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Case study

All Terrain Vehicle (ATV) crashes in an unregulated environment: A prospective study of 56 cases

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ABSTRACT

All terrain vehicle (ATV) use is increasing at a rapid pace in settings without proper safety regulations. Aim: To define injury patterns, impairments, and outcomes among patients injured in ATV crashes; to determine prevalence of protective equipment use; and to define the potential role of injury prevention in addressing the problem.

Methods: During a recent 10 month period, 56 patients were reported as injured in ATV crashes seriously enough to require admission and were prospectively entered into a study-specific database. Patient demographics, site of crash, prior ATV experience, and use of safety equipment were recorded. Injuries were characterized by body system and tabulated. Outcomes, including deaths and impairments, were defined.

Results: There were 47 males (84%) and 9 females (16%). Most injuries occurred in patients older than 18 years, but 20% occurred in children less than 14 years of age. Helmet use was confirmed in 12%. Three patients died (5% mortality). Significant disability occurred in 19 patients (34%) and was permanent in 4 (7%). Head, face and musculoskeletal injuries were most common.

Conclusions: ATV crashes can cause serious injuries including death and permanent disability. The lack of awareness of the injury potential for this popular recreational activity has escalated the risk of injury, and the absence of safety programs and regulations has further aggravated the problem. Based on these data, a public education program, compulsory use of helmets and other protective clothing, and penalties for non-compliance should be implemented. Interventions at recreation sites and the point of ATV sale may be most beneficial.

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INTRODUCTION

All terrain vehicles (ATV) are four-wheeled motorized means of transport which have become popular as a form of recreational sport. They are designed for various configurations of non-paved surfaces, have low pressure tires, a seat designed to be straddled, handle bars for steering and engines that vary widely in power and size. Following the expiration of a consent decree in 1998, the manufacturers of ATVs sold in the United States began marketing vehicles with increasing power and weight. This adjustment in ATV marketing strategy has had a global impact. Engines now range from 50cc to 1000cc, top speeds may exceed 100 km/h, and gross vehicle weights may exceed 400 kg. ATVs are defined by class. Class 1 have an engine displacement of less than 800 cubic centimeters (cc's), a width less than 1.2 meters, and a weight less than 400 kg. Class 2 ATVs have an engine displacement exceeding 800 cc's, a width greater than 1.2 meters and weight between 400 kg and 600 kg. ATVs have also found a niche in farming, where they serve as work vehicles both for transport and hauling.

In Qatar, recreation makes up a significant part of daily life. The interest in ATVs has increased enormously over recent years, and trailers carrying one or more ATVs are a common sight on the roads of Qatar, especially on the weekends. Early experience in other countries, most notably the United States, with ATV crashes prior to regulation and the potential benefits of safety measures stimulated this review of patients injured in ATV crashes in Qatar. Because the trauma consequences are severe and the environment is largely unregulated, the potential value of injury prevention efforts to improve outcome must be seriously considered.

METHODS

A data collection tool was designed to define injuries, impairments and outcome among a group of patients injured in ATV crashes and requiring hospitalization for treatment of their injuries. Data was collected prospectively over a recent ten month period and included the injury mechanism, location of the trauma incident, experience of the patient as an ATV driver, and use of protective equipment. Injuries were characterized by body system. Outcomes, including impairments and deaths, were tabulated. Patients injured fatally at the scene and those seeking medical attention, but not admitted, were excluded from the study. These data and a review of what is known about ATV safety form the basis for this report.

RESULTS

During the ten-month period ending August, 2008, 56 patients injured in ATV crashes were admitted to the Trauma Service at Hamad General Hospital. There were 47 males (84%) and 9 females (16%). Ages ranged from 3 to 60 years. Mean Injury Severity Score was 8–9 with a range from 1 to 50. Most injuries occurred in patients older than 18 years, but 20% of those injured were less than 14 years of age. Injuries to the head, face and musculoskeletal system were most common, followed by torso and spine (Table 1). Head and face injuries were more common in the childhood group. Previous ATV riding experience appeared to reduce the severity of injuries sustained, but this did not reach statistical significance. Major impairments affected 19 patients (35%) and were permanent in four (7%). There were 3 deaths for a mortality rate of 5%. No protective equipment was used in 88%, and most injuries occurred at recreational sites.

