An evidence based review of the assessment and management of penetrating neck trauma

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Background: Although relatively uncommon, penetrating neck trauma has the potential for serious morbidity and an estimated mortality of up to 6%. The assessment and management of patients who have sustained a penetrating neck injury has historically been an issue surrounded by significant controversy.

Objectivesof review: To assess recent evidence relating to the assessment and management of penetrating neck trauma, highlighting areas of controversy with an overall aim of formulating clinical guidelines according to a care pathway format.

Type of review: Structured, non-systematic review of recent medical literature.

Search strategy: An electronic literature search was performed in May 2011. The Medline database was searched using the Medical Subject Headings terms 'neck injuries' and 'wounds, penetrating' in conjunction with the terms 'assessment' or 'management'. Embase was searched with the terms 'penetrating trauma' and 'neck injury', also in conjunction with the terms 'assessment' and 'management'. Results were limited to articles published in English from 1990 to the present day.

Evaluation method: Abstracts were reviewed by the first three authors to select full-text articles for further critical appraisal. The references and citation links of these articles were hand-searched to identify further articles of relevance.

Results: 147 relevant articles were identified by the electronic literature search, comprising case series, case reports and reviews. 33 were initially selected for further evaluation.

Conclusions: Although controversy continues to surround the management of penetrating neck trauma, the role of selective non-operative management and the utility of CT angiography to investigate potential vascular injuries appears to be increasingly accepted.

Penetrating neck trauma is a relatively uncommon occurrence in the United Kingdom. One study from southern Finland has estimated the incidence of non-ballistic penetrating neck injuries to be 1.3/100 000 per annum in that region.[1] Worldwide, the most common mechanism of injury is a stab wound from a violent assault, followed by gunshot wounds; road traffic accidents and other miscellaneous mechanisms constitute a much smaller percentage of injuries[2–7] (Table 1). The ratio of stab wounds to firearm injuries as a cause of penetrating neck injury in the United Kingdom is likely to be similar to that observed in Canada,[5] given that Hospital Episode Statistics data from England (2009–2010) recorded 4770 hospital attendances following an 'assault by sharp object' in contrast to 220 attendances secondary to 'assault by firearms'.[8]

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Even if penetrating neck trauma comprises only a small percentage of ENT emergency referrals, the potential for significant morbidity and possible mortality is readily apparent. Indeed, the overall mortality rate for penetrating neck trauma is estimated to be between 3 and 6%, with the major cause being exsanguinating haemorrhage from vascular injury.[9] Other causes of death include airway obstruction, cerebral ischaemia and sepsis from oesophageal injuries.[9]

Given that penetrating neck trauma in the United Kingdom is significantly more likely to result from a low-velocity stab injury than from a high-velocity firearm injury, our review will focus on the assessment and management of low-velocity injuries to the neck. The principles of the management of high-velocity injuries are in fact similar to those for low-velocity injuries,[7] but the unpredictable trajectory of firearm projectiles through soft tissue, potential for cavitation or thermal injury, and impairment of cross-sectional imaging by retained metallic fragments all mean that high-velocity injuries are much more likely to require operative exploration than low-velocity injuries.[7]

Table 1. Mechanisms of injury from recent large case series of penetrating neck injuries. 'Stab wounds' comprise wounds secondary to injury with a knife, bottle or razor blade; 'Gunshot wounds' include injuries caused by both handguns and shotguns

Study authors	City and country of study	Number of patients	Stab wounds	Gunshot wounds	Other
Biffl et al.[2]	Denver, USA	312	233	74	5
Demetriades et al.[3]	Johannesburg, South Africa	335	283	39	13
Demetriades et al.[4]	Los Angeles, USA	223	89	107	27
Nason et al.[5]	Winnipeg, Canada	130	97	6	29
Osborn et al.[6]	Portland, USA	120	63	31	26
Thoma et al.[7]	Cape Town, South Africa	203	159	42	2
	Totals (% of total)	1323	924 (70%)	299 (22%)	102 (8%)

Methods

A literature review was performed in May 2011. The Medline database was searched using the Medical Subject Headings terms 'neck injuries' and 'wounds, penetrating' in conjunction with the terms 'assessment' or 'management'. Embase was searched with the terms 'penetrating trauma' and 'neck injury', also in conjunction with the terms 'assessment' and 'management'. Results were limited to articles published in English from 1990 to the present day. A total of 147 potentially relevant articles were identified using this strategy. The abstracts of these articles were reviewed, and 33 were deemed to be the most relevant. Full-text copies of these articles were obtained, and their references and citation links were hand-searched to identify further articles of relevance.

