AMJ Australasian Medical Journal [AMJ 2019;12(4):123-130]

Cattle related trauma: Are we underestimating its severity?

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REVIEW

Please cite this paper as: Wheeler JA. Cattle related Trauma: Are we underestimating its severity? AMJ 2019;12(4):123–130. https://doi.org/10.35841/1836-1935.12.4.123-130

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ABSTRACT

Background
Cattle related trauma is a serious subset of trauma that is common in rural hospitals around the world.

Aims
The purpose of this review was to investigate the current literature, and to highlight the severity of cattle related trauma.

Methods
A systematic review of the literature was completed through Medline and EMBASE databases from January 1990 to December 2018. The author screened the data sources, full text, English written articles, peer reviewed journal articles and case reports were included. The search netted 14 articles that are reviewed in this paper.

Results
Injuries sustained from cattle are wide ranging in type and severity. The most common are those affecting the upper and lower extremities, which are associated with higher patient morbidity. Injuries to the head, chest and abdomen are less common, and are associated with higher levels of mortality.

Conclusion
Cattle related trauma is common within the agricultural industry, yet it is under reported and preventative safety measures need to be improved.

Key Words
Trauma, cattle, cow, dairy, beef, animal-related injury, fracture, orthopaedics, injuries, farming, agriculture

What this review adds:

1. What is known about this subject?
Cattle account for more fatal work injuries than any other animal. By profiling cattle related injuries with injuries sustained from high velocity motor vehicle trauma, it demonstrates that farming is a dangerous occupation.

2. What new information is offered in this review?
The review focuses on the types of injuries sustained, mechanism of injury, patient demographics and seasonal variation in injury presentation, and outlines recommendations for injury prevention.

3. What are the implications for research, policy, or practice?
As this subset of trauma is unique, current literature is limited to predominantly retrospective cohort studies. Improvements in the collection of data for this mechanism of injury will improve diagnostic incidence, and lead to improved farming safety measures and education, thereby minimising the risk of cattle related trauma, and the associated healthcare costs.

Introduction

Cattle related trauma has been studied across major beef and dairy cattle communities around the world. Cattle are large, strong animals and can be unpredictable in their behaviour.[1,2] Injuries caused by cattle, require hospilisation and should be considered high energy injuries.[3] Cattle related trauma is the equivalent to high velocity trauma sustained from motor vehicles by comparing injury severity scores (ISS).[4] The aim of this study is to examine the current

published literature focusing on the injuries sustained, how they occurred, cattle characteristics, patient demographics and providing safety recommendations.

Method

The Medline and EMBASE databases were searched from January 1990 to December 2018. Sources were identified using an electronic search of the following terms; trauma, cattle, cow, dairy, beef, animal related injury, fracture, orthopaedics, injuries, farming, agriculture. All studies from the searches were independently reviewed by the author and were included if they meet the following criteria; written in English language, full text, peer reviewed journals and case reports. Additional grey literature was included with reference lists screened to identify additional studies. The reviewer title screened the papers, followed by abstract screening based on the inclusion and exclusion criteria (Figure 1). A full text review was completed with the remaining articles and a total of 14 papers were identified for this review; 8 of those are retrospective cohort studies, and 2 prospective cohort studies (Table 1).

Injuries sustained

Injuries sustained from cattle are serious and concerning. Distal and extremity Injuries are associated with high patient morbidity, whereas central torso or head injuries are associated with high patient mortality.