Table 1. Injuries by Body System in 56 ATV Injured Patients

Injured System	Number	Percentage (%)
Head & Face	25	45
Musculoskeletal	24	43
Torso	18	32
Spine	10	18

DISCUSSION

Experience with patients admitted to the Trauma Service after ATV crashes confirms the seriousness of this problem in both adults and children. Data from other investigators suggest that the number of individuals injured in ATV incidents, then treated and released from the emergency department, is at

least as great as those requiring admission to the hospital (1). That admission data under-reports the actual magnitude of the problem is to be expected. However, other than those victims who die pre-hospital, the admission data provide a good picture of the scope and seriousness of this contemporary threat to safety.

Injury Mechanisms

Injury mechanisms include collisions and rollovers. Collisions may be with fixed objects, with another ATV or with other vehicles. Rollovers may occur side-to-side or backward, a common mechanism when ascending hills or dunes or doing “wheelies” (Fig. 1). Brandenburg et al. identified distinct injury mechanisms based on age, demonstrating that children were more likely to be injured in collisions or in lateral rollovers while adults were most commonly injured in backward rollovers (1). However, the increase in size, speed, and power has raised the risks. In 1988, Greene and Metzler described the typical ATV mishap as happening at low speed, during the day and in good weather (2). The same year, responding to a marked increase in injuries from 32,100 to 106,000 over a three year period, the Consumer Product Safety Commission (CPSC) in the United States issued a consent decree with ATV distributors which called for the institution of specific safety measures, including the implementation of a nationwide training program; development of voluntary safety standards; provision of safety warnings to buyers; and setting of age restrictions on operation. As a result, injuries declined from a peak in 1987 of 300,00 to 50,000 in 1993. The decree expired in 1998 which led to expansion of vehicle size, power and weight. This expansion in risk was not accompanied by a corresponding expansion in safety efforts. The CPSC-manufacturer labeling of the ATV as unsuitable for young drivers if over 90cc is still in place but is not universally applied. Rodgers confirmed that almost all children under age 16 years ride ATVs intended for adults (3). The use of safety equipment is not required and, in many places, not encouraged even if available (personal observation).



Figure 1. Photo of unsafe ATV operation—performing “wheelie”.

Injury Prevention

There are no required ATV safety measures in Qatar. By contrast, in the United States, safety laws regarding ATV use have been enacted in 44 states. Laws differ from state to state, are tailored to the needs of the region and population, and are known as off-road laws and regulations (5). Most have common themes. A tabulation of recommended safety measures is cited in [Table 2](#).

This concept is bolstered by requiring helmet use specifically in children (protective equipment by regulation), plus certain restrictions on registration, age of operator, and carrying passengers. In most states, children under age ten years cannot operate an ATV off family-owned land. Children between 10 and 16 years of age must have parental supervision and/or have successfully completed an ATV safety course. In some states, an ATV Safety Certificate is required for all drivers under age 16.

Table 2. Specific Measures to Improve ATV Safety

Take ATV Safety Training Course
Wear protective gear, including approved helmet
Do not drive with, or ride as, a passenger
Limit use to off-road environs
Do not permit children to drive or ride on an adult ATV
Do not drive under the influence of alcohol or other drugs
Require parental oversight of children's ATV use

Since ATVs are designed for interactive operation, drivers must be able to shift their weight to maintain balance in response to variations in terrain and other conditions. Carrying passengers restricts the interactive nature of the ATV experience and increases the chance of rollovers (Fig. 2). Children should not ride ATVs designed for adults. Most childhood deaths and serious impairments come from children riding ATVs designed for adults. Other educational messages relate to eliminating alcohol and other drug use which impair reaction time and judgment, two essential skills for safe ATV operation. Alcohol and other drug use are known contributing factors to ATV crashes (4). Hands-on safety training courses are available and data shows that drivers with hands-on ATV training have lower likelihood of injury than drivers with no formal training. The cost for such courses is modest. Other beneficial safety initiatives consist of use of proper safety equipment, including helmets designed and approved for off-road vehicles, and limiting use to off-road environs. Driving ATVs on roads or highways is dangerous. Most ATVs have fixed rear axles which do not allow the inner rear wheel to rotate freely when turning, causing sudden release of torque which, on firm surfaces, promotes lurching and loss of control.

