

Clinical Paper

All-Terrain Vehicle(ATV) Injuries – An Institutional Review Over 6 Years.

Adil MT, Konstantinou C, Porter DJ, Dolan S

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ABSTRACT

Objective: Quad bike or all-terrain vehicle (ATV) related injuries are a significant cause of trauma and may present with severe or fatal injuries. Most of the literature describing ATV related injuries come from North America and Australasia and data from the United Kingdom is scarce despite a high prevalence of ATV use. The aim of this study was to describe our single centre experience with ATV injuries over a 6-year period from 2010 to 2015.

Materials and Methods: This is a cohort analysis of 65 patients who presented with ATV related injuries in South West Acute Hospital, UK between 2010 and 2015.

Results: 65 patients had ATV injuries. 34 (52%) patients were children between 0 – 17 years of age. 88% (n=57) patients were ejected from the ATV, six got trapped underneath and two had collisions. “Ejection” as a mechanism of injury was significantly more common than the other mechanisms (p<0.0001). Compliance with helmet use was low at 16% (n=10). Extremity (48%) and head and face trauma (43%) were the most common injuries. One (1.5%) patient died while 3 (4.6%) patients had major morbidity.

Conclusion: ATV injuries are an important cause of trauma admissions and carry a significant risk of morbidity and mortality. Extremity and head trauma are the most common injuries resulting from ATV accidents. More than 50% of the injured are children. Compliance with helmet use is low and calls for legislation and public awareness strategies to reduce the impact of ATV accidents on health care.

Key words: all-terrain vehicle injury, quad bike, trauma, helmet, childhood trauma, occupational hazard

INTRODUCTION

All-Terrain Vehicles (ATVs), popularly known as Quad bikes are defined by the All Terrain Vehicle Industry European Association as “any motorised vehicle designed to travel on four low pressure tyres on unpaved surfaces, having a seat designed to be straddled by the operator and handlebars for steering control”.¹ They were first designed for work-related use in farms; but have become increasingly popular for recreation and sports.^{2,3} After their introduction in the early 1980s, it soon became evident that ATVs were a significant user hazard with an estimated 106,000 injuries needing treatment and 347 deaths in 1986.^{4,5} 40% of these deaths and injuries involved children less than 16 years.⁵ According to estimates in United States, there is a 0.7 risk of death occurring per 10,000 ATVs in use and over 4 billion dollars spent each year in estimated lifetime economic costs.^{6,7} Several studies from the United States, Canada, Australia and New Zealand confirm the danger of ATV use and the findings suggest a high incidence of both fatal and non-fatal injuries.^{4,5,8-11} It is known that the use of helmet and crush protection devices reduce the impact of injury in an ATV accident.⁹ A crush protection device is a small unobtrusive

hairpin shaped hoop mounted on an ATV behind the rider meant to counter some of the risks associated with a rollover. Despite the high prevalence of ATV use in the UK and Ireland both off-road and on-road, literature on ATV use and injuries is scarce. There is only 1 study on ATV related accidents from the Republic of Ireland published in 2003 and a more recent case series in 2012.^{11,12}

The purpose of this study was to describe our single centre experience with ATV related injuries in Northern Ireland, UK. This study on 65 ATV injury patients is the largest series of its kind from either UK or RoI to date. We describe our experience with ATV related injuries over a 6 year period including analysis of demographics, presenting characteristics, pattern of injuries, management of injuries, outcome in terms of morbidity, mortality and follow-up.

Department of General Surgery, South West Acute Hospital, Enniskillen, BT74 6DN, UK.

seamus.dolan@westerntrust.hscni.net

Correspondence to: Seamus Dolan



METHODS

Data Collection

A cohort analysis was performed on a prospectively maintained database of all patients who presented to South West Acute Hospital, Enniskillen, UK (previously known as Erne Hospital) from 2010 to 2015. Using clinical notes, we identified 65 patients with ATV related injuries.

A review of the clinical notes was carried out to collect information regarding demographics, clinical features, mechanism of injury, pattern of injuries, ICU admission, laboratory results, radiological findings, operative interventions, crucial events (morbidity and mortality) and follow-up. We also studied compliance with helmet use and childhood (0 – 17 years) injuries due to ATV-related accidents.

TABLE 1:

Mechanism of ATV related injuries.

Mechanism of Injury	Number (%) of Patients (n=65)
Ejection	57 (88%)
Entrapment	6 (9%)
Collision	2 (3%)

The type of surgery performed, operative findings, postoperative hospital stay, and complications were recorded. Injury pattern was classified as per the Abbreviated Injury Scale(AIS) and a score of 3 and above was defined as a major injury. Follow-up was arranged for injuries as deemed necessary by the treating clinician.