Anatomical considerations

Penetrating injuries of the neck can be classified according to the anatomical level of the injury (Fig. 1).[5] Zone I is defined as the region between the clavicles, sternal
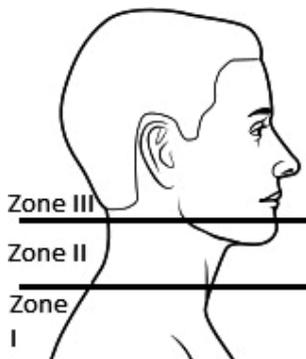

Fig. 1. Zone classification of penetrating neck injuries. Zone I extends from clavicles to cricoid, zone II from cricoid to angle of mandible, and zone III from angle of mandible to skull base.

notch and the level of the cricoid cartilage, zone II lies between the cricoid and the angle of the mandible, and zone III comprises the area between the angle of mandible and the skull base. The assessment and surgical management of injuries in zones I and III are complicated by the proximity of the thoracic cavity and skull base region, respectively. The majority of penetrating injuries occur in zone II however,[2,4,5,10] where the major structures are relatively more accessible surgically.

Areas of controversy

Figure 2 is a flow diagram of the decision pathway of a patient with penetrating neck trauma the areas of controversy being in numbered yellow boxes. The text that follows addresses the evidence to consider in the controversy and each controversy is summarised in a yellow Keypoints box at the end.

I *Initial approach and stabilisation*

The Advanced Trauma Life Support approach to significant injury emphasises a systematic approach to the assessment and management of any form of significant trauma.[11] A primary survey and stabilisation routine centred around an 'ABCDE' approach is advocated, followed by a secondary survey to identify additional injuries. 'A' refers to 'Airway with cervical spine protection', 'B' to 'Breathing', 'C' to 'Circulation [and haemorrhage control]', 'D' to 'Disability or neurologic status' and 'E' to 'Exposure (undress) and Environment (temperature control)'.[11]

More recently, the concept of <C>ABCDE has evolved. Battlefield data have demonstrated that many preventable deaths occur as a result of massive haemorrhage that may be controlled with simple pressure.[12] For this reason, army medics and civilian pre-hospital medical teams are now taught to attend to <C> – massive exsanguinating haemorrhage – before returning to the traditional pri-

mary survey. The need to prioritise the management of significant haemorrhage is especially appropriate in the context of penetrating neck trauma, given that exsanguination accounts for 50% of the mortality from such injuries.[9]

The requirement for cervical spine immobilisation in the context of penetrating neck trauma is an area of contention. One retrospective study demonstrated that the rate of cervical fracture or cervical spinal cord injury following a stab wound to the neck was exceedingly rare, occurring in 11 of 7483 patients (0.15%).[13] All patients with cord injury had an obvious neurological deficit on

presentation, and no patients who were neurologically intact on presentation required surgical stabilisation. Furthermore, a recent retrospective review of 199 cases of penetrating neck trauma found that cervical spine immobilisation was associated with an increased risk of death (odds ratio 2.77, $P < 0.02$).[14] The authors speculate that immobilisation-related mortality could be secondary to delayed pre-hospital transport, obscuration of clinical findings, impaired intubation and reluctance to remove a cervical collar to treat life-threatening injuries.[14]

Given the lack of benefit and indeed possible detriment of cervical spine immobilisation in the context of a low-
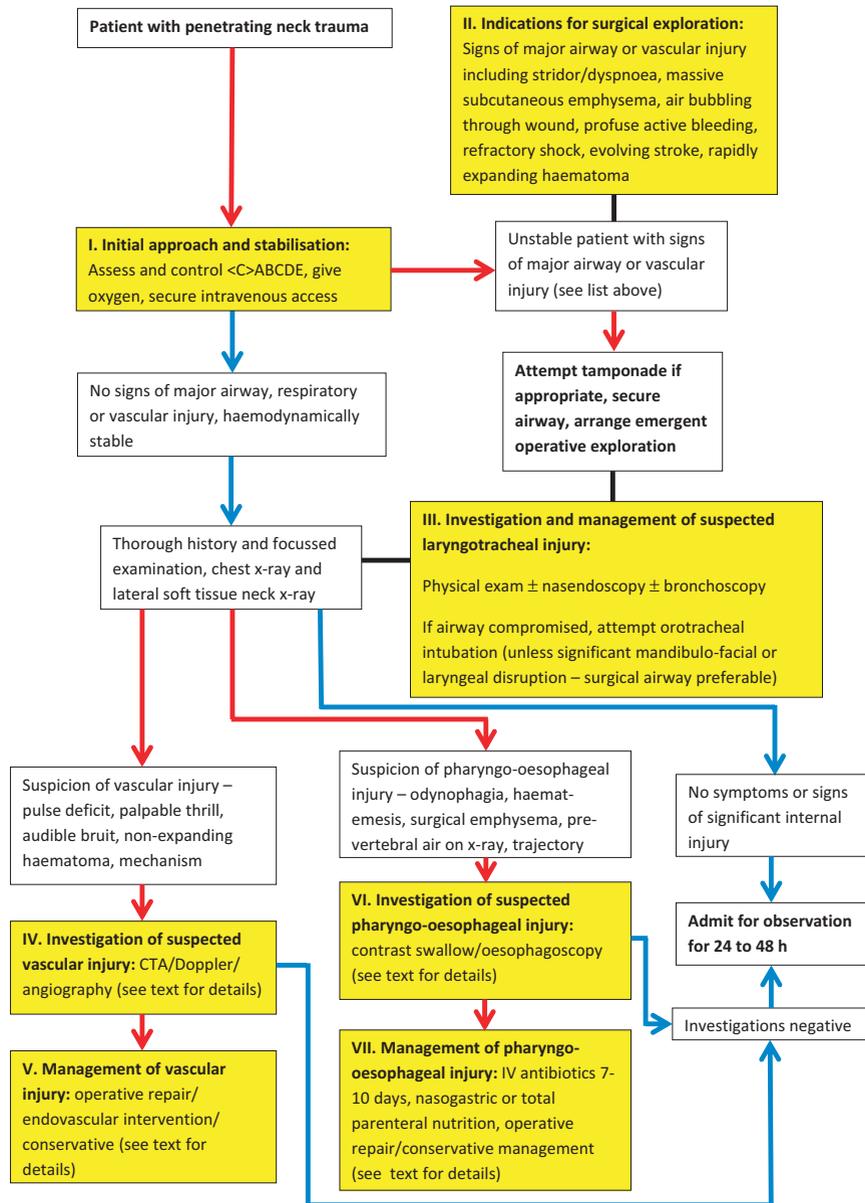