Nogalski et al. completed a retrospective analysis of medical records of 1,872 patients with animal related injuries at their Trauma and Emergency Hospital in Poland during 2001–2004. Only 5% of the cohort suffered injuries from cattle, yet of all the patients requiring inpatient hospital treatment, 55% of admissions were due to cattle trauma.[3]

Sheehan and Deasy retrospectively examined patient admissions over a 5-year period who had sustained bovine related trauma at Cork University Hospital, Ireland. Fifty-four patients identified, with 35 suffering cattle related trauma, 12 as a result of bulls, two horse related and five were not recorded. The most common injuries were fractures to the lower extremity, blunt chest trauma, head injury, upper limb extremity fractures, followed by pelvic and spinal fractures.[5]

Further to this, Caglayn investigated cattle related trauma in Northeastern Turkey and found that lower extremity fractures where more common than upper extremity fractures. In addition to the sustained extremity limb trauma, patients often suffered secondary chest and abdominal injuries, due to the high energy transfer of penetrating and blunt force mechanism of injury.[6]

Similar injury patterns are described in other parts of the world, including New Zealand and Sweden, with the most severe injuries sustained being fractures to both upper and lower extremities.[2,7] Soft tissue injuries including cerebral concussion, abrasions and contusions of the extremities, where among other injuries reported. Injuries sustained from cattle were the most severe injuries of all groups of animals.[2,4-6]

A study conducted at Drogheda, Ireland, compared the ISS of patients injured from motor vehicle accidents and those injured from cattle, and concluded that cow related trauma is equivalent to high velocity motor vehicle trauma. Injuries to the lower and upper extremity where the most common, followed by blunt chest and head injuries.[4]

Norwood et al. examined a regional trauma center's experience with large animal related injuries. Overall 145 patients were included; 47 suffering injuries by bulls, and 16 by cows. The most common regions injured were the torso and pelvis. Fractures of the upper extremity were less common than fractures of the lower extremity, however, upper extremity injuries were associated with a higher incidence of injury to multiple body regions and were more serious overall.

Extremity injuries to the lower and upper limb are the most common injury sustained in motor vehicle accidents. Although the majority of these injuries are not life threatening, they are a major cause of patient morbidity.[8] Injuries sustained at higher velocities are more commonly associated with head and facial fractures. This is followed by lower limb fractures, more specifically fractures of the femur. These injuries are associated with higher patient mortality, and are comparable to those sustained from cattle related trauma.[4,9]

The safe work Australia report outlines work related injuries and fatalities on Australian farms. The report used a range of data sources over an 8-year period from July 2003 to June 2011 and profiled the type and frequency of work-related injuries and fatalities that involved cattle. Of the 356 deaths reported, 11 of the fatalities were as a result of cattle trauma.[9] An Example discussed in the report includes the following exert from the paper:

The deceased went to feed cattle and when she has thrown the feed into the trough the cattle have come running up. One cow was heavily in calf and was particularly aggressive

at feed times. This cow has knocked the deceased to the ground and trampled her.[9]

Dogan et al. specifically looked at the injuries and deaths occurring as a result of bull attacks. In this study of 30 cases, there were seven deaths and 23 traumatic injuries. Animals such as bulls can be the cause of serious trauma resulting in death for those working in the animal husbandry. [10]

Traumatic injuries sustained from cattle are wide ranging and varied in location and severity. This is better appreciated when the mechanism of injury is understood.

Mechanism of injury

The injuries sustained from cattle can occur through various mechanisms. Farming activities that are not limited to feeding, transporting, branding, milking and assisting in the delivery of newborn calves, can result in the worker being butted or kicked, crushed against barriers, trampled, bitten or gored.[2,6,7] Kicking was reported as the most common mechanism of injury, followed by pushing and head butting. Charging, body contact and trampling were the least common, yet were associated with the highest ISS score.[4,11]

The Occupational Health Nurses in Agricultural Communities (OHNAC) surveillance program from 1991 to 1996 was undertaken to determine the nature of farm injuries. Cattle related injuries represented 7% of all injuries. Within this the circumstances in which they occurred where investigated. Most injuries were within a barn, fenced area or whilst transporting cattle.[11]

Cattle characteristics

Dairy cattle are more likely to injure than beef cattle, as dairy cattle have more frequent contact with humans due to handling during milking, as well as being more possessive of their herd.[12] A prospective study from New Zealand reported that 90% of injuries sustained to farmers were caused by dairy cattle as opposed to only 3% of beef cattle.[2]

Seasonal variation has been identified as a contributing factor in hospital presentations. It has been reported that the most presentations to hospital coincided with the cattle's osterous cycle, and when the bull was with the herd.[4] This cycle coincides with the months of March, September and October, with the lowest numbers being reported in July, November and December.[2] This variation can be attributed decreased handling of dairy cattle milking in July, and peak milking and birthing in September.