Statistical Analysis

Results were interpreted as mean and range where applicable. Analysis and comparison of groups was performed using numbers and percentages or statistical tests depending on the variables and distribution of data. One-sided or two-sided

tests were performed using SPSS software (ver. 22) where applicable and a P-value of less than 0.05 was considered statistically significant.

RESULTS

65 patients were identified with ATV related injuries between 2010 and 2015. The mean (SD) age of the study population was 21 (9) (range – 3-74) years. 52% (n=34) of the injured were children in the age group of 0 – 17 years of whom 12 patients (19%) were between 3 and 10 years of age. Eleven were female.

62 patients (95%) were driving quad bikes at the time of injury while the remaining 3 were passengers. The analysis of the mechanisms of injury is listed in Table 1. Ejection was found to be significantly more common than the other mechanisms (p<0.0001). Analysis of compliance with the use of helmets revealed that only 10 (16%) of the 65 patients were wearing helmets at the time of injury.

The injury pattern was found to be variable in the study group with involvement of all major organ systems. Thirty-four out of 65 (52%) were found to have multiple injuries involving more than one organ system. Forty-six patients (71%) had minor and moderate injury (AIS ≤ 2) while 19 patients (29%) had an AIS of 3 and above consistent with major injury. Fifteen patients (23%) were found to have injuries which did not require any investigation or intervention. A detailed analysis of the pattern of injuries identified is given in Table 2.

A total of 108 radiological investigations were requested. Skiagrams (X-rays) were most common constituting 71% (77). Computed tomography scans constituted 25 of 108 (23%), Ultrasonography of the abdomen was performed in 4 patients (4%) and magnetic resonance imaging of the spine was performed in 2 patients (2%). Detailed analysis of the radiological investigations is given in Table 3.

Inpatient admission was required in 14 patients (22%) due to the severity of their injuries. Four (6%) were admitted to an Intensive Care Unit. Surgical intervention was performed in 7 patients (11%). One patient was treated with decompressive craniotomy for subdural hematoma and 6 required orthopedic

TABLE 2:

Patterns of injuries identified and description of major injuries with respect to organ system involvement.

Location of Injury	No (%) of Patients (n = 65)	Number and Description of Major Injuries
Head and Face	28 (43%)	8 5 intracranial haematomas 2 temporal bone fractures 1 zygomatic fracture
Thorax	19 (29%)	3 2 clavicular fractures 1 sternal fracture
Abdomen	7 (11%)	1 liver laceration
Pelvis	8 (12%)	1 pelvic fracture
Back/Spine	20 (31%)	2 vertebral fractures
Extremities	31 (48%)	6 extremity fractures



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TABLE 3:
Investigations done for ATV related injury patterns.

Location of Injury	No (%) of X-rays (n = 77)	No (%) of Computed Tomography Scans (n=25)
Head and Face	3 (5%)	9 (14%)
Thorax	15 (23%)	3 (5%)
Abdomen	4 (6%) (+4 ultrasonography)	3 (5%)
Pelvis	8 (12%)	1 (2%)
Back/Spine	19 (30 %)	9 (14%) (+2 MRI)
Extremities	28 (43%)	0

fixation (1 clavicular fixation for fracture, 1 pelvic fracture treated with internal fixation and 4 extremity fractures treated with open reduction and internal fixation). Twenty patients (31%) were followed up at the outpatient clinic. None of the 20 patients showed any further progression of their injury or development of new symptoms.

Analysis of treatment is given in Figure 1.

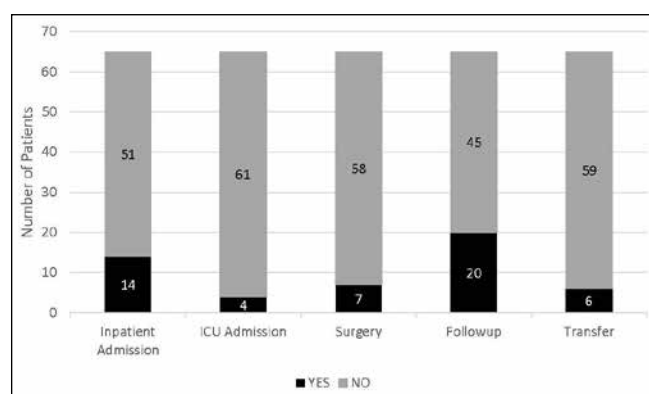


Fig 1. Analysis of treatment given for ATV injuries

Analysis of morbidity and mortality data revealed 4 crucial events. One patient died as a result of severe traumatic brain injury with multiple contusions on the day of admission. One patient developed a left sided hemiplegia after she recovered from severe head injury (Glasgow Coma Score – 8). Another patient with a fracture of the petrous part of right temporal bone developed permanent hearing loss in his right ear after recovering from head injury. Both of these patients were less than 17 years of age. One patient had multiple haematomas and lacerations involving the right lobe of liver. He developed acute kidney injury during the course of his ultimately successful conservative treatment. Ten out of 14 admitted patients were discharged uneventfully without any major sequelae.

