

Major injury associated with all-terrain vehicle use in Nova Scotia: a 5-year review

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ABSTRACT

Background: Riding all-terrain vehicles (ATVs) is a popular recreational activity, with approximately 1.5 million users in Canada. Despite legislation aimed at reducing injury rates, ATV-related incidents remain a major cause of trauma and death. This paper reviews the epidemiology of major injury associated with ATV use in Nova Scotia.

Methods: The Nova Scotia Trauma Registry was used to identify all adults over age 15 who sustained major ATV-related trauma (Injury Severity Score [ISS] ≥ 12) within a 5-year period. Demographic variables, temporal statistics, alcohol use, helmet use, injury characteristics and injury outcome variables, including ISS, length of stay (LOS), Glasgow Coma Scale score and discharge status were evaluated.

Results: Twenty-five patients met the inclusion criteria. Most (92%) were males, and 64% were between 16 and 34 years of age. Most injuries occurred between 1300 hrs and 1900 hrs, 52% occurred on the weekend, and 40% occurred in the spring. The average ISS was 22.1, and injuries to the central nervous system comprised 39% of all major injuries. Alcohol was involved in up to 56% of all incidents, and only 4 patients (16%) were known to be wearing a helmet at the time of injury. Average hospital LOS was 21.6 days.

Interpretation: ATV-related incidents are a continuing source of major injury. This paper describes the epidemiology of ATV-related major trauma presenting to the sole tertiary care referral centre in one province. Information gained from this study should be used to influence ATV public education programs.

Key words: all-terrain vehicle, trauma, epidemiology

RÉSUMÉ

Contexte : La conduite de véhicules tout terrain (VTT) est une activité récréative populaire, avec environ 1,5 millions d'adeptes au Canada. Malgré les lois visant à réduire le nombre de blessures, les incidents liés aux VTT demeurent une cause importante de traumatismes et de mortalité. Le présent article passe en revue l'épidémiologie des blessures associées à l'usage de VTT en Nouvelle-Écosse.

Méthodes : On a eu recours au Registre de Traumatologie de la Nouvelle-Écosse pour identifier toutes les personnes âgées de plus de 15 ans ayant été victimes de traumatismes importants liés aux VTT (Score de gravité de la blessure [ISS] > 12) au cours d'une période de cinq ans. Les variables démographiques, incluant l'ISS, la durée d'hospitalisation, le score de l'échelle de trauma Glasgow et l'état lors du congé furent évalués.

Résultats : Vingt-cinq patients répondaient aux critères d'inclusion. La plupart d'entre eux étaient

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des hommes (92 %) et 64 % étaient âgés entre 16 et 34 ans. La plupart des blessures s'étaient produites entre 13 h et 19 h, 52 % s'étaient produites la fin de semaine et 40 % s'étaient produites au printemps. L'ISS moyen était de 22,1 et les blessures au niveau du système nerveux central représentaient 39 % de toutes les blessures importantes. L'alcool était en cause dans jusqu'à 56 % de tous les incidents et seulement 4 patients (16 %) semblaient porter un casque protecteur au moment de l'accident. La durée moyenne d'hospitalisation était de 21,6 jours.

Interprétation : Les incidents liés aux VTT sont une source constante de blessures importantes. Le présent article décrit l'épidémiologie des traumatismes majeurs liés aux VTT reçus à un seul centre de consultation de soins tertiaires dans une seule province. L'information contenue dans cette étude devrait être utilisée pour influencer les programmes de sensibilisation de la population aux VTT.

