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## Patients with Gunshot Wounds to the Head Do Not Require Cervical Spine Immobilization and Evaluation

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### Abstract

**Objective:** The purpose of this study was to determine the incidence of indirect spinal column injury in patients sustaining gunshot wounds to the head.

**Methods:** A retrospective review of patient records and autopsy reports was conducted of patients admitted with gunshot wounds to the head between July of 1990 and September of 1995 were included. Those with gunshot wounds to the neck and those who were dead on arrival were excluded.

**Results:** A total of 215 patients were included in the study. Cervical spine clearance in 202 patients (93%) was determined either clinically, radiographically, or by review of postmortem results. No patients sustained indirect (blast or fall-related) spinal column injury. Three patients had direct spinal injury from bullet passage that were apparent from bullet trajectory. More intubation attempts occurred in patients with cervical spine immobilization (49 attempts in 34 patients with immobilization versus five attempts in four patients without cervical spine immobilization,  $p = 0.008$ ).

**Conclusions:** Indirect spinal injury does not occur in patients with gunshot wounds to the head. Airway management was compromised by cervical spine immobilization. Protocols mandating cervical spine immobilization after a gunshot wound to the head are unnecessary and may complicate airway management.

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**Key Words:** Gunshot wound to head, Cervical spine immobilization, Cervical spine injury.

The risk of cervical spine injury associated with head injury has been reported to be from 3.5% up to 10% of cases. [1-7] This occurrence, however, represents all trauma patients, from both blunt and penetrating mechanisms. Numerous studies have evaluated cervical spine injury in blunt trauma patients and its association with facial and head injuries. Additionally, the need for cervical spine evaluation and clearance has been extensively studied in blunt trauma patients. [8-12].

The occurrence of cervical spine injury in patients sustaining penetrating trauma to the head is essentially unknown. Despite this lack of knowledge, these patients routinely are immobilized in rigid collars and are treated with cervical spine precautions. These interventions have implications for airway management and necessitate diagnostic intervention (i.e., cervical spine clearance), accordingly, their utility should be determined. This study was performed to test the hypothesis that cervical spine injury, other than from direct bullet injury, does not occur in patients who sustain gunshot wounds (GSW) to the head and that these patients do not require cervical spine immobilization or clearance.

### MATERIALS AND METHODS

The trauma registry records of all patients admitted to University Medical Center, a Level I trauma center, between July 1, 1990, and September 30, 1995, were reviewed, and patients with GSW to the head were identified. Hospital records were reviewed and data were abstracted, including age, sex, Glasgow Coma Scale score at emergency department (ED) presentation, other injuries, the use of cervical spine immobilization, cervical spine radiographs, and survival or autopsy results. The presence of cervical spine injury and direct (penetrating) or indirect (from associated blast injury of fall) mechanism was also recorded. Cervical spine

clearance was by clinical or radiologic criteria in survivors; in nonsurvivors, clearance was by radiologic or postmortem examination (including the cervical ligaments, vertebrae, and spinal cord). Criteria for clinical clearance included alert mental status and absence of neurologic findings or cervical pain. Radiologic criteria included a five-view cervical spine series and an alert patient. In the obtunded patients, dynamic fluoroscopy was also used in conjunction with plain radiography. [13] Patients with GSW to the neck and those dead on arrival to the ED were excluded from the study.

## RESULTS

There were 215 patients identified as having sustained GSW to the head over the study period. The majority were men (188 patients, 87%), with an average age of 28 years. The mean patient Glasgow Coma Scale score was 8 at the time of ED arrival. The injuries resulted from assault in 136 patients, and the remaining 79 patients had self-inflicted injuries. Forty-three patients sustained multiple gunshot wounds with the other wounds being to the torso or extremities. Death occurred in 123 of 215 patients (57%) with 64 patients dying in the ED (29%).

One hundred eighty patients (84%) had cervical spine immobilization instituted in the prehospital setting or the ED. Cervical spine clearance was determined either clinically (45 patients) or radiographically (47 patients) in survivors, and radiographically (37 patients) or by autopsy (73 patients) in nonsurvivors (Figure 1). Patients had clinical clearance only if they had a Glasgow Coma Scale score of 15, either at the time of admission or later in the hospital course. Cervical spine films were obtained in 84 patients (40%). Cervical spine clearance was possible for 199 patients (93%) overall. Twelve patients who committed suicide had no autopsies performed, and the autopsy report for one homicide victim could not be located.

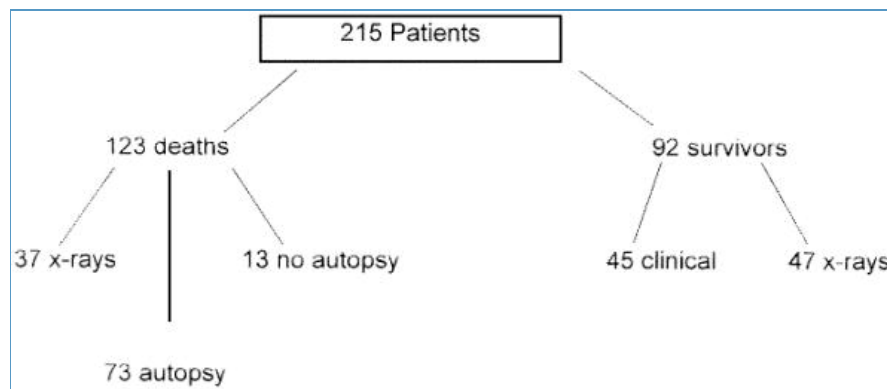


Figure 1. Cervical spine clearance in patients with gunshot wounds to the head.

