BRIEF REPORT

Epidemiology of Hunting Stand Injuries Presenting to US Emergency Departments, 2008–2013

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Objective.—To determine the epidemiology of injuries from hunting stands presenting to US emergency departments (EDs).

Methods.—The National Electronic Injury Surveillance System (NEISS) database was queried for ED visits for the period 2008 through 2013 for hunting stand injuries and analyzed for age, diagnosis, sex, race, anatomic location of the injury, the use of alcohol, and association with a gunshot wound.

Results.—There were an estimated 38,308 visits with an average age of 40.0 years (range, 1–83 years). The patients were predominantly male (93.3%), white (99.1%), and seen at small- or medium-size hospitals (80.6%). Disposition from the ED was admission in 20.1% and released in 79.9%. A fall occurred in 80.3%, a gunshot wound in 0.4%, and alcohol was involved in 0.6%. The most common diagnoses were a fracture (34.7%), contusion or abrasion (24.0%), strain or sprain (16.8%), laceration (7.7%), and internal organ injury (5.4%). Those injured in a fall were more frequently admitted (23.0% vs. 8.7%) and more likely to have a fracture (37.9% vs. 9.1%). Those with a fracture were older (44.6% vs. 37.9%). Those with internal organ injuries were more frequently admitted (44.8% vs 18.6%).

Conclusions.—This study has characterized the epidemiology of hunting stand injuries with most occurring from falls. A fracture was the most common injury with a very low alcohol intoxication rate. These baseline data can now be used to compare other studies of hunting stand injuries and guide prevention strategies, such as education regarding the need for safety measures to prevent falls.

Key words: firearm, injury, hunting, epidemiology, tree stands, hunting stands

Introduction

Recreational hunting is a popular sport in the United States. The US Fish and Wildlife Service estimated that approximately 13 million people annually participated in hunting activities between 1991 and 2011.¹ Hunting stand injuries (Figure 1) have a higher associated mortality than gunshot injuries for hunters.^{2,3} There have been several small studies evaluating the injuries associated with such stands,^{2–9} and one has investigated the overall pattern of injuries across a national database to include all patients.¹⁰ The purpose of this study was to expand the pattern of injuries from hunting stands using a national database, and specifically focus on fracture location as well as if the patient fell from the stand, sustained a fracture or gun shot wound, and/or was alcohol involved. This will provide a comprehensive

perspective of this issue and the associated injuries. These data can then be used to propose future prevention programs for patients and education of first responders (eg, emergency medical technicians), and to guide medical kit development and future studies.

Methods

The data for this study were obtained from the National Electronic Injury Surveillance System (NEISS). The NEISS collects data from a probability sample of hospitals in the United States and its territories that have at least 6 beds and an emergency department (ED). The sample contains 5 strata, 4 based on size (the total number of ED visits reported by the hospital: small [0–16,830], medium [16,831–21,850], large [28,151–41,130], and very large [$>41,130$]) and 1 stratum consisting of children's hospitals of all sizes. Currently there are 100 hospitals in the NEISS. Each hospital has an associated weight based on its ED size and geographic location. To produce national estimates of

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Figure 1. A hunter sitting in a hunting stand during the winter. A fall from such a height can result in serious injury. (Figure courtesy of the Indiana Department of Natural Resources.)

injuries, the statistical weights must be used rather than raw case counts. Estimates across the entire data set (in this instance the United States and its territories) are thus calculated using appropriate statistical software that accounts for the stratified, weighted data. This database is in the public domain and can be found at www.cpsc.gov/library/neiss.html.

The detailed data for ED visits for the 6-year period from January 2008 through December 2013 owing to hunting stands (NEISS product code 1895) was downloaded from the NEISS website and analyzed for age, diagnosis, sex, race, anatomic location of the injury, and the use of alcohol. Race was classified as White, Black, Amerindian (Hispanic and Native American), and Indo-Malay (Asian origins).¹¹ The years 2008 through 2013 were chosen to amplify the data from the previous published study which stopped at 2007.¹⁰ This study received an exemption from the local institutional review board.

The narrative features for each case were analyzed to determine whether the patient fell from the stand or sustained a gunshot wound, or whether alcohol was involved. The

terms used for gunshot wound were *shot*, *gunshot*, and *GSW*. The terms used for a fall were *fall*, *fell*, and *fallen*. The terms used to search for alcohol were *alcohol*, *EtOH*, *intoxicated*, *drinking*, *drank*, *drunk*, *club*, *ethanol*, *saloon*, *tavern*, *liquor*, *booze*, *beer*, *whiskey*, *brandy*, *rum*, *vodka*, *scotch*, *tequila*, *wine*, *sake*, *champagne*, and *cognac*.

