Surgery Clinics Journal

ISSN 2687-6973

Research Article

Pediatric Snowboarding Severe Abdominal Trauma: Report of Our Experience

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Abstract

Purpose: The purpose of this study is to report our experience with abdominal trauma treated in high mountain with a well skilled rescue team.

Materials and methods: we retrospectively review cases of severe abdominal trauma in snowboarder aged 6-18 years treated between December 2010 and December 2018. This specific high mountain ski area has a well skilled rescue team with doctor. Demographic, type of injury, type of organ trauma, morbidity and outcomes were recorded and evaluated.

Results: After reviewing cases, 32 patients were enrolled, 30 were male, 18 (56%) cases had an associated head trauma with concussion and neurocognitive deficits; other 5 cases had head trauma without deficits. One patients had thoracic spine injury associated with complete spine injury. Twenty were injured in a fall, 10 collided with a stationary object and in 2 cases the mechanism of injury was unclear. 19 patients had single organ injury (18 spleen and 1 kidney); 5 patients had spleen and kidney, 6 patients liver and spleen and 2 patients had spleen, liver and pancreatic injury. Two patients underwent splenectomy and nephrectomy while only one patients had splenectomy alone. All the other were treated conservatively without morbidity. Younger patients <15 years were more likely to have multiple organ injuries ($p<0.05$); all patients were secured and hospitalized by helicopter support. Mean time from injury to hospitalization was under 45 minutes.

Conclusion: Young male snowboarders are at risk for having multiple organ injuries; it is essential to hospitalyze these cases as soon as possible. Abdominal trauma especially after collision with stationary object are at risk for severe organ failure.

Keywords: Trauma; Pediatrics; Snowboarding; Abdominal

Introduction

Alpine skiing and snowboarding are popular winter sports and they are associated with a high risk of injury [1]; the type of injuries related to these sports have changed over time as the equipment and slope-grooming technologies have evolved. The current literature shows that experienced snow sports participants are more likely to be injured while performing tricks or jumps into a snowpark [1,2].

Musculoskeletal injuries in snowboarding are common and the types of injiuries varies. Hand, wrist, shoulder and ankle injiuries are the most common; on the other hand, snowboarding injiuries are different respect to the type of trauma: collisions *vs.* falls have different trauma energy with different results: rails, wood, stationary objects could have different organ injiuries associated.

Alpine rescue team is essential in high mountain especially with severe trauma and essential is the first management of these cases. It has been reported that Expert emergency care and direc treferral to the trauma center are associated with reduced 2-week mortality in severe trauma [1,3].

In this condition, especially in high mountain, mild-to-moderate trauma can become life-threatening under extreme atmospheric conditions [1,2].

The aim of this study is to report our experience as a high mountain rescue team with pediatric blunt abdominal trauma.

Materials and Methods

From a tourist point of view, this ski area has some important data to report: data from archieves reported more than 800.000 tourists (November–May) per year; every year there were more than 550 trauma in the slopes. At least 20 were child <6 years of age, with a total of 80 cases less than 18 years of age per season. From our archives (pediatrics and adults) we had: Type of trauma:1-joint distortion2-bone fractures3- blunt abdominal/thoracic/head trauma, 3-joint dislocations, 4-skin lesions, 5- medical problems (stroke,cardiac arrest or other cairdia arrhythmia, head-hake, high pressure, panic attack). Do tue the workplace temperature between -25°C to10°C, usually 24% of accidents had mild hypothermia.

Team Organization: Mountain rescue team:1doctor, 4 rescuers specialized for alpine rescue; Trauma Clinic team:2 orthopedics, 1 radiology technician, 1 nurse.

Citation: Nicola Z, Massimo C, Enrico C, Carlo R, Saverio CF. Pediatric Snowboarding Severe Abdominal Trauma: Report of Our Experience. Surg Clin J. 2019; 1(1): 1005.

Publisher Name: Medtext Publications LLC

Manuscript compiled: April 06th, 2019

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Rescue team equipment: snowmoto, ski, rescues led (Toboggans),vacuum mattress, vacuum splint, femoral traction splint, pelvicslings, braces, spineboards, backboards, cervicalcollars, defibrillator, drugs, oxygen, first aid kit (sutures, surgical instruments), thermoblanket.

We retrospectively review medical charts of patients aged 6 to 18 yrs treated in the ski area in high mountain (2800-3000mt) between December 2010 and December 2018 (Alpen zone).

Data were analyzed focusing on type of injury and type of management. The rescue team worked with helicopter support when necessary due to the difficulty to treat these patients in a locum first-aid centre. Exclusion criteria: patients lost to follow-up or repatriated for treatment.

