

Complications of Vehicular-Related Injuries: A Scoping Review of Literature

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Abstract

Context: Complications of vehicular-related trauma contribute to the overall morbidity, and ultimately the costs, of road accidents. However, direct evidence on the burden of complications of vehicular-related trauma injuries is not directly explored. This scoping review aims to provide a summary of the relevant literature on the most significant acute complications and consequences of trauma caused by motor vehicle accidents or similar mechanisms.

Evidence Acquisition: Multiple electronic databases, as well as grey literature, were explored. Studies were included in this scoping review if they evaluated adult patients with acute complications of traumatic injury caused by motor vehicle trauma or similar mechanisms.

Results: Trauma-related complications contribute to increasing mortality of patients. Complications of traumatic injuries are also the main cause of patients' readmission to hospitals. Various studies report the rate of high-grade complications around 10%, but the overall rate of complications, ignoring severity, is approximately 60%. Depending on the surveyed population, different complications are identified as the most prevalent, but pneumonia is identified as the most prevalent complication in the majority of studies. The most important factors predicting the occurrence of complications in trauma patients are older age and poor Glasgow coma scale.

Conclusions: Complications of trauma-related injuries are significant factors affecting the outcome of patients. There has been limited research directly exploring this topic, possibly due to the difficulty of undertaking such studies. A particularly important research topic is the prevention and management of complications in elderly trauma patients with comorbidities. In conclusion, complications of trauma related injuries are significant considerations for clinical practice and research.

Keywords: Complications, Trauma, Vehicular Trauma

1. Context

Road traffic crash casualties impose considerable economic costs to societies (1). Costs of road traffic crash casualties include medical and rehabilitation, long-term care, labour in the workplace and quality of life (1). Complications secondary to vehicular-related trauma contribute to these costs.

Although each particular complication has its own specific definition (2), in this paper we broadly consider complications as undesirable and unexpected adverse health events happening for patients after the initial injury. Trauma patients may have higher rates of complications in comparison with other patients who undergo general surgery (3). Various types of complications are reported in trauma patients, such as: myocardial infarction, pulmonary embolism, renal failure, sepsis, pneumonia, urinary tract infection and wound disruption (3). The reason that trauma patients could be susceptible to compli-

cations might be related to physiological or immunologic effects of trauma and high risk cares such as mechanical ventilation and long-term immobilisation (4).

Complications of trauma-related injuries are associated with many variables, as illustrated in Figure 1. There are many studies that have explored the relationship of particular elements with each other, for example, the association between a particular risk factor with a particular injury; or a particular complication in patients with a specific injury. However, despite all the individual studies, this is the first review to provide a summary of the relevant literature on the most significant acute complications and consequences of trauma caused by motor vehicle accidents or similar mechanisms by finding the best evidence for answering the following questions: What is the importance of complications in trauma patients? How common are complications in trauma patients? What are the most common complications? And which patients are more at risk for complications?