STATISTICAL ANALYSES

Statistical analyses were performed with SUDAAN 10 software (RTI International, Research Triangle Park, NC, 2008), which accounts for the weighted and stratified nature of the data. Continuous data are reported as the mean, and discrete data, as frequencies. Analyses between groups of continuous data (age) were performed with the Student's *t* test (2 groups) or analysis of variance (3 or more groups). Differences between groups of discrete data (sex, race, ED disposition, stratum, diagnosis, month, weekday, and yes or no for internal organ injury, fall from stand, gunshot wound, alcohol involvement, and fracture) were analyzed by the χ^2 test. A probability value of less than .05 was considered statistically significant. As this was an exploratory descriptive study, there were no preconceived outcomes. However, I did analyze for any differences between those who had or had not fallen from the stand, sustained a gunshot wound, sustained a fracture, or sustained an internal organ injury.

Results

During the 6-year period there were an estimated 38,308 ED visits (95% CI [35,595, 40,925]) owing to hunting stand injuries (Table 1). This gives an annual average of 6385 patients sustaining injuries from hunting stands. The average age of the patients was 40 years (Figure 2). The demographics are shown in Table 1; most patients were white men. The distribution of injuries is shown in Table 1 and Figure 3. One fifth of the patients were admitted, and approximately 80% fell from the stand. Alcohol use and sustaining a gunshot wound were very rare. The most common diagnosis was a fracture. Detailed analyses of the internal organ injuries revealed that 2126 (83.2%) involved the brain or head (from a simple concussion to intracranial bleed, excluding skull fractures), 301 (11.8%) the chest (eg pneumothorax, mediastinal hemorrhage), and 177 (5.0%) the abdomen (eg, liver or spleen laceration). Detailed analyses of the disposition are shown in Table 2. With increasing hospital size there were fewer patients transferred to another hospital, but more were directly admitted.

Discussion

There are several studies that discuss falls from tree or hunting stands (Table 3).^{2–10} There is one previous study

Table 1. Demographics of patients sustaining injuries from hunting stands

	<i>All</i>	<i>Fall</i>	<i>No Fall</i>	<i>p value</i>	<i>Fracture</i>	<i>No Fracture</i>	<i>p value</i>	<i>Internal Organ Injury</i>	<i>No Internal Organ Injury</i>	<i>p value</i>
n	38308	30501	7807		12244	26064		2557	30753	
Age (yrs)	40.0	40.3	38.9	0.32	44.6	37.9	<0.0001	37.2	40.0	0.29
Sex										
Male	35748	28559	7189	0.61	11514	24234	0.47	2185	29046	0.13
Female	2560	1942	618		730	1830		372	1707	
Race										
White	30982	24835	6147	0.30	9499	21483	0.19	2064	24420	0.31
Black	178	86	92		0	178		0	86	
Amerindian	111	111	0		15	95		0	111	
Disposition										
Released	30470	23385	7085	<0.0001	7074	23396	<0.0001	1411	24913	0.034
Admitted	7684	7003	681		5155	2529		1146	5686	
Stratum										
Small	22519	17739	4780	0.09	6526	15994	0.07	1559	18396	0.80
Medium	8332	6664	1669		2542	5790		372	6499	
Large	2387	1905	483		901	1486		256	2054	
Very Large	5019	4169	851		2262	2757		363	3773	
Children's	49	25	24		12	37		7	31	
Major Diagnosis										
Contusion/Abrasion	8744	7152	1592	<0.0001		8744	NA		8744	NA
Fracture	12610	11895	715		12610				12610	
Laceration	2809	1023	1787			2809			2809	
Internal Organ Injury	1982	1542	440			1982		1982		
Strain/Sprain	6117	4767	1351			6117			6117	
Other	4105	2335	1770			4105			4105	
Internal Organ Injury										
Yes	2557	2056	501	0.99						
No	30753	24690	6063							
Location of Internal Organ Injury										
Brain	2126	1647	479	0.22						
Chest	301	286	15							
Abdomen	129	123	6							
Fracture										
Yes	12244	11529	714	<0.0001						
No	26064	18972	7093							

Table 1. (continued)