Introduction

All-terrain vehicles (ATVs), 3- and 4-wheeled motorized vehicles designed for off-road use, have been available in North America since 1972. Although initially marketed for farming and ranching,¹ riding ATVs has become a popular recreational endeavour. During the early 1980s, a growing number of ATV-related injuries and deaths prompted the US Consumer Product Safety Commission (CPSC) to evaluate the associated hazards.² This evaluation was basis for a series of consent decrees between ATV manufacturers and the CPSC. Between 1988 and 1998, these decrees led to termination of 3-wheeled ATV sales, age restrictions on certain size vehicles, and voluntary standards for ATV design.³ They also required manufacturers to attach warning labels to vehicles, provide training programs for purchasers, and run media campaigns alerting the public of ATV dangers.³ Current Canadian manufacturing and sales standards have been modified slightly (R. Ramsay, Executive Director, Canadian All-Terrain Vehicle Distributors Council: personal communication, May 15, 2001).

The number of ATV-related incidents declined initially, then leveled off, and ATVs remain a major cause of injury and death.⁴ US data from 1997 suggested that there were 149 emergency department (ED) injuries and 0.65 deaths for every 10 000 ATVs in use,⁵ while a recent 1-year New Brunswick review of ATV injuries found that there were approximately 3.3 deaths for every 10 000 registered ATVs.⁶ In 1999, there were approximately 3.66 million ATVs in use in the United States.² More recent Canadian data suggest there are over 500 000 ATVs in use in Canada, with an average of 3.1 drivers per vehicle.⁷

During the 5-year period between 1994 and 1998, the Canadian Institute for Health Information (CIHI) National Trauma Registry documented 4680 hospital admissions related to off-road vehicles other than motorcycles and snow vehicles.⁸ Health Canada's Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) (www.hc-sc.gc.ca/english/lifestyles/injury.html, accessed 2002 May

6) and others⁹⁻¹² have characterized the danger that ATVs pose to children, but only 2 published Canadian studies have addressed ATV injuries in adults^{12,13} and none have done so during the last decade. Our objective was to describe the epidemiology of ATV-related major trauma and to make comparisons with relevant data from the CIHI National Trauma Registry.

Methods

Setting and patients

Study data were extracted from the Nova Scotia Trauma Registry (NSTR), which includes patients treated at the 794-bed Queen Elizabeth II (QE II) Health Sciences Centre. The QE II is accredited by the Trauma Association of Canada as a tertiary trauma centre, which is equivalent to a Level 1 designation in the US. QE II is the sole trauma referral centre for adults (age >15) in the province of Nova Scotia (pop. 950 000).

Data collection

NSTR data are gathered using prospective chart review methodology on all blunt-trauma victims with an ISS of 12 or higher.¹⁴ The NSTR comprehensive data set includes 49 elements describing extent and severity of injuries, care process descriptors and outcome at discharge. Trained coders recorded mechanism of injury using the ICD-9-CM E-code categories.¹⁵ All data were entered into a database at a central input site (Halifax), and logic checks were performed to detect input and scoring errors. The NSTR now contains information on over 1000 patients.

For this study, we extracted trauma cases with the E-codes 821.0 and 821.1, which identify drivers and passengers of vehicles involved in off-road incidents (and exclude incidents involving snow vehicles or motorcycles). From these E-codes we selected cases involving ATVs for analysis. NSTR data were reviewed for the time period from Apr. 1, 1995, to Mar. 31, 2000.

Nova Scotia data were then compared to aggregate data

from all provincial trauma registries housed in the CIHI National Trauma Registry. The NSTR and the CIHI registry are similar databases in that both use an ISS score of 12 or greater to define major trauma, both perform regular validity checks on all data, and both use the same Collector[®] software system (Digital Innovation, Inc., Forest Hill, Md., and Tri-Analytics Inc., Bel Air, Md.). The CIHI registry data for the time period Apr. 1, 1996, to Mar. 31, 1999, was evaluated.

Data elements

Data elements analyzed were age, gender, ISS, site of injury, time and date of injury, helmet use, method of transport, time seen at QE II, ED disposition, blood alcohol

level (if drawn), Glasgow Coma Scale score¹⁶ at QE II, major injuries sustained, hospital length of stay and status at discharge.