**Figure 2. Photo of unsafe ATV operation – carrying passenger.**

A great deal is known about the dangers of ATV use – much of it learned through the tragedies of fatal ATV crashes and those causing lasting impairments (Figs. 3a and 3b). In Qatar, the failure to address this emerging menace to safety continues to lead to serious injuries among our youth and young adult population. The observation that most of these injuries occur at specified recreational sites, where safety measures could be monitored and enforced, suggests that a well designed safety oriented injury prevention program could be successful. This initiative is long overdue.

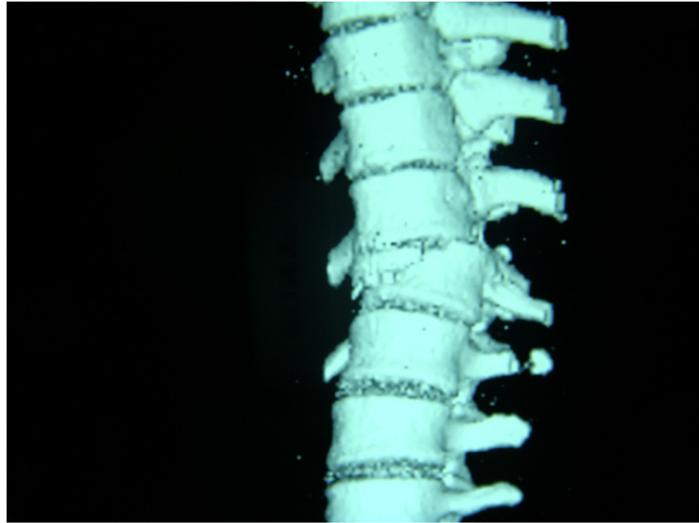


Figure 3a. Spine CT with reconstruction showing comminuted fracture of 12th thoracic vertebra with displacement in young man rendered paraplegic following ATV crash.

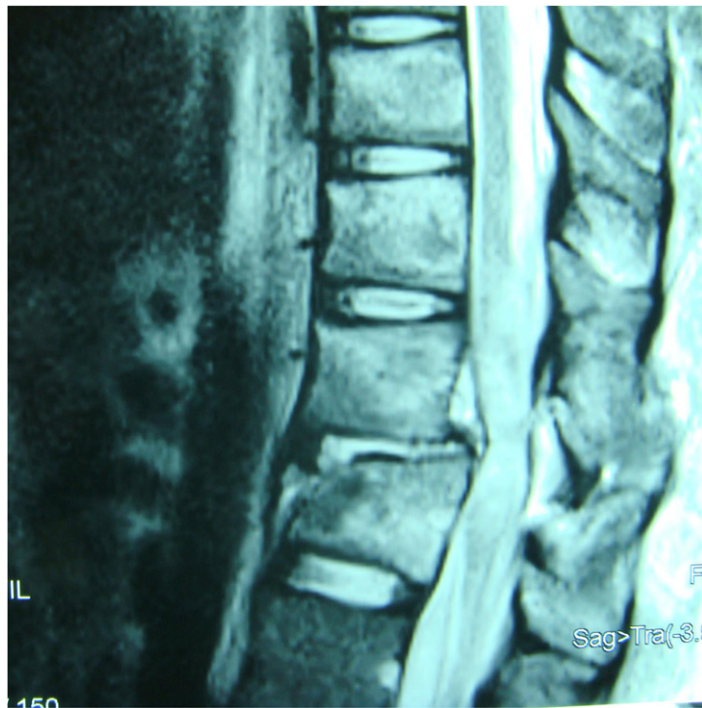


Figure 3b. Magnetic resonance image showing damage to spinal cord in same patient.

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