

Discrepancy in clinical outcomes of patients with gunshot wounds in car hijacking: a South African experience

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Introduction: Discrepancy in outcomes between urban and rural trauma patients is well known. We reviewed our institutional experience with the management of gunshot wounds (GSWs) in the specific setting of car hijacking and focused on clinical outcome between rural and urban patients.

Methods: A retrospective review was conducted at a major trauma centre in South Africa over an 8-year period for all patients who presented with any form of GSWs in car hijacking settings. Specific clinical outcomes were compared between rural and urban patients.

Results: A total of 101 patients were included (74% male, mean age 34 years). Fifty-five per cent were injured in rural areas and the remaining 45% (45/101) were in the urban district. Mean time from injury to arrival at our trauma centre was 11 hours for rural and 4 hours for urban patients ($p < 0.001$). Seventy-six per cent (76/101) sustained GSWs to multiple body regions. Sixty-three of the 101 (62%) patients required one or more operative interventions. In individual logistic regressions adjusted for sex and number of regions injured, rural patients were 9 (95% CI: 1.9-44.4) and 7 (95% CI: 2.1-24.5) times more likely than urban patients to have morbidities or required admissions to intensive care respectively. The risk of death in rural patients was 36 (95% CI: 4.5-284.6) times higher than that of urban patients.

Conclusions: Patients who sustained GSWs in carjacking incidents that occurred in rural areas are associated with significantly greater morbidity and mortality compared with their urban counterparts. Delay to definitive care is likely to be the significant contributory factor, and improvement in prehospital emergency medical service is likely to be beneficial in improving patient outcome.

Keywords: gunshot, hijacking, trauma

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Introduction

Prompt and appropriate access to definitive trauma care impacts positively on the outcome of trauma. The development of major trauma centres in the United States has consistently been shown to benefit patients.¹⁻³ South Africa is consciously attempting to follow this concept of a trauma system and to develop major urban trauma centres.^{4,5} There is great interest in investigating factors which present barriers to accessing care, one of which is geographical location.⁶⁻⁹ Patients from rural areas may encounter barriers to access for a variety of logistical reasons.⁶⁻⁸ This study focuses on a specific traumatic condition, namely, car hijacking, and interrogates the impact of geographical location on the outcome. Car hijacking, referred as 'carjacking' in South Africa, is a form

of aggravated robbery in which an occupied vehicle is seized violently.^{10,11} This often involves the use of firearms and many victims are injured during the event.^{10,11} If the victim sustains a firearm injury during the hijacking, it is usually in the form of multiple gunshot wounds (GSW) to multiple body regions. These can be challenging to treat and are best managed in major trauma centres. Car hijackings frequently occur in areas remote from urban trauma centres and this study seeks to compare outcomes in patients with similar injuries and similar profiles from different geographical locations to quantify the effect of geographical location on outcome. It seeks to quantify the impact of rural as opposed to urban status on the outcome of patients who sustain a GSW during attempted car hijackings in South Africa.

Methods

Clinical setting

This was a retrospective, observational study that focused on a specific group of patients who sustained GSWs as a direct result of involvement related to carjacking incidents. The study was based at the Pietermaritzburg Metropolitan Trauma Service (PMTS), Pietermaritzburg, South Africa. The PMTS provides definitive trauma to the city of Pietermaritzburg, the capital of KwaZulu-Natal (KZN) province. KwaZulu-Natal is located on the east coast of the country and has a population of over 11 million.⁵ Fifty per cent of the population lives in the rural areas.⁵ PMTS is the largest academic trauma centre in western KZN and is the tertiary trauma referral centre covering a total catchment population of over three million people. The catchment area is divided into two distinct health districts. The urban district (UD) includes the city of Pietermaritzburg and the surrounding suburban areas. The rural district (RD) includes all areas outside the geographical boundaries of the city of Pietermaritzburg. There is a chronic shortage of ambulances within the province, and delays in evacuation of victims and transportation are common. Each year, approximately 5 000 trauma cases are admitted to the PMTS with over half of these due to penetrating trauma. This is directly related to the high incidence of firearm related inter-personal violence and criminal activities throughout the province.

The PMTS maintains a formal regional trauma registry. All patients who present to our trauma centre are prospectively entered into the database, and the information entered includes details regarding injury mechanism, operative intervention, patient progress and clinical outcomes.