Increased handling, as well as hormonal variations, can lead to increased stress on cattle and more unpredictable behavior.[2,4]

Patient demographics

The majority of cattle related injuries occur in men under the age of 50 years.[2,4,6] Caglyan reported the mean age of patients was 29 years of age, with injuries more frequently reported in males.[6] The cohort in the Watts and Meisel paper also had a mean age of 34 years, ranging from 17 to 67 years, with 68% being male and 32% female.[2] The demographics were similar in the Murphy paper, with a mean age of 49 years, and 75% of the cohort being male. Interestingly, 25% of the cohort were aged over 65 years.[4] These demographics were highlighted further in the paper by Sheehan, with a mean age of 56 years, and 37% of their cohort being over the age of 65.[5]

As agricultural farms are often family owned businesses, it is not unusual for farmers to work beyond the average retirement age.[12] Animal related deaths were the fourth most common cause of death in those over 55 years in the agricultural industry in Australia from 2001-2004, causing 7.1% of deaths.[13] The National Institute for Occupational Safety and Health (NIOSH) reported that farmers aged over the age of 75 were more likely to die in the workplace.[12] Age related conditions such as hearing loss, visual impairment and osteoarthritis, result in elderly workers being more vulnerable to dangerous situations, as it reduces their reaction time, and their ability to quickly remove themselves from a dangerous situation. This combined with their preexisting fragility and lower physiological stamina compared to younger workers, results in higher levels of mortality from cattle related trauma.[9]

Recommendations

Cattle are large and unpredictable. It is important to take preventative measures by reducing the risk of exposure through environmental design, workplace education, and personal protective safety equipment for farmers working near cattle.

Training and understanding of animal behavior is vital, and learning correct handling techniques can reduce the farm workers risk of injury.[9,10]

There is no legal requirement for farmers to wear protective equipment or clothing in an agricultural work place. This is different to other professions, such as a construction site. Farmers' working with large animals should receive compulsory safety training, and wear appropriate protective

equipment and clothing, similar to the regulations imposed on construction workers'.[9,10] Wearing protective helmets would be useful especially for preventing head injuries.[14] The lack of safety training and regulations within the farming and agricultural industry need to be reviewed by governing bodies to minimize the risk of workplace injuries sustained from livestock. Incentive schemes could be set up to subsidize safety equipment, similar to that of the New South Wales government scheme to purchase suitable helmets for quad bike use on farms.[15]

It is possible that cattle related trauma is under reported in the literature, as most of the published research involves retrospective cohort analysis. This method of data recording relies on the accuracy and diligence of data entry from the initial treating practitioner. This was identified by Björnstig et al., who attempted to capture all hospital presentations and subclassify cattle related injuries by using a specific classification system. The authors concluded that they were successful in identifying which particular animal caused the injuries, and eliminated the issue of under reporting within their department.[7]

The current diagnostic coding system to identify cattle related trauma is broad and non-specific. Additionally, there is no specific coding for cattle related injuries in the ICD 9 or ICD 10 classification manual.[4] This may contribute to inaccurate recording of injury datasets. Improved sub-classification systems and diagnostic coding is recommended to allow more easily identifiable cattle related trauma. This in turn would allow more accurate funding for hospital admissions, and improvements in financial distribution of hospital treatment costs.