	<i>All</i>	<i>Fall</i>	<i>No Fall</i>	<i>p value</i>	<i>Fracture</i>	<i>No Fracture</i>	<i>p value</i>	<i>Internal Organ Injury</i>	<i>No Internal Organ Injury</i>	<i>p value</i>
Fall										
Yes	30501				11529	18972	<0.0001	2056	24690	0.99
No	7607				714	7093		502	6063	
Gun Shot Wound										
Yes	139	0	139	0.10	0	139	0.10	0	47	0.084
No	38169	30501	7668		12244	25926		2557	30706	
EtOH										
Yes	242	242	0	0.07	96	147	0.78	0	162	0.16
No	38066	30259	7807		12148	25918		2557	30591	
Month										
Jan	2064	1649	415	0.97	430	1634	0.40	149	1567	0.008
Feb	390	314	77		64	326		72	313	
Mar	279	246	33		149	131		17	171	
Apr	431	319	111		92	338		0	401	
May	307	181	126		109	198		0	228	
June	344	232	113		163	181		0	285	
July	457	386	71		163	294		16	426	
Aug	1466	1083	383		460	1006		37	1113	
Sep	4495	3725	770		1640	2856		167	3287	
Oct	10645	8369	2276		3387	7259		752	8947	
Nov	12301	10040	2261		4307	7994		1318	9858	
Dec	5128	3956	1171		1280	3847		31	4156	
Week Day										
Sun	7665	6036	1629	0.65	2142	5523	0.46	405	6189	0.45
Mon	5538	4679	860		1726	3812		235	4980	
Tue	3903	2995	909		1119	2784		258	2927	
Wed	3898	3122	778		1256	2642		352	2913	
Thr	5127	4071	1056		1483	3644		596	3858	
Fri	5047	4145	903		1766	3281		335	4346	
Sat	7128	5454	1674		2750	4378		377	5539

Figure 2. The number of emergency department (ED) visits for injuries associated with hunting stands by age.

that examines all injuries with hunting stands using the NEISS database.¹⁰ That study, however, included only those aged 16 years or older, nor were analyses performed by groups of falling/not falling from the stand, sustaining/not sustaining a gunshot wound, association with alcohol use, or detailed analyses regarding the anatomic site for

those with fractures which is of interest to orthopaedic surgeons. Some review all hunting injuries, including those associated with stands.^{3,9} Others review only falls from hunting stands^{2,4,5} or only spinal injuries from hunting stand falls.⁶⁻⁸ One reviews both those released and admitted.¹² The exclusion and inclusion criteria in

Figure 3. (A) Anatomic distribution of spine fractures associated with hunting stand injuries. (B) Anatomic distribution of upper-extremity fractures associated with hunting stand injuries. (C) Anatomic distribution of lower-extremity fractures associated with hunting stand injuries.

Table 2. Detailed disposition from the emergency department for hunting stand injuries

Parameter	Rx/Release		Rx/Transfer		Admit		Observation		p value*
	n	%	n	%	n	%	n	%	
n	30470	79.5	3570	9.3	3374	8.8	894	2.3	
Age (yrs)	38.2		48.3		47.1		43.6		<0.0001
Age 4									
0 to 14 yrs	999	90.9	39	3.5	62	5.6	0	0.0	<0.0001
15 to 34 yrs	11526	87.9	806	6.1	536	4.1	240	1.8	
35 to 54 yrs	12827	80.2	1261	7.9	1526	9.5	380	2.4	
≥ 55 yrs	5118	63.1	1464	18.1	1250	15.4	274	3.4	
Hospital Size									
Small	18918	84.0	2583	11.5	435	1.9	583	2.6	0.0005
Medium	6464	77.6	781	9.4	964	11.6	123	1.5	
Large	1795	63.3	158	5.6	371	13.1	64	2.3	
Very Large	3257	64.9	47	0.9	1591	31.7	124	2.5	
Children's	36	73.5	0	0.0	13	26.5	0	0.0	
Major Dx									
Contusion/Abrasion	8545	97.7	81	0.9	103	1.2	15	0.2	<0.0001
Fracture	7292	57.8	2257	17.9	2690	21.3	371	2.9	
Laceration	1669	59.4	110	3.9	30	1.1	0	0.0	
Internal Injury	970	48.9	655	33.0	282	14.2	75	3.8	
Strain/Sprain	5986	97.9	75	1.2	16	0.3	41	0.7	
Other	3470	84.6	151	3.7	238	5.8	245	6.0	
Internal Organ Injury									
Yes	1411	55.2	579	22.6	344	13.5	152	5.9	0.14
No	24913	81.0	2603	8.5	2596	8.4	71	0.2	
Organ Injured									
Brain	1411	66.3	515	24.2	64	3.0	152	7.1	0.0007
Chest	0	0.0	48	15.9	166	55.1	71	23.6	
Abdomen	0	0.0	0	0.0	129	100.0	0	0.0	
Fracture									
Yes	7074	57.8	2184	17.8	2615	21.4	371	3.0	<0.0001
No	23396	89.8	1386	5.3	759	2.9	523	2.0	
Fall									
Yes	23385	76.7	3380	11.1	3176	10.4	560	1.8	<0.0001
No	7085	90.8	190	2.4	198	2.5	334	4.3	
Fracture Location									
Spine	1443	38.1	1211	32.0	1086	28.7	46	1.2	0.005
Upper Extremity	1627	87.2	146	7.8	78	4.2	16	0.9	
Lower Extremity	3185	63.2	739	14.7	1023	20.3	96	1.9	
Head/Face	90	84.9	0	0.0	16	15.1	0	0.0	
Rib	744	51.1	88	6.0	412	28.3	213	14.6	
Spine	1443	38.1	1211	32.0	1086	28.7	46	1.2	0.00008
Extremities	4812	69.6	885	12.8	1101	15.9	112	1.6	
Head/Face/Rib	834	53.4	88	5.6	428	27.4	213	13.6	