Prehospital emergency medical service

Prehospital emergency medical service (EMS) in South Africa is unique in that it operates a 'two-tier' prehospital EMS system, consisting of a public sector service and a private service.⁵ All the patients in this study were transported by the public sector EMS. The available literature on the prehospital burden of trauma in KZN suggests that the system is overwhelmed and has inadequate command and control systems. In addition, the level of training and experience of the public service EMS personnel is extremely heterogeneous.⁸ All this translates into delays in both evacuation and transportation of rural trauma patients. Once a patient has been retrieved, he is usually evacuated to the nearest healthcare facility. This may not be the most appropriate facility and attempts to develop a more robust trauma system are ongoing.⁴

The study

A retrospective review was conducted over the 8-year period from January 2010 to January 2018 on all patients who presented with any form of GSW with a clear history of being involved in a carjacking incident. Only those who sustained GSWs were considered. Those with unclear history, or where circumstances were uncertain, were excluded. Basic demographic details including age and gender were reviewed. Specific information was sought from prehospital emergency

medical rescue services (EMRS) documentation in relation to the location of incident, transport time and time of arrival at our trauma centre. Further clinical information reviewed included body regions injured, operative interventions, need for intensive care unit (ICU) admission, morbidity and mortality.

Statistical analyses

Data were processed and analysed using Stata 143.0 (StataCorp. College Station, TX). Chi-squared tests were used to assess the differences in outcomes (ICU admission, mortality, morbidity) between urban and rural groups, while a one-way ANOVA reported differences in mean hospital stay between groups. A chi-squared test also assessed mortality in those with single or multiple regions injured. Following these descriptive statistics, logistic regressions examined the association between urban/rural groups and each outcome, adjusted for sex and number of regions injured.

Results

Demographics

During the 8-year study period, a total of 101 patients were included. Seventy-four per cent were male (75/101) and the mean age was 34.4 years (SD: ± 10.2). Fifty-five per cent (56/101) of these occurred in the RD outside the catchment of Pietermaritzburg and the remaining 45% (45/101) occurred within the UD. The mean from injury to arrival at our trauma centre was 10.5 hours (SD: ± 2.9) in the RD and 3.9 hours (SD: ± 3.9) ($p < 0.001$). The graphical relationship between transport time and mortality is displayed in Figure 1.

Injury pattern

Seventy-six per cent (76/101) of all patients sustained GSWs to multiple body regions, while the remaining 25% (25/101) were confined to a single body region. Sixty-three of the 101 (62%) patients required one or more operative interventions.

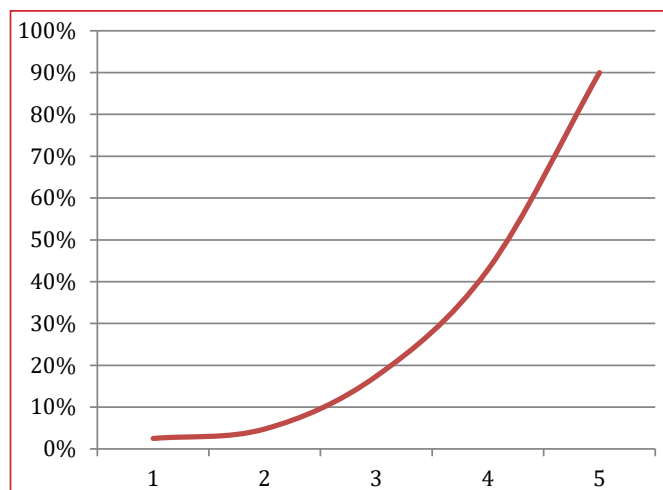


Figure 1. Correlation between time of injury to arrival at our trauma centre (hours) vs mortality

Clinical outcome

Eighteen per cent (18/101) of all patients required ICU admission. The mean length of hospital stay was 8.1 days (SD: ± 2.5). The overall morbidity rate was 13% (13/101) and the mortality rate was 18% (18/101). The 18 deaths were related to the following: 6 succumbed to hospital acquired pneumonia, 4 from multi-organ failure, 4 exsanguinated from intra-abdominal vascular injury prior to vascular control being possible, 3 with major cardiac and/or pulmonary hilar injury and 1 had combined thoracic great vessel and intra-abdominal vascular injury, 1 died from severe sepsis and MOF (from missed enteric injury) and arrested in the ward 48 hours after the initial operation, and 1 from ARDS. Table 1 summarises the difference in clinical outcome between urban and rural patients.