A limitation of this review is the language bias. Only articles published in English were included. As rural and agricultural trauma is not confined to English speaking countries, it is not a complete retrieval of the available research thus a large cohort of the research could not be included. By only using two databases such as Medline and EMBASE it is not a full representation of the databases available. As one independent reviewer selected and screened the literature there could have been personal bias and the potential eligibility of a study could have been overlooked. Future studies would include non-English written articles, an increase in the number of databases used and the inclusion of additional reviewers involved within the screening and process.

Current literature is retrospective and relies on datasets of specific patient cohorts within a specific area. Future research may involve prospective studies, investigating the recommendations listed in this paper. This may involve the implementation of safety equipment during seasonal variation in different geographic locations, as well as investigating areas with specific breeds of cattle which are not located in other areas. Furthermore, prospective studies investigating the impact of safety measures for farm workers over the age of 60 years would be of benefit.

Conclusion

Cattle related injuries should be treated in the same category as high velocity motor vehicle trauma. More research needs to be done to improve current safety measures for agricultural workers. Future research may involve prospective studies, investigating the effects of increased safety equipment and training in relation to hospital presentations during seasonal handling of cattle.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

None

Figure 1: Method flow diagram

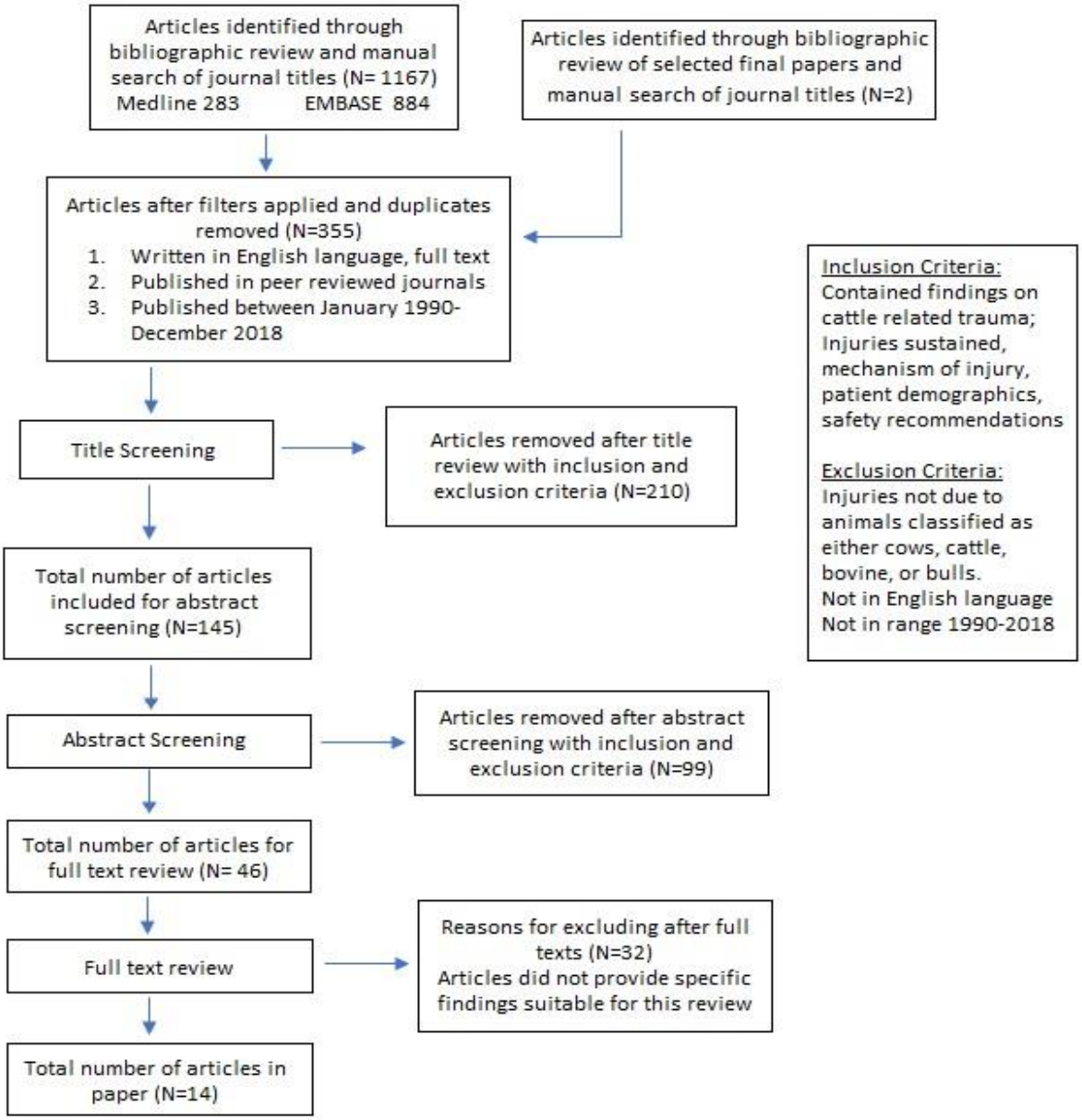