DISCUSSION

ATV related injuries are a recognised public hazard with significant morbidity, mortality and healthcare costs.^{4,5,8-10,13} In the UK, about 1200 patients visited Accident and Emergency in 1998 after quad bike injuries.¹⁴ By the year 2000, the

number had reached 3200 and in 2002, more than 4200 people had an ATV accident.¹⁴ The UK Health and Safety Executive (HSE) has stopped releasing figures of ATV related injuries but it is assumed that the numbers have grown since then.¹⁴ Most of the studies on ATV injury come from North America and the Australasian continent. There is a paucity of literature from other parts of the world. Our study is the largest review of ATV related injury over a 6-year period within the UK.

It is now recognised that young children may lack the physical power and cognitive capacity to operate a quad bike with safety.⁸ Studies have shown that children less than 16 years account for 30% to 50% of all ATV related injuries and 35% of all ATV related deaths.^{10,15,16} Our findings are similar with children in the age group of 0 – 17 years accounting for 52% of the injuries and 19% were between 3 and 10 years of age. According to HSE guidance, it is illegal to carry a child on a quad bike as a passenger and children less than 13yrs of age are prohibited from using ATVs for off-road riding.¹⁷ For on-road use, it is illegal to drive an ATV without a valid driving license.¹⁸ The high incidence of ATV related injuries in children in our study reflects a lack of adherence to the existing laws.

According to a study, 61% of quad bike riders experience at least one loss of control event.¹⁹ Risk factors for ATV accidents include uneven ground, taller and heavier riders, increasing mileage and higher speeds.¹⁹ One recommended strategy which has been studied previously pertains to the use of helmets.^{9,20,21} Helmet use is associated with reduction of non-fatal head injury by 64%.²¹ The risk of overall fatal injury is reduced by 42% and overall injury by 15% with helmet use.²¹ Compliance with the use of helmet varies between 30% to 70% in the literature.^{11,22} Our study shows an unusually low compliance. Out of the 28 patients who sustained head injury, only two (7%) were wearing helmets at the time of the accident and both had a minor head injury. The overall compliance was 16% (10 out of 65). Our findings are in contrast to a study from RoI where 78% of ATV injured patients were wearing helmets at the time of injury and only 2 patients (6%) suffered from head injury.¹¹ An explanation could be that 66% of the injuries in the RoI study occurred during supervised commercial courses where helmets are

compulsory.¹¹ In contrast, HSE only recommends wearing a helmet whilst riding a quad bike but does not make it compulsory.¹⁸ Stricter governance in this regard would probably be appropriate as we believe that compulsory helmet use while riding an ATV would reduce the severity of head trauma which can constitute up to 70% of all major ATV related injuries.²²

The most common injuries to occur after an ATV accident are extremity and head trauma.^{23,24} According to a study, 40% of ATV related injuries involve the extremities and 27% involves the head and face.²⁴ This is followed by thoracic and spine injuries which occur in 13% cases each while 5% of the injury occurs in the abdomen and pelvis.²⁴ Another study by Clapperton et al showed that fractures constitute more than half of all admissions.⁹ Our study showed similar findings with 48% injuries involving the extremities and 43% involving the head and face. Fractures account for 19% of all extremity trauma in our series. Analysis of data revealed that a potentially major injury was more likely to occur following head trauma than any other organ injury, though the results were statistically insignificant (21.4% vs 15.3%; $p=0.5$).

Literature on the mechanism of an ATV accident shows that the most common mechanism of injury is ejection where the driver or passenger is thrown off the quad bike (32% to 48%).^{25,26} This is followed by rollovers where riders get trapped under their vehicles (14% to 33%) and collisions where the vehicle collides against a moving or stationary object (27% to 31%).^{25,26} A steep slope is associated with 69% of fatalities in an ATV injury.²⁷ In our study, 88% of ATV accidents occurred as a result of ejection while 9% were rollovers which got the victims trapped under the quad bike and 3% were ATV collisions. Ejection was the commonest mechanism of injury ($p<0.0001$). These findings are in contrast with those of McIntosh et al who showed rollovers to occur in 70% of ATV accidents with entrapment in 49% cases.²⁸

There was one death in our study which was due to traumatic brain injury incurred while driving without a helmet. The mortality rate attributed to ATV related injury was 1.5% while disruption of an organ system posing threat to life or affecting the quality of life was observed in 4.6% of patients.

CONCLUSION

ATV injuries are an important cause of trauma-related emergency and hospital admissions. Extremity and head trauma are the most commonly observed injuries; some may be life-threatening. More than 50% of the injured victims are children. There is an unusually low compliance with wearing a helmet while riding a quad bike. A change in legislation and public awareness strategies may address these issues by prohibiting children from ATV use and mandating the use of helmet under all circumstances.

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