

## ADVANCES

# Airway management in penetrating neck trauma at a Canadian tertiary trauma centre

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**ABSTRACT**

**Objectives:** The optimal approach to airway management in penetrating neck injuries (PNIs) remains controversial. The primary objective of this study was to review the method of endotracheal intubation in PNI at a Canadian tertiary trauma centre. Secondly, we sought to determine the incidence of PNI in our trauma population and to describe the epidemiologic elements of this population.

**Methods:** We conducted a review of patients with PNIs who were enrolled in the Nova Scotia Trauma Registry database. We included all patients 16 years of age or under who presented between April 1, 1994 and March 31, 2005 with penetrating injuries of the neck and an Injury Severity Score (ISS) of 9 or less or who underwent Trauma Team activation at our Tertiary Trauma Centre (regardless of ISS) and/or who were identified upon admission as a "major" trauma case. The variables of interest were patient age and sex, injury mechanism, injury location, place of intubation and method of intubation.

**Results:** There were 19 people who met inclusion criteria and they were enrolled in our study. The injury mechanisms involved knife ( $n = 13$ ) or gunshot ( $n = 5$ ) wounds (one patient's injuries were categorized as "other"). Three patients (15.8%) were not intubated. The remaining 16 patients were intubated during prehospital care ( $n = 5$ ), in the emergency department ( $n = 6$ ) or in the operating room ( $n = 5$ ). Of these, 8 patients (42.1%) underwent awake intubation and 8 (42.1%) underwent rapid sequence intubation.

**Conclusion:** There is clear variability of airway management in PNI. We believe that such patients represent a heterogeneous group where the attending physician must have a conservative yet varied approach to airway management based on the individual clinical scenario.

**Key words:** neck injury, penetrating wounds, endotracheal intubation, rapid sequence intubation, trauma center

**RÉSUMÉ**

**Objectifs :** La façon optimale de prendre en charge les voies aériennes dans les cas de plaie pénétrante du cou (PPC) suscite toujours la controverse. Cette étude visait principalement à revoir la méthode d'intubation endotrachéale utilisée à un centre de traumatologie tertiaire du Canada dans des cas de PPC. Nous voulions aussi déterminer l'incidence des PPC dans notre population de

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traumatisés et décrire les éléments épidémiologiques de cette population.

**Méthodes :** Nous avons procédé à une étude des patients victimes de PPC inscrits dans la base de données du Registre des traumatismes de la Nouvelle-Écosse. Nous avons inclus tous les patients de 16 ans ou moins qui se sont présentés entre le 1er avril 1994 et le 31 mars 2005 avec une plaie pénétrante du cou et dont l'indice de gravité de la blessure (IGB) s'établissait à 9 ou moins, et qui ont fait intervenir l'équipe de traumatologie à notre centre de traumatologie tertiaire (sans égard à l'IGB), ou qui ont été identifiés à l'admission comme un cas de traumatisme "majeur". Les variables d'intérêt étaient l'âge et le sexe du patient, le mécanisme du traumatisme, l'emplacement de la blessure, le lieu et la méthode d'intubation.

**Résultats :** Il y avait 19 personnes qui satisfaisaient aux critères d'inclusion et qui ont été inscrites à notre étude. Les mécanismes traumatisants ont inclus le couteau ( $n = 13$ ) ou la blessure par balle ( $n = 5$ ) (dans un cas, on a classé les blessures du patient dans la catégorie "autres"). Trois patients (15,8 %) n'ont pas été intubés. Les 16 autres patients ont été intubés au cours des soins qui ont précédé l'hospitalisation ( $n = 5$ ), à l'urgence ( $n = 6$ ) ou à la salle d'opération ( $n = 5$ ). Sur ce total, 8 patients (42,1 %) ont été intubés éveillés et dans 8 cas (42,1 %), on a procédé à une intubation à séquence rapide.

**Conclusions :** La prise en charge des voies aériennes dans les cas de PPC varie clairement. Nous sommes d'avis que ces patients représentent un groupe hétérogène à l'égard duquel le médecin traitant doit suivre une approche conservatrice mais variée de prise en charge des voies aériennes qui tienne compte du scénario clinique du patient.

## Introduction

The optimal approach to airway management in penetrating neck injuries (PNIs) remains a controversial topic with a paucity of literature. A search of PubMed revealed that most articles published on PNI focus on evaluation and surgical management. The research to date on airway management in PNI has been observational, case-based and varied in terms of a recommended approach.<sup>1-7</sup> The primary options for the emergency intubation of these patients are awake intubation and rapid sequence intubation (RSI); the use of dissociative anesthesia with ketamine has also been described.<sup>8</sup> Other, less well-reported or supported options include blind nasotracheal intubation,<sup>1</sup> intubation directly through the wound site and a primary surgical airway.<sup>9</sup>

PNIs are not commonly seen in Canadian trauma centres.<sup>10</sup> Nevertheless, the potentially critical and evolving nature of such patients' injuries poses considerable challenges and, thus, warrants research attention. Severe trauma to the airway or to critical juxtapositioned structures can complicate the resuscitative management and definitive intubation of these patients.