After trauma if patient is stable without acute urgencies went to Trauma clinic for consideration; while with patients stable/unstable with acute urgencies was usually: transferred after stabilization by helicopter to Acute Trauma Centre (III level Hospital). In this specific ski area distance from Hospital is 6-15 minutes by Helicopter while 2 hours by ambulance.

All patients were treated and scored using the Injury severity score (ISS) [4] before hospitalization; Alcohol and drugs involved were recoreded. Patients treatment: a) 1 rescue start immediately after call for localization into the sky area; b) after evaluation he asks for advanced treatment; c) team organization and starting with materials; d) diagnosis, prepare patients and decision. When helicopter support was impossible into 20 minutes, patients were stabilized in the ski area and secured at the Trauma Clinic while helicopter coming. All patients were stabilized in the ski area with peripheral venous cannulation, fluids and pain-killer infusion, thermo blanket, oxygen, braces and vacuum devices as indicated.

All organ injuries were recorded and classified using the common Organ injury scaling [5,6].

Informed consent to archive trauma data and morbidity was obtained before Hospitalization by patients parents with oral consent and with written consent during statement with Police after trauma, while writing a report of accident as required by legislator. Statistical analysis was performed using the student t-test, chi-square and Fischer exact tests. Significance value was set at $p<0.05$. The analysis was conducted with the Statistical Package for Social Sciences (SPSS) software version 15 for Windows SPSS Inc, Chicago, USA.

Results

During the study period 177 cases were bewteen the age range; after reviewing medical charts 32 patients were included. 30 were male and 2 were female. ($p<0.05$). All subjects under 14 years had Helmets as reguired by Italian legislator. About others they also had Helmet especially inside the snowpark as required by the legislator. 18 cases (56%) had an associated head trauma with concussion and neurocognitive deficits: other 5 cases had head trauma without deficits. One patients had thoracic spine injury associated with complete spine injury and one patients required oral intubation (ISS 32); Nationality: CZ (28%) , Denmark (15.6%) , Poland (25%), Sweden (15.6%), Russia (3%) , Italy (6.2%), UK(6.2%).

About rescue, the mean time to start immediately after call and localized patient into the sky area was 3,7 minutes; after evaluation the mean time to ask for advanced treatment was 3,3 minutes; mean time for team organization and starting with materials was 4,2 minutes and the mean time for final diagnosis, prepare and stabylized patient for transport was 6,4 minutes. These intervals were longer in rescue conducted under worst weather or in cases with collisions. ($p<0.05$).

21 cases (64%) were treated with a temperature under -15°, 15% between 0° and -15° and the other over 0° ($p<0.05$).

Patients characteristics: 20 were injuried in a fall (13 after a jump), 10 collided with a stationary object, 2 cases unclear (alcohol involved).

Statistical considerations: 19 cases had single organ injury (18 spleen and 1 kidney) 5 cases had spleen and kidney 6 cases had liver and spleen injury 2 cases had spleen, liver and pancreatic injury (collision with rail) During hospitalization 2 patients underwent splenectomy and nephrectomy while only one patients had splenectomy alone. All other cases were treated conservatively without morbidity.

Symptoms

After reviewing medical charts we found: 1- tachicardia (73%), 2- confusion (65%), 3- abdominal tenderness/abdominal stiffness (62%), 4- vomit (21%), 5- flank hematoma (12.5%) 6- Breathing difficulty (12.5%). 18 (56%) patients had at least 2 symptoms, while 5 (15%) had more than 3 symptoms ($p<0.05$).

The mean ISS value was 17 (range 9 to 30). Subjects older than 13 were more likely to have ISS between 18 and 27 ($p<0.05$) and the ISS value was statistically correlated with weather and type of trauma (collision *vs.* falls) ($p<0.05$). Patients with major trauma (higher ISS score) were found to be correlated with a sunny day and around an international snowboarding show ($p<0.05$).

Patients with trauma outside slopes (free riders) where more likely to have hypothermia (mild) and bone fractures associated if compared with others (<0.05).

Regarding the type of injury we had: Liver trauma: grade II-III, Spleen trauma: grade II-IV, Kidney trauma:grade II-IV and Pancreatic trauma: grade 3.

Patients older than 15 years were more likely to have multiple organ injuries ($p<0.05$); Patients older than 15 years were more likely to have injuries against stationary objects ($p<0.05$) and patients younger than 10 years were more likely to have skeletal fractures associated. ($p<0.05$).