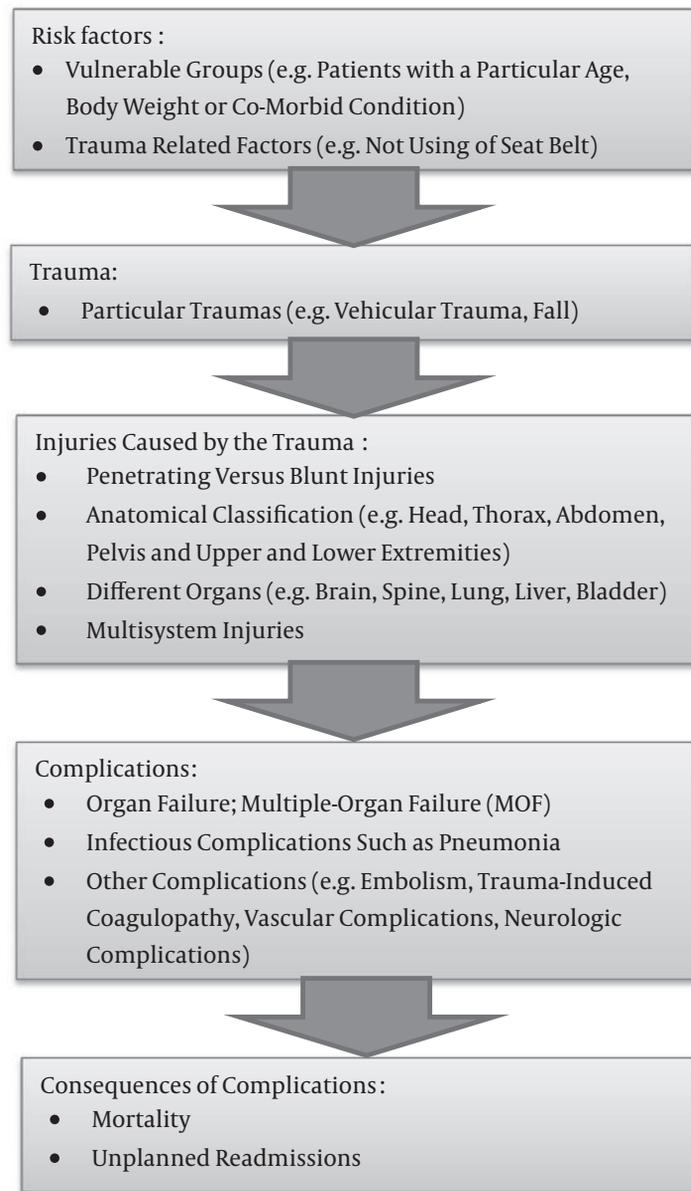


Figure 1. Illustration of Various Factors Associated With Complications of Trauma-Related Injuries

2. Evidence Acquisition

This is a scoping review on complications of motor vehicle trauma-related injuries. A scoping review is an evolving literature review methodology (5, 6), which is transparent and aims to map the literature and address broad research questions on a topic (5-7). Mapping the literature is an action that provide background information necessary for upcoming projects (8); identifying concepts, gaps, strategies and barriers (9). Therefore, scoping reviews of

fer a broad view of the material available on a topic, rather than the more focused picture normally provided by a systematic review (7).

Medline was searched using the following medical subject headings and phrases: wounds and injuries/[complications]; wounds and injuries/[epidemiology]; motor vehicle accident; (vehicle accident or traffic accident); (Australia and trauma). This search was restricted to publications in English and

studies on adult humans (19 plus years) in the past five years (2009 - 2014). In addition, other sources such as Google Scholar, the Cochrane library, online websites of governmental organisations and seminal books were also searched with no time limitations. In addition, queries were made from a number of key researchers. Criteria for considering studies for this scoping review were: adult patients from developed countries; target conditions were acute complications (up to three months post incident) of traumatic injury caused by motor vehicle trauma or similar mechanisms. Data from disparate populations, psychological and mental health issues, and gunshot and military trauma were excluded.

3. Results

Initial search identified 2,731 items. Using titles and abstracts, 2,695 items were excluded. Full texts were obtained for 36 papers and 21 were finally included in the study. The identified studies are presented according to the review's research questions and are also introduced in Tables 1 - 4. Presenting papers in different tables assisted focusing on different elements of the studies that are more relevant to each research question. Some studies are included in more than one tabulation. The following result section is structured based on the four research questions.

3.1. What is the Importance of Complications in Trauma Patients?

Trauma-related complications contribute to increasing mortality of patients (4, 10, 11). It has been documented that complications such as organ failure (12), multiple-organ failure (MOF) (13, 14) and trauma-induced coagulopathy (15) are associated with higher mortality of trauma patients. The rate of mortality increases by the number of organ system failures (12-14). Organ failure and MOF have been identified in 5% - 15% of trauma patients; the higher incidences are related to patients with more severe injuries (12, 14, 16).

Complications of trauma injuries are also the main cause of 30-day readmission to hospital. It is reported that 30% of readmissions of trauma patients are due to complications and in comparison with non-trauma patients, trauma patients are ten times more likely to be re-admitted due to complications (17). The most frequent complications leading to readmission of trauma patients include anastomosis haemorrhage (4.3%), orthopaedic wound infection (3.0%), pneumonia (3.0%), iatrogenic congestive heart failure (2.4%) and loss of bony reduction/fixation (2.0%) (17).

Re-admissions to the intensive care unit (ICU) are also problematic. The majority (71.6%) of unplanned readmissions of trauma patients to ICU happen during the 72 hours after ICU discharge (18). The most common complications that lead to readmission to ICU are respiratory, bleeding, cardiovascular, neurologic, non-respiratory infection and pulmonary embolism. Pneumonia is the most common complication that leads to ICU admission of trauma patients (18, 19).