% is row percentages

* p value for differences between those released, transferred, admitted, or observed for each of the parameters

these studies do introduce an element of bias. However, in spite of these different inclusion and exclusion criteria, all studies demonstrate an age range (38 to 45 years) similar to the average age of 40 years in this study, and a similar proportion of males (90% to 100%) compared with 93.3% in this study.

Many studies record fatalities (Table 3). No fatalities were noted in this series. This is likely because very seriously injured patients with potentially fatal injuries were immediately transferred to major trauma centers. Hunting, by its particular nature, occurs in rural areas with small hospitals, and those with serious injuries are

Table 3. Hunting stand injuries compiled from the literature

Study	Year	Location	Time Span	n	Age (yrs)	Disposition	% Male	% Fatality
Present Study	—	Entire USA	2004-2012	57820	39.7	All	94.3	0
Terry ¹⁰	2010	Entire USA	2000-2007	46860	—	All	95.2	—
Crockett ³	2010	Ohio	1998-2007	130	41	Admit	90	2.3
Gates ⁵	2002	West Virginia	1994-1999	90	38.6	Admit	99	7.8
Crites ⁶	1998	North Carolina	1981-1997	27	40.8	Admit	100	0
Urquhart ²	1991	Georgia	1982-1989	19	40	Admit	100	5.2
Metz ⁴	2004	New York, Maryland	1996-2001	51	42.6	Admit	100	5.8
Fayssoux ⁸	2008	Pennsylvania	1995-2005	22	46	Admit	—	—
Lawrence ⁷	1996	Louisiana	1985-1994	41	38	Admit	90.2	—
Steuland ¹²	1995	Wisconsin	1989-1992	125		All		0
Halanski ⁹	2008	Wisconsin	1999-2004	24	45	Admit	95	8

likely transferred to major trauma centers. A fatality occurring at the subsequent hospital would not be captured by the NEISS database, explaining the lack of fatalities in this study. Finally, it is possible that not all the injuries are included because some might have been coded as a gunshot wound rather than associated with a hunting stand.

Spine fractures are another serious injury, with most occurring in the lumbar and thoracic spine. The proportion of cervical spine fractures in this study is similar to that of Crites et al.⁶ but less than that of Fayssoux et al.,⁸ whose patients were treated at a major spinal cord injury center. Such a study skews the data toward those with more severe injuries or paralysis and is not an accurate global description of the different levels for spine fractures from hunting stands. Another serious injury involves internal organs. In this study the most frequent organ system injured was the brain, followed by the thorax and finally the abdomen. These are similar to those observed by Gates et al.,⁵ but different from those of Metz et al.⁴ Overall the differences between this study and the literature in the proportion of spine fractures and internal organ injuries is likely attributable to the use of a large national database, which adds more representative values.

Alcohol use and hunting stand injury has been previously noted, ranging from 2.3% to 21%,^{2,3,6,8} although it was much less in the current study at 0.6%. This is likely owing to the fact that all injuries were included, not just those admitted or seen at major trauma referral centers with more serious injuries.

In addition to the limitations noted above, there are other limitations to this study. One is that the NEISS only identifies individuals who sought care in an ED. The overall number of injuries in this study is therefore lower than the real number of injuries. The NEISS is skewed to more serious injuries, because patients sustaining significant injuries will likely seek immediate care in the ED. Another potential limitation is the

accuracy of the NEISS data. However, it has been demonstrated to have more than 90% accuracy. I thus believe the numbers in the current study to be accurate. With this in mind, these results can serve as a reference for future studies regarding injuries associated with hunting stands.

Conclusions

This study has characterized the epidemiology of hunting stand injuries. Approximately 6385 patients annually sustain injuries from hunting stands with an average age of 40 years. The patients are predominantly male, white, and seen at small- or medium-size hospitals. A fracture is the most common injury and there is a very low alcohol intoxication rate. This baseline data can now be used to educate first responders, guide medical kit development, and serve as an epidemiological basis for future studies.

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