Table 1:

Source	Population [country; N]	Methodology	Demographic [years; sex M/F]	Type of Farming; Type of Worker/ animal	Mechanism of Injury [number]	Type of Injury [number]
Watts et al. [2]	New Zealand; N=78	Prospective cohort study over 1-year period. Chart review and patient interviews	Average age 34 [range 16-67]; M 53/F 25	Dairy 70 Beef 2 Unknown 6	Crushed 17 Head butted 4 Kicked 45 Stood on 7 Other 5	Contusion 43 Fracture 19 Laceration 9 Spain 4 Abrasion 2 Dislocation 1
Nogalski et al. [3]	Poland; N=1,872 [98 cattle related]	Retrospective, single centre, cohort study over a 4-year period. Medical record and chart reviews	Median age 42 [23% aged 16-21, 34% aged 22-40, 27% aged 41-64, 16% aged >65]; M 1,161 [62%]/F 711 [38%]	Cattle 98 [5% of all presentations] Dog 284 Horse 45 Cat 254 Pig 96 Insects 894 Other 201	Cattle – attacking with horns, battering: Cattle: Hospitalization 28 [55% of all animal injuries] Ambulatory treatment 70 [4% of all animal injuries] All Animals: Hospitalization 51 Ambulatory 1,821	135 surgical procedures for 51 hospitalised patients [21 had multiple operations]; 92% due to horses and cattle. Craniotomy 4 Pleural cavity drainage 18 Thoracotomy 2 Laparotomy 25 Fracture stabilisation 38 Plastic reconstruction 16 Debridement and ablation of necrotic tissue 32 Fatalities 3
Murphy et al. [4]	Ireland; N=47	Retrospective cohort study over 10-year period. Medical record and chart reviews	Mean age 49; 4 aged <16 and 12 age >65; M 35/F 12	Farmer 36 Abattoir worker 4 Vet 3 Non farming 4	Kick 21 [ISS 3] Charge/headbutt 13 Body contact 8 Trample 5 [ISS 23]	Long bone fracture 11 Forearm fracture 10 Toe/finger fracture 5 Blunt chest injury 4 Soft tissue injury 4 Head injury 3 Extremity laceration 3 Haematoma 3 Scalp/facial laceration 2 Abdominal viscera injury 1 Cervical spine fracture 1