To date, there have been no Canadian studies published on airway management in PNI. The primary objective of this study was to review the method of endotracheal intubation in PNI at a Canadian tertiary trauma centre. Secondly, we sought to determine the incidence of PNIs in our trauma population and to describe this population's epidemiologic features.

## Methods

We conducted an observational, retrospective study. Since 1994, the Nova Scotia Trauma Registry has collected data on all major trauma patients in the province who are referred to the province's sole adult tertiary care centre (the Queen Elizabeth II Health Science Centre). This registry currently contains comprehensive data on more than 3000 major trauma patients and was the primary data source in our study.

We obtained data from the trauma registry on all patients 16 years of age or under who presented between April 1, 1994 and March 31, 2005 with penetrating injuries of the neck, as well as an Injury Severity Score (ISS) of 9 less or who underwent Trauma Team activation at our Tertiary Trauma Centre (regardless of ISS) and/or who were identified upon admission as a "major" trauma case. We performed an additional individual chart review of identified patients using explicit criteria. We defined RSI, as per the American College of Emergency Physicians policy statement on RSI, as a technique in which a potent sedative or induction agent is administered virtually simultaneously (i.e., in rapid sequence) with a paralyzing dose of a neuromuscular blocking agent to facilitate the placement of a tracheal tube.<sup>11</sup> As per the American Society of Anesthesiologists (ASA) difficult airway algorithm, we defined awake intubation as any intubation involving topical anesthesia as the primary pharmacologic adjunct.<sup>12</sup>

The variables of interest were patient age and sex, mech-

anism of injury, location of injury (as per the 3 standard neck zones: zone 1, which extends from the clavicles to the cricoid cartilage; zone 2, which extends from the cricoid cartilage to the angle of the mandible; and zone 3, which extends from the angle of the mandible to the mastoid process) place of intubation and method of intubation. We generated descriptive statistics (mean, median and percentages), as appropriate. We also included range and interquartile range to describe the data distribution. Due to the small sample size, we did not use comparative statistical approaches. We obtained approval of the protocol from the Research Ethics Board of the Capital District Health Authority, Halifax, NS.

## Results

We identified 19 cases of penetrating neck trauma that met study inclusion criteria. The mean patient age was 39.4 years (range 16–75, median 39), and 17 patients were male (89.5%).

The injury mechanisms involved knife ( $n = 13$ ) or gunshot ( $n = 5$ ) wounds (one patient's injuries were categorized as "other" and were identified only as the result of a "sharp object in a motor vehicle crash"). The mean ISS was 17 (range 1–50, median 17). Fourteen cases involved isolated injury to zone 2, no cases involved injury only to zone 3, and one involved injury to only zone 1. One case involved injury to all 3 zones, and 2 involved injury to zones 1 and 2.

Three of the patients (15.8%) were not intubated. The remaining patients were intubated either in the prehospital setting ( $n = 5$ ), in the emergency department (ED) ( $n = 6$ ) or in the operating room (OR) ( $n = 5$ ). Table 1 shows the number of patients who underwent awake intubation, compared with RSI.

## Discussion

PNI are relatively rare in Canadian major trauma centres,<sup>10</sup> yet in some US centres they account for 5%–10% of trauma cases.<sup>13</sup> Such injuries are challenging in their complexity and in their initial resuscitation, particularly in terms of optimal airway management. In our review, we identified only 19 cases of PNI over a period of 11 years. This speaks to the rarity of this type of injury at our centre and to the challenge that these cases present to the attending physician. Our findings underscore the variety of approaches taken in cases of PNI. Approaches to management did not follow a set universal protocol, but instead appeared to have been tailored to the individual patient's

presentation and/or the skills and comfort level of the provider.