3.2. How Common are Complications in Trauma Patients?

Patients in trauma centers are more likely to have a complication compared to patients in non-trauma centers (2). Overall rate of complications (considering all different types of complication) can be as high as 60% (4), however, if considering more severe complications, the rate is reported to be approximately 10% (4, 10, 20). The rate of complications are higher in patients with more severe injuries, such as those with multi-trauma (4) or patients admitted to ICU (19). Particular types of complications have different rates (Table 2), for example infectious complications have been identified in 5.7% in patients with vehicular trauma (21).

3.3. What Are the Most Common Complications

Depending on the surveyed population, different items are identified as the most common complications (Table 3). For example, among the patients with spinal cord injuries, the most common infectious complications are urinary tract infections and pneumonia; while after colon injuries, the most common infectious complications are sepsis and surgical site infections (21). Pneumonia is identified as the most prevalent complication in the majority of studies (2, 4, 18-20, 22). The other complications frequently found are urinary tract infections and other types of infections (2, 4, 17, 18, 20).

3.4. Which Patients are More at Risk for Complications?

Complications can be predicted based on various factors (see Table 4). The most important factors predicting the occurrence of complications in trauma patients are older age, and poor Glasgow coma scale (2, 25). In addition, elderly population are not only more vulnerable to complications, but also have higher mortality following post-trauma complications (14, 22). Injury-type is also related to risk of complication. Patients with particular forms of injuries are prone to complications, for example, 70% of patients with spinal cord injury are reported to have at least one complication (23). Pre-existing conditions are other factors that increase mortality in trauma patients (26). In

Table 1. Rate of Consequences of Complications in Trauma Patients

Study	Country of Study	Type of Patients	Evaluated Consequences	Rate of the Consequences, %
Osler et al. 2012 (11)	USA	Adult patients admitted to hospitals for traumatic injury	Mortality	2.8
Saltzherr et al. 2010 (4)	The Netherlands	Adult patients with multi-trauma admitted to level one trauma centers	Mortality	18.8
			Readmission	4
Haas et al. 2011 (10)	Canada	Adults patients admitted to trauma centers for at least 2 days	Mortality	7.9
Fakhry et al. 2013 (18)	USA	Adult trauma patients discharged from ICU	Readmission to ICU	4.8
Moore et al. 2014 (17)	Canada	Adults discharged from trauma centers	Unplanned readmission	Cumulative rates:
				At 30 days: 5.9
				At 3 months: 10.9
				At 6 months: 15.5
				At 12 months: 21.1

Table 2. Rate of Specific Complications in Trauma Patients

Study	Country of Study	Type of Patients	Evaluated Complication	Rate of the Complication, %
Dewar et al. 2009 (13)	Australia	Adult trauma patients admitted to ICU	MOF	17
Haas et al. 2011 (10)	Canada	Adult patients admitted to trauma centers for at least 2 days	Major complications	9.6
Fraser et al. 2011 (21)	USA	Adult vehicular trauma patients	Infectious complications	5.7
Benns et al. 2012 (12)	USA	Adult patients admitted to trauma centers	Concurrent organ failure	6.5
Dewar et al. 2013 (14)	Australia	Adult trauma patients admitted to ICU	MOF	15
Hyllienmark et al. 2013 (19)	Sweden	Adult trauma patients admitted to ICU	Pneumonia	26
Xu et al. 2013 (15)	China	Adult patients with severe trauma admitted to emergency intensive care unit	Trauma-induced coagulopathy	23.3
Vogel et al. 2013 (16)	USA	Adult trauma patients	MOF	5

addition to the factors related to patients, health care setting is also an influential factor. Patients admitted to centers which provides higher levels of care are more prone to complications, possibly due to accepting more complicated patients and performing more aggressive procedures at these centers (2, 25).

It is notable that each complication can have specific risk factors. For example, the likelihood of developing pneumonia after trauma can increase because of seemingly extraneous factors such as having a larger gastric volume at the time of trauma (27), patient's environment before admission (28) and intubation in the field (19). In addition, there are care-related factors that can lead to various complications; for example, the use of pulmonary artery catheter is associated with arrhythmias, cardiac arrests and pulmonary embolism (2).