Data analysis

Descriptive statistics, including proportions, means, standard deviations, medians and ranges, were determined. Missing data were reported as such. All statistics were calculated using SPSS statistical software (Chicago 1999).

Results

During the study period, 25 patients with major ATV-related injuries were entered into the NSTR. Table 1 summa-

Table 1. All-terrain vehicle (ATV)-related injuries: national versus Nova Scotia data

Characteristic	CIHI National Trauma Registry data: E-codes 821.0 and 821.1 (%) [*] <i>n</i> = 92	Nova Scotia cohort (%) [*] <i>n</i> = 25
Age in years, <i>n</i>		
16–34	48 (52)	16 (64)
35–64	39 (42)	8 (32)
65 and over	5 (5)	1 (4)
Mean (and SD)	34.9 (15.5)	34.4 (14.0)
Male, <i>n</i>	78 (85)	23 (92)
Transport mode, <i>n</i>		
Air	40 (43)	4 (16)
Ground or other	21 (23)	18 (72)
Unknown	31 (34)	3 (12)
Admission type, <i>n</i>		
Direct	19 (24.1)	5 (20)
Transfer	60 (65)	20 (80)
Other or unknown	13 (14)	0
ISS, mean (and SD)	22.1 (8.0)	22.1 (6.6)
GCS score, mean (SD)	Not available	14.1 (2.3)
Length of stay, d		
Mean (and SD)	12.5 (15.6)	21.6 (25.4)
Median (range)	7 (1–101)	13 (2–125)
Outcome, <i>n</i>		
Discharged	89 (97)	24 (96)
Deceased	3 (3)	1 (4)
Helmet use, <i>n</i>		
Yes	Not available	4 (16)
No	Not available	16 (64)
Unknown	Not available	5 (20)
Alcohol use (<i>n</i> = 35)		
Level >17 mmol/L	10 (29)	6 (24)
Clinically suspected [†]	Not available	8 (32)

^{*} Unless otherwise stated.

[†] Based on hospital staff suspicion.

CIHI = Canadian Institute for Health Information; SD = standard deviation; ISS = Injury Severity Score; GCS = Glasgow Coma Scale

rizes clinical, injury and outcome data for 2 patient cohorts: major off-road injury victims (E-codes 821.0 and 821.1) from the CIHI registry¹⁷ vs. major ATV injury victims from the NSTR. Table 1 shows that most patients were not using helmets and that over half had documented or suspected alcohol intoxication. In this study, patients with documented or suspected alcohol use had a higher mean ISS (24 vs. 19 days; $p = ns$) and longer mean LOS (28 vs. 13 days, $p = ns$). Table 2 shows that 76% of major traumas occurred in the spring or summer (i.e., March 20 to September 21), 52% on weekends, and 71% between 1300 and 1900 hrs. Table 3 shows that over 60% of injuries involved the head, face or spine.

Discussion

This paper describes the demographics, temporal characteristics and injury patterns seen in a population of patients with major ATV-related injuries presenting to a tertiary referral centre. Our Nova Scotia data mirror national data in terms of patient age, gender, type of admission, ISS and alcohol use. With respect to injury patterns, we found that 28 (61%) of 46 major injuries involved the head, face or spine, and that relatively few involved abdominal or thoracic viscera. Alcohol was a factor in 24% to 56% of our ATV incidents, and our study patients with documented or suspected alcohol use had more severe injuries (mean ISS = 24 vs. 19, $p = ns$) and longer hospital lengths of stay (28 vs. 13 days, $p = ns$). We found that, despite Nova Scotia's mandatory helmet law (www.gov.ns.ca/just/regulations/regs/ohvregs.htm, accessed 2002 May 7), only 16% of our patients were using helmets — ironic in that helmets pre-

vent up to 64% of head injuries and 42% of fatalities during ATV incidents.¹⁸ In this study, ISS scores were higher and lengths of stay longer in patients not wearing helmets. Previous authors have also found that alcohol use and helmet non-use are associated with more severe injuries after ATV trauma.^{1,6,12,19,20}