We identified only 6 papers on the topic of PNI and only 2 reported findings of direct relevance to emergency physicians. Our study is the first published Canadian review of airway management in PNI. Some authors advocate the use of RSI as the definitive and default method for airway management in PNI.<sup>1–3</sup> However, there are clear and reoccurring cautions in the medical literature concerning the indiscriminate use of this method.<sup>9,14</sup> The main general concern with this technique is that it causes apnea in patients who have the potential to spontaneously breathe, thereby removing supportive muscle tone. This can make some patients difficult to intubate and to support with positive pressure ventilation via bag-valve-mask. As a result of this and other potential anatomic issues (discussed below), some authors recommend awake intubation in PNI,<sup>5,14</sup> possibly with pharmacologic adjuncts (such as ketamine), and often in conjunction with fiberoptic techniques for endotracheal intubation.<sup>8</sup> If there are unequivocal injuries in proximity to, or involving, the larynx or the trachea, a primary surgical approach may be preferable.<sup>3</sup> Owing to the diversity and complexity of these patients, coupled with their relative rarity to the resuscitative physician, there is likely not one single method of choice.<sup>6,7</sup>

Our results indicate that there is clear variety of airway

**Table 1. Cases of PNI meeting study inclusion criteria ( $n = 19$ )**

| Variable                    | No intubation ( $n = 3$ ) | Awake intubation ( $n = 8$ ) | RSI ( $n = 8$ ) |
|-----------------------------|---------------------------|------------------------------|-----------------|
| % of total cases            | 15.8                      | 42.1                         | 42.1            |
| Place of intubation ( $n$ ) |                           |                              |                 |
| Pre-hospital                | —                         | 4                            | 1               |
| ED                          | —                         | 2                            | 4               |
| OR                          | —                         | 2                            | 3               |
| Zone of injury              |                           |                              |                 |
| Zone 1                      | 1                         | 0                            | 0               |
| Zone 2                      | 2                         | 5                            | 7               |
| Multiple zones              | 1                         | 2                            | 1               |
| Mechanism of injury         |                           |                              |                 |
| Knife                       | 2                         | 7                            | 4               |
| Gun                         | 1                         | 1                            | 3               |
| Other                       | 0                         | 0                            | 1               |
| Median ISS (IQR)            | 10 (15)                   | 26 (11)                      | 9 (16)          |
| Survival, $n$ (%)           | 3 (100)                   | 5 (62.5)                     | 8 (100)         |
| Male sex, $n$ (%)           | 2 (66.7)                  | 7 (87.5)                     | 8 (100)         |
| Median age (IQR)            | 26 (41)                   | 42 (12)                      | 28.5 (19)       |

ED = emergency department; IQR = interquartile range; ISS = injury severity score; PNI = penetrating neck injury; OR = operating room; RSI = rapid sequence intubation  
— = not applicable

management in PNI consistent with the ongoing debate in the literature. The difficult airway is defined by the ASA as a “clinical situation in which a conventionally trained anesthesiologist experiences difficulty with mask ventilation, tracheal intubation or both.”<sup>12</sup> Application of the ASA difficult airway algorithm is predicated on the clinician first assessing the “likelihood and clinical impact” of encountering difficulty. If a difficult airway is considered likely and is clinically significant, then the ASA algorithm advises an awake approach. In a patient with a PNI, the difficult airway scenario occasionally applies because of anatomic distortion, swelling or copious amounts of blood. This can preclude optimal intubation conditions and compromise positive pressure ventilation with bag-valve-mask devices.

We found that the use of RSI, compared with awake intubation in PNI, was evenly divided and that no adverse airway-related outcomes were identified in either group. Nevertheless, we are extremely hesitant to endorse the recommendation of default RSI in PNIs, as some authors have.<sup>1-3</sup> We believe that such patients represent a heterogeneous group where the attending physician must have a conservative, yet varied, approach to airway management based on the individual clinical scenario. If there is clear, imminent compromise of the airway with laceration to the trachea or to the larynx in an awake, cooperative patient, then a careful, planned intubation under fibre optic guidance would be a prudent approach. If no obvious primary airway compromise is evident, but juxtapositioned wounds make progression of a hematoma or swelling inevitable, then a formal RSI with airway adjuncts, such as a gum elastic bougie, may be reasonable. Another option is for the attending physician to perform an “awake look” with a laryngoscope and topical anesthesia, as used in an awake intubation. The purpose of an awake look is to ensure that there is no anatomic distortion that would preclude glottic visualization and endotracheal tube passage. Once reassured of this, the attending physician could proceed to an RSI. We did not encounter any examples of this approach in our review.

## Conclusions

Patients with PNI represent some of the most difficult and challenging airway management cases in emergency medicine, and a single approach that lacks options for encountered difficulty should be discouraged. In addition, physicians in all relevant specialties (including emergency medicine; anesthesia; trauma surgery; and ear, nose, and throat surgery) should, whenever possible, be collaboratively involved in the resuscitative care of these patients.

The 2 primary approaches to airway management in PNI are both associated with good outcomes. For such patients, we recommend that the attending physician adopt an approach to airway management based on the individual clinical scenario rather than on a preset algorithm.

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