Three patients were found to have bullet injuries of the bony cervical spine; all had entrance or exit wounds suggesting a cervical trajectory. Two of these patients survived without neurologic deficit related to the cervical spine injury; the third patient's injury was found at autopsy. No bony or ligamentous injury, other than from direct bullet injury, was identified in any patient.

Endotracheal intubation was attempted in the field in 38 patients and was unsuccessful in 16 (42%). Intubation failures occurred in 14 patients with cervical spine immobilization and in only two patients whose cervical spines were not immobilized. Additionally, multiple efforts at intubation were attempted: 49 attempts in 34 patients with immobilization and five attempts in four patients without immobilization (chi squared test,  $p = 0.008$ ).

Furthermore, there were six patients who required reintubation in the ED for endotracheal tube malposition or dislodgement not recognized in the field. Five of these six patients had cervical spine immobilization (chi squared test,  $p < 0.001$ ).

## DISCUSSION

Although it has been theorized that patients sustaining GSW to the head may incur cervical spine injury either from the blast of the gunshot or from falling to the ground after the injury, these assertions have never been demonstrated. The Advanced Trauma Life Support program manual states "Any patient sustaining an injury above the clavicle or a head injury resulting in an unconscious state should be suspected of having an associated cervical spinal column injury," and obligates the care provider to immobilize the patient until cervical spine injury can be excluded. [14]

Research to support cervical spine immobilization and clearance in patients with GSW to the head is limited. In a recent retrospective review of patients with GSW to the head, none of 105 patients who had complete lateral cervical spine films and GSW confined to the calvaria had cervical spine injury. In an additional 52 patients who had complete neck films and who also had entrance or exit wounds not limited to the head, five direct injuries to the cervical spine or spinal cord were identified. In that study, the authors also noted no diagnosed cervical spine injury in the 109 patients who had no cervical spine radiographs and survived. [15]

Cervical spine immobilization has important implications for airway management. This group of patients with serious head injury is at high risk for hypoxia and aspiration. Airway control and the administration of oxygen are of paramount importance in these patients. Numerous studies have demonstrated the frequent occurrence of hypoxia in head injured patients and its detrimental effects. Chesnut et al., in reviewing data from the National Traumatic Coma Bank, found a 22% incidence of hypoxia at the time of initial evaluation. [16] Others have reported that 30% to 46% of patients with severe head injury have initial hypoxia (PaO<sub>2</sub> less than 65 torr). [17] For patients with head injury, any occurrence of hypoxia is linked with not only an 85% increase in mortality, but also an increased likelihood of permanent disability. [18,19] In the prehospital setting, in which intubation is done with limited personnel, suboptimal conditions, and frequently without pharmacologic intervention, cervical spine precautions may significantly limit the provider's ability to secure the airway.

Although the importance of intubation and hyperventilation are recognized, the presence of cervical spine immobilization complicates airway control and management. [20] In the present study, unsuccessful attempts at intubation were closely associated with patients in cervical spine immobilization. Although attempts were made to intubate 38 patients in the prehospital setting, 16 patients could not be intubated in the field or required reintubation upon ED arrival. Additionally, immobilized patients had multiple intubation attempts when compared with nonimmobilized patients. All but two of these patients were in cervical spine immobilization. In the previous study of GSW and cervical spine injury, 45% of patients with intracranial injury required immediate intubation, but only three patients were intubated in the prehospital period, emphasizing the problems cervical spine immobilization causes for prehospital providers in obtaining airway control.

In this series of 215 patients, 202 had examinations for cervical spine injury after GSW to the head, and no occult cervical spine injuries were found. No patient had a blast effect, or indirect ligamentous cervical spine injury from the GSW to the head clinically, radiographically, or by detailed autopsy. The three cervical spine injuries diagnosed were all from direct bullet contact, and in all three patients, the position of the entrance and/or exit wounds indicated cervical spine traverse.

Cervical spine immobilization, although a routine part of trauma care, is unnecessary for the patient with a gunshot wound to the head without evidence of bullet traverse of the neck. The use of cervical spine precautions may, in fact, impede airway management and oxygenation of the patient. The patient with a GSW to the head who has no evidence of neck traverse does not need or benefit from cervical spine immobilization. However, if the bullet trajectory cannot be determined or if the patient had focal neurologic deficit suggestive of spinal column injury, cervical spine immobilization should be implemented.

Obtaining multiple view radiographs of the neck simply for the sake of protocol adds unnecessary expense and delay to the care of the patient. Routine cervical spine clearance after GSW to the head should be abandoned unless trajectory indicates direct injury.

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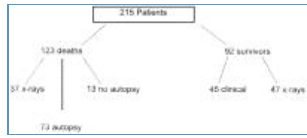


Figure 1

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