Many injuries incurred by our patients were preventable. We believe that, in the context of ATV use, passive elements (smaller engines, 4 wheels instead of 3) and active elements such as education and legislated helmet use are important preventive measures.²¹ Public education programs about ATV use should target young adult males and focus on alcohol awareness, helmet use and the ability to select safe riding conditions. Legislative parameters concerning ATV use and manufacturing standards may need to be revisited, as they were in the 1980s when 3-wheeled ATVs were banned.

Limitations

E-codes 821.0 and 821.1 do not link exclusively to 3- and 4-wheel all-terrain vehicles; therefore, it is possible that some of the CIHI registry data analyzed related to other off-road vehicles, such as 6-wheelers, dune buggies and tanks. However, of 23 619 off-road vehicles registered in Nova Scotia, 73% were 4-wheel ATVs and 6% were 3-

Table 2. Temporal statistics for ATV-related trauma

Temporal parameters	Nova Scotia cohort <i>n</i> = 25
Time of day (24-hr)	1546h ± 5.1 hours
Day of trauma, <i>n</i> (%)	
Weekday	12 (48)
Weekend	13 (52)
Season of trauma	
Spring	10 (40)
Summer	9 (36)
Fall	4 (16)
Winter	2 (8)
Mean time from injury to TTC, * minutes (SD)	468.9 ± 572.2 (297.3 ± 161.8*)

* This mean time/SD includes only those patients transferred by emergency medical services and excludes 2 outliers that were brought to hospital exclusive of EMS.
TTC = tertiary trauma centre

Table 3. Major injuries in 25 ATV incidents

Type of injury	<i>n</i> (%)*
CNS	
Major head injury†	11 (24)
Spinal cord	7 (15)
Chest	
Hemo- or pneumothorax	2 (4)
Pulmonary contusion	4 (9)
Abdomen	
Bowel	2 (4)
Spleen	2 (4)
Kidney	3 (6)
Orthopedic	
Long bone	1 (2)
Pelvic	2 (4)
Spinal fracture	5 (11)
Vascular	
Peripheral vascular	1 (2)
Other	
Peripheral nervous system	1 (2)
Major facial fracture	5 (11)
Ruptured bladder	1 (2)
Total	46

*Percent of total number of major injuries
† Subdural hematoma, epidural hematoma or intracranial hemorrhage

wheel ATVs (P. Benoit, Research and Statistical officer, Government of Nova Scotia: personal communication, July 26, 2001). An additional 20% were snow vehicles or motorcycles (both excluded by the selected E-codes). This means that, based on 2000 Nova Scotia data, 99.3% of registered off-highway vehicles that would have been captured by the study E-codes were 3- or 4-wheeled ATVs.

ATV use is associated with major and minor injuries, but this paper is limited to major trauma associated with ATV use. Many patients with less severe injuries would not have been transported to our trauma centre; therefore, overall ATV injury statistics may include a larger proportion of other injuries — notably extremity trauma. In addition, our study may underestimate ATV-related mortality, since patients who died prior to transport were not included in either trauma registry, and deaths attributed to ATV use were not captured specifically by the Provincial Medical Examiner. Finally, we did not study pediatric (age 15 or younger) major trauma associated with ATV use.

Conclusion

This paper describes demographics, temporal characteristics and injury patterns seen in a sample of adult patients with major ATV-related trauma. Head and spinal injuries were common, alcohol was a factor in many cases, and several injuries could probably have been prevented by appropriate helmet use. Future studies should include a national review of ATV injury patterns and an ATV injury surveillance strategy. Emergency physicians are in an excellent position to lead injury surveillance initiatives and influence future injury prevention strategies.

Competing interests: None declared.

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