4. Conclusions

Complications of trauma related injuries are significant factors affecting the outcome of patients. In general, despite the importance of complications in the morbidity, mortality and cost of care of trauma patients, there has been limited research directly covering the complication-related outcome of vehicular traumas. A reason for the shortage may be the difficulty in undertaking studies on complications as they involve manual handling of medical records and are therefore expensive and limited (11). In this review it was observed that information on the trauma-related complications is not directly discussed in many academic and governmental reports. For example, even though the Australian Bureau of statistics is collecting data on various aspects of injuries, complications are not directly reported (29). Therefore it is difficult to determine

Table 3. The Most Common Complications in Various Groups of Trauma Patients (Up to Five Items Are Displayed From Each Study)

Study	Country of Study	Selected Patients	Evaluated Complications	The Most Prevalent Complications (Rates), %
Holbrook et al. 2001 (20)	USA	Adult patients admitted to trauma hospitals for at least 24 hours	In-hospital complications	- Pulmonary (5.8)
				- Infections (1.4)
				- Gastrointestinal (1.4)
				- Vascular (1.0)
				- Neurologic (1.0)
Ang et al. 2009 (2)	USA	Patients admitted to Level I trauma centers	All complications	- Pneumonia (12.0)
				- More than 3 complications (7.9)
				- Urinary tract infection (6.3)
				- Multi-organ failure (5.5)
				- Unplanned ICU visits (4.8)
Access Economics 2009 (23)	Australia	Hospitalized adult patients with spinal cord injury	All complications	- Urinary tract infections (24.3)
				- Other bacterial infections (23.7)
				- Pressure ulcer (19.3)
				- Disorders of the bladder (17.1)
				- Streptococcus/Staphylococcus infection (13.8)
Harris et al. 2009 (24)	USA	Adult patients with limb-threatening lower extremity traumas	All complications	- Wound infections (28.3)
				- Non-union of fracture (23.7)
				- Wound necrosis/breakdown (8.6)
				- Osteomyelitis (7.7)
				- Joint arthritis (7.3)
Haas et al. 2011 (10)	Canada	Adult patients admitted to trauma centers for at least 2 days	Major complications	- Pneumonia (5.9)
				- Acute respiratory distress syndrome (2.4)
				- Sepsis (1.8)
				- Cardiovascular complications (1.8)
				- Renal failure (1.2)
Fraser et al. 2011 (21)	USA	Adult vehicular trauma patients	Infectious complications	After spinal cord injury:
				- Urinary tract infection (11.15)
				- Pneumonia (10.46)
				After colon injuries:
				- Sepsis (9.15)
Adams et al. 2012 (22)	USA	Adult trauma patients	End organ complications	- Surgical site infection (5.02)
			Infectious complications	- Pulmonary complications have higher rates comparing with other end organ complications. (The reported rate varied among different age groups).
				- Pneumonia has higher rates comparing with other infectious complications. (The reported rate varied among different age groups).

the precise nationwide prevalence of trauma-related complications. Finally, it is notable that age and comorbid conditions are among the factors that can increase the risk of

complications. As people are expected to live longer in developed countries, the prevalence of age-related comorbid conditions will also increase. Thus, a particularly impor-

Table 4. Studies Explored Prediction of Complications

Study	Country of Study	Study Methodology	Findings on Predictors of Complications
Ang et al. 2009 (2)	USA	Analyzing data from 18 level 1 trauma centers and 51 non-trauma centers	Admission to trauma services predicts higher rate of complications, probably due to more aggressive treatments
de Jongh et al. 2011 (25)	The Netherlands	Analyzing records of complications in a trauma registry	Complications are associated with institution, diagnosis and injury severity
Yeung et al. 2012 (27)	USA	Comparison of 81 trauma patients with pneumonia with a control group	Larger initial gastric volumes at the time of trauma predicts pneumonia
Adams et al. 2012 (22)	USA	Analyzing data from a trauma registry of a level 1 trauma center	Older age predicts higher rates of mortality, organ failure and thrombo-embolic complications
Kahl et al. 2013 (26)	USA	Analyzing data from a Level 1 trauma center	Pre-existing medical conditions plays an important role towards increasing Mortality rate
Dewar et al. 2013 (14)	Australia	Prospective study of patients admitted to an ICU in a level 1 trauma center	Older age and low platelet count predicts MOF
Zarzaur et al. 2013 (28)	USA	Analysis of data from a Level 1 trauma center	Neighbourhood in which trauma patients live (zip code) is associated with the risk of ventilator-associated pneumonia

tant research topic is the prevention and management of complications in elderly trauma patients with comorbidities (26).

4.1. Limitations

In this study, we focused on the acute complications of trauma and hence the chronic consequences of trauma such as disability and psychological sequel were not covered by this review. We did not directly explore the financial burden of the consequences of trauma.

Complications of trauma-related injuries are significant considerations for clinical practice and research.

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Footnotes

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