Weather and trauma correlation: Big trauma where more common in March and April (sunny) and after important snowfalls (> 48 hours) ($p<0.05$). Abdominal trauma associated with skeletal fractures were more common in "winter" and associated with falls ($P<0.05$).

Discussion

Trauma is frequent in pediatric age. Recently in 2015, there were an estimated 13,436 injuries related to snow sports in children younger than 15 years old in the U.S., resulting in over 1300 hospital admissions [3]. The most recent data available from the National Ski Areas Association reported 39 deaths due to skiing or snowboarding. In high mountain the role of a well organized rescue team (one doctor and three specialized rescuers) is essential to avoid complications especially in ski area without country hospitals or first aids. The most important phase of treatment is the prevention of post-rescue collapse during the first 30 minutes following rescue, and during transportation to a Hospital.

As reported by other Authors, in mountain one important factor is the presence of low temperature during [7-10]; in fact in many cases low temperature does not permit patients to be disrobed for a physical examination. The feasibility of on-site monitoring and diagnosis

is severely limited but if conducted fast, rescuers could have more information to organized the hospitalization.

As reported by a recent article trauma was the most common pediatric emergency indication (91.3%) in alpine areas for helicopter support, and 77.5% of the indications were related to skiing and snowboarding [10,11]. Despite the predominance of extremity and head injuries, nearly 20% of injuries were to the chest or abdomen; an interesting result is that snowboarders sustain a disproportionate number of left upper extremity fractures compared with right. As reported by Authors, the predominance of left-sided abdominal injury may be related to the predominance of left upper extremity injury [9-11]. From a clinical point of view some questions are necessary: 1. If effective treatment technology had been available, would an individual have survived? 2- Are a significant number of people treated by personnel that are not knowledgeable, or not equipped with current technology? 3-If a hypothermic victim is rescued but has complications during recovery, and there is no other significant trauma or disease, does this suggest that complications may have resulted from inappropriate or ineffective treatment, or no treatment at all?.

Rescuers have an important role in the first medical treatment of victims; In high Mountain an important factor to remember is the association between trauma and hypothermia. Accidental hypothermia, especially after trauma, is defined as an unintentional drop in core body temperature below 35°C. Hypothermia is classified as mild (32-35°C), moderate (28-32°C), severe (20-28°C) and profound (<20°C). The importance to recognized hypothermia and to treat it, is to avoid the potential risk to add complications with the main trauma management. The most important risks are associated with circulation; Hypothermic cardiac arrest is defined as cessation of circulation caused by hypothermia, including ventricular fibrillation (VF), ventricular tachycardia without pulse (VT), pulseless electric activity (PEA) and asystole (AS) Treatment of hypothermia starts in the field. Many rescuers and first-aid providers do not have equipment to institute rewarming with warm, humidified oxygen, and warm i.v. fluids, although these methods should be initiated to help prevent (core) temperature after drop as soon as possible. The classification of hypothermia represents respectively: a preserved capability to maintain core temperature through compensating thermoregulatory mechanisms (mild), loss of ability to sustain temperature voluntary and autonomic (moderate), high risk of malignant arrhythmias (severe) and cardiac arrest (profound) [12-16]. Treatment of hypothermia starts in the field. Many rescuers and first-aid providers do not have equipment to institute rewarming with warm, humidified oxygen, and warm i.v. fluids, although these methods should be initiated to help prevent (core) temperature after drop the most important phase of treatment is the prevention of post-rescue collapse during the first 30 minutes following rescue, and during transportation to a Hospital or Clinic. There are some differences in the overall injury patterns between skiers and snowboarders: while skiers have usually trauma of legs and arms and spine, snowboarders had also important abdominal trauma. These patients, with the recent opening of snowparks are prone to injury with stationary objects with serious consequences. Abdominal trauma could be associated with morbidity even if, at present, many of abdominal trauma is treated conservatively. Injury prevention efforts should evaluate modifiable extrinsic risk factors, such as strategies to increase use of protective equipment.

Conclusion

Young male snowboarders are at risk for having multiple organ injuries. In the slopes and in extreme conditions there are no clear signs of intraabdominal organ failure but undestanding the dynamicity of traumas could be useful to suspect them. It is essential to understand also the kinetic power of trauma as soon as possible to avoid morbidity. Abdominal trauma especially after collision with stationary object are at risk for severe organ failure.

Ethical Approval

All procedures performed in study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendements or comparable ethical standards. IRB of our Institution approved the study.

Informed Consent

Informed consent was obtained from all patients parent included in the study.

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