.9%, 17 were treated conservatively (close follow –up to the vital signs, haematocrit and serial U/S) which was successful in all patients and only one underwent splenectomy. The observative method is more suitable in children than in adults because of their thick capsule. Followed by bowel injuries, unlike the results found in the literature, which revealed that the second injured abdominal organ is the liver , this is due to the mechanism of injury , which is a combination of compressive and crushing forces against a distended or a fixed viscus, Initially all patients with bowel injuries showed no signs other than anterior abdominal wall bruising, but with close follow-up and repeated examinations (which was the main stay in evaluating patients with suspicion of bowel injuries) they showed signs of peritonitis. Bruising of the abdominal wall is an important finding, This is a universal finding in our patients with significant intra-abdominal catastrophe(Fig.7) , Crash Injury Research Engineering Network database (CIREN) has proved that, abdominal wall bruising in restrained children, is frequently indicative of intra abdominal injury[(6)]. The effect of blunt traumatic injury may be more diffuse, but in cart related trauma it is usually focused and resembles that of handle bar injury; significant force applied to small area of the abdomen –epigastrium – leads to pancreatic injuries, Three of our patients had pancreatic injuries, two had transection of the pancreas (Fig.8), the third one had pancreatic pseudo cyst, who underwent cystgastorostomy.

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Figure (7): Bruises of the Anterior Abdominal Wall

Figure (8): Transection of the Pancreas

Eight patients had liver injury; all were hemodynamically stable and so were treated conservatively. Two of our patients had renal injury and they were treated conservatively. One had Bladder Injury, exploration and repair was done. Thoracic Injury in six patients, one needed chest tube due to haemopeumothorax. Head injury was encountered in one patient (Fig.9) linear skull fracture. Three patients had skeletal injury, simple limbs fractures.

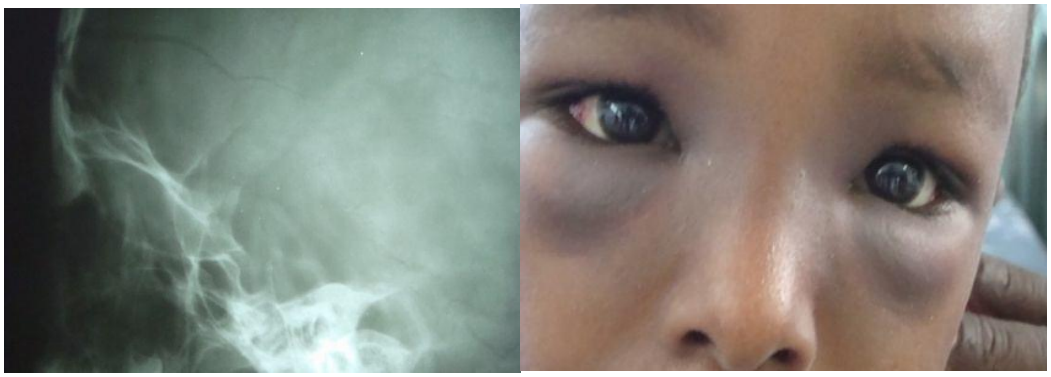

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Figure (9): Linear Skull Fracture

The overall mortality rate was 1.8 % (n=1), who was unconscious on arrival, late presentation, he died during resuscitation, most likely due to severe head injury.

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