In individual logistic regressions adjusted for sex and number of regions injured, rural patients were 9.2 (95% CI: 1.9-44.4) and 7.2 (95% CI: 2.1-24.5) times more likely than urban patients to have morbidities or be admitted to ICU, respectively. In a similar model, the risk of death in rural patients was 35.7 (95% CI: 4.5-284.6) times higher than that of urban patients.

Clinical outcome	Urban (N = 45)	Rural (N = 56)	p-value
ICU admission, n (%)	4 (7%)	14 (31%)	p < 0.005
Hospital stay (days), mean (SD)	6 (1)	10 (2)	p < 0.001
Mortality, n (%)	1 (2%)	17 (38%)	p < 0.001
Morbidity, n (%)	2 (4%)	11 (24%)	p < 0.005

Discussion

The word ‘carjacking’ is a portmanteau of ‘car’ and ‘hijacking’ and was first coined by EJ Mitchell, an editor with The Detroit News.¹⁰ Despite the usual media coverage, carjacking remains an under-researched crime.¹¹ Due to the ease of access to firearms in South Africa, coupled with organised criminal syndicates operating in major cities, the incidence of carjacking continues to increase each year. Most incidents are associated with the use of a firearm during the crime in order to neutralise the victim and deter contact with law enforcement. Despite the scale of the problem, the literature on this topic is limited. Based on our experience, the majority of victims sustain multi-regional GSWs and almost two-thirds of victims require surgery. If the trajectory of the bullet is trans-axial the associated mortality is extremely high. Management of these injuries is challenging, with the skills and resources needed to appropriately manage them unlikely to be available outside of major urban trauma centres. This means patients who sustain such an injury in a rural area distant from a major trauma centre are likely to be prejudiced against. One of the limitations of this study was the limited information on the actual circumstances of the hijacking incidence, such as the

types and numbers of firearms or whether they first were shot through the body of the vehicle or in the immediate vicinity outside of it. Nevertheless, what we described is a unique spectrum of injury sustained by victims in a specific setting, which to date has never been reported in the literature.

Globally, the literature has shown consistently that rural trauma patients have a higher mortality than their urban counterparts for a whole range of injuries.¹⁻³ In a study by Esposito et al. from Washington, it was found that the overall crude mortality rate for patients in rural settings was three times that of urban areas.² Furthermore, Gomez et al. from Ontario showed that in those rural patients who survived long enough to reach the hospital, there was a three-fold increase in mortality among those injured in a region with limited access to specialist trauma care.³ Our own centre has documented a discrepancy in outcome for patients who sustain a cerebral GSW, depending on whether they are urban or rural in origin.⁸ The reasons that have been postulated to explain such discrepancies are complex, and include differences in quality of prehospital care, delay in transport and prolonged discovery time.^{1-3,8}

KwaZulu-Natal is a large province with a population of over 11 million, 50% of whom reside in rural areas.⁵ South Africa is considered a developing country, with an overwhelming burden of trauma, where the resources allocated are perennially insufficient.⁹ Although a prehospital system of EMS exists, the organisation is less structured than that of the developed world. Critically injured patients are often transferred primarily to ill equipped rural facilities, and are subsequently transferred to urban trauma centres.⁵ This translates into significant delays to definitive management. Our study has shown that the mean transport time for rural patients was significantly longer than for their urban counterparts. Delay to definitive treatment is strongly associated with poor outcome and the rural patients in this series had a 36-fold increase in mortality compared with their urban counterparts and a 7 and 9 fold increase in need for ICU and morbidity. Almost certainly, prolonged transfer time, coupled with the heterogeneous level of prehospital EMS available in the rural setting contributes to the poor outcomes for rural patients in our setting.

While cynics may argue that the ‘devil of distance’ is difficult to overcome, investing in the reorganisation of EMS service to improve patient transfer could potentially improve the outcome in these patients. A systematic review by Henry et al. concluded that improving prehospital trauma systems in developing countries reduces the overall mortality.¹² Other studies from high-income countries also support the evidence of mortality reduction for rural patients secondary to the implementation of organised trauma networks.^{7,12-15}

Decentralisation of skilled surgeons to rural hospitals may also improve the level of care received by rural patients. While the reasons behind the higher mortality rate for rural trauma patients are certainly multifactorial, current effort should be directed at improving the prehospital EMS to ensure swift transfer of patients for definitive care in order to improve patient outcome.

Declarations of conflict of interest

The authors declare no conflict of interest.


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