Sheehan et al. [5]	Ireland; N=54	Retrospective cohort study over a 5-year period. Medical record and chart reviews	Median age 56 [range 2 – 83]; M 46/F 8	Farmer 27 Unknown 16 Farm labourer 3 Student 2 Retired 2 Cow related 35 Bull related 12 Horse related 2 Unknown 5	MOI Not recorded Mean length of stay 10 days [median 4, range 3 to 90 days]. Median LOS age >65 was 5.5 days Median LOS age <65 was 4 days	Lower limb fracture 20 Blunt chest trauma 6 Head injury 6 [1 fatality] Upper limb fracture 11 Abdominal injury 4 Facial fracture 2 Hand fracture 2 Pelvic fracture 1 Spinal fracture 1 Laceration 1
Caglayan et al. [6]	Turkey; N=157	Retrospective cohort study over 2.5 years. Medical record and chart reviews	Average age 29 [range 3 – 83]; M 132/F 25	Horse related 112 Bovine related 45	Horse: fall 42; kicked 70 Bovine: butted 23; kicked 22	Multiple organ 32 Maxillofacial 69 Extremities 31 Cranial 28 Thorax 16 Abdominal 13
Björnstig et al. [7]	Sweden; N=48	Retrospective cohort study over two, non-consecutive, one-year periods. Chart reviews	Age not specified; M 30/ F 18	Unknown. Handling bulls, cows and calves	Crushed, kicked or trampled 31 Gored 4 Bitten 2 Not specified 11	Fractures 11 [4 upper limb, 4 lower limb, 2 ribs, 1 facial] Soft tissue knee 5 Cerebral concussion 2 Abrasions and contusions 30
Norwood et al. [8]	United States of America; N=145	Retrospective, multi-centre [2], cohort study over a 7-year period. Medical record and chart reviews	Median age 35 [range 4 – 88]; M 111/F 34 [42% M injuries bull related; 94% F injuries equine related]	Equine 79 Bull 47 Cow 16 Wild game 3	Fall/thrown 59 [57% horse riding; 30% bull riding] Kicked 21 [38% cows] Trampled 28 [45% bulls] Crushed 11 Gored 9 Other 11 [31% cows]	Brain/Craniofacial 49 [32% of equine injuries] Spinal fractures 12 Chest/Abdomen/Pelvis 56 [49% of bull injuries; 63% of cow injuries] Upper extremity fractures 23 [52% associated with multiple body regions] Lower extremity fractures 36 [19% associated with multiple body regions] Fatality: 1 equine 1 bull

Casey et al. [11]	United States of America; N=57	Prospective cohort study over 5-year period. Chart review and patient interviews	M 50/F 7; 3 aged between 15-16, 46 aged 23-58, 8 aged >60	Farmers 36 Farm worker 19 Non-worker 2 Dairy cattle 56 Livestock sale yard 1	Kicked 16 Pushed 14 Fell on 7 Stepped on 6 Knocked down 5 Head butted 4 Pinned against barrier 3 Handling rope 1 Tail flick 1	2 fatality [1 in livestock sale yard] Lower & Upper Limb/ Torso/ Head: Fracture 17 [7 upper limb] Laceration 11 [7 head/ face] Crush 21 [10 lower limb] Soft tissue injury 11
CDCP. 2009. [12]	United States of America; N=21	Retrospective, multi-centre [4 states], cohort study over a 6-year period. Medical record and chart reviews	Median age 65 [range 8 to 86]; M 20/F 1	Bull 10 Cow 6 Multiple cattle 5	Working in enclosed space, pen or chute 7 Herding 5 Loading into trucks or trailers 3 Feeding 3 Working in open pasture 3	Fatalities 21 Purposeful animal strike 16 Crushed against stationary object 5 Blunt force trauma to chest and/or head 20 Other 1
Dogan et al. [14]	Turkey; N=30	Retrospective cohort study over a 4-year period. Medical record and chart reviews	Median age 60 [range 33 to 86]; M 24/F 6	Farmer 23 Farm labourer 7	Crushing/Trampling 17 [3 fatal] Horn Injury 13 [4 fatal] Penetrating Injury 10 [3 fatal]	23 Injury: Chest 9 Abdomen 14 7 Fatality: Chest 5 Head 2