Fig. 2. Care pathway for penetrating neck trauma. Yellow boxes indicate areas of controversy explored in further detail in the main text.

velocity penetrating injury to the neck, cervical spine protection is not advocated as part of an initial stabilisation strategy. Exceptions to this guidance include a focal neurological deficit at presentation or a high index of suspicion for spinal injury in an unconscious or heavily intoxicated patient.

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I Keypoints on Initial approach and stabilisation

- Massive exsanguinating haemorrhage from a cervical vascular injury may kill more quickly than a suboptimal airway and should therefore be an immediate management priority in the context of penetrating neck trauma.
- Cervical spine immobilisation is usually not necessary and may be detrimental in the context of an isolated, low-velocity penetrating neck injury.

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II *Indications for surgical exploration*

Military experience in World War II resulted in the adoption of a policy of mandatory neck exploration for any injury that was found to breach the platysma.[2,15] It was subsequently shown that in civilian practice, this approach was associated with a significant number of negative neck explorations (neck explorations that did not identify an internal injury requiring surgical intervention): in one paper based on data from the 1970s, 56% of neck explorations were described as non-therapeutic.[2] These findings, coupled with advances in imaging technology, have led many centres to adopt a selective approach to neck exploration. This advocates the conservative management of asymptomatic patients with no clinical signs of significant injury and the absence of findings on appropriate investigations.

In one series reviewing the outcomes of this selective approach, 207 of 312 patients (66%) with penetrating neck injuries were managed conservatively following a thorough physical examination and angiography/oesophageal investigation if indicated.[2] Only one of the patients managed conservatively in this series required delayed exploration on account of a missed oesophageal injury. The remaining patients were discharged on average 1.5 days after admission, which contrasts with an average hospital stay of 5.1 days following a negative neck exploration. A further prospective study of patients who had sustained penetrating neck injuries demonstrated that 269 of 335 such patients (80%) could be managed conservatively with no adverse outcomes.[3] Two of the conservatively managed patients required semi-elective procedures during their admission for arteriovenous fistula diag-

nosed following the detection of bruits the day after their original injury. Numerous additional studies from a variety of countries and institutions have demonstrated similarly good outcomes for patients with penetrating neck trauma managed non-operatively on a selective basis.[5,7,16,17]

Although there are clear advantages to a policy of selective non-operative management of penetrating neck trauma, there of course remain certain circumstances when immediate operative exploration of a penetrating neck injury is required. Signs of significant injury that are widely agreed to necessitate emergent surgical intervention include signs of major airway injury (airway compromise, massive subcutaneous emphysema or air bubbling through a wound) or signs of major vascular injury (severe active bleeding, refractory shock, evolving stroke or a rapidly expanding haematoma).[1,2,4] The role of further investigations to detect injuries warranting intervention in the absence of such signs is discussed below.

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II Keypoints on Indications for surgical exploration

- Indications for immediate surgical exploration of penetrating neck injuries include airway compromise, massive subcutaneous emphysema, air bubbling through a wound, profuse active bleeding, refractory shock, evolving stroke or a rapidly expanding haematoma.
- A policy of mandatory surgical exploration for all injuries that breach the platysma is now no longer widely practised.
- Retrospective and prospective case series data support a conservative approach to the management of asymptomatic patients with negative physical examinations and investigations.

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III *Assessment and management of suspected laryngotracheal injury*

The assessment of patients with suspected penetrating injury to the larynx or trachea initially involves careful clinical examination. The presence of hoarseness, stridor, subcutaneous emphysema (in the absence of pneumothorax), and a sucking or bubbling neck wound indicate trauma to the upper aerodigestive tract. In such cases, the priority is to secure and maintain the compromised airway.

A variety of means of securing the compromised airway have been described in penetrating neck trauma. In one retrospective study of 748 patients with penetrating neck trauma, 58 patients (11%) required immediate air-

way control.[18] This was achieved by oral endotracheal intubation using rapid sequence induction of anaesthesia (RSI) in 42 patients. Five patients were unconscious and managed with simple oral endotracheal intubation, while two patients required tracheostomy. It is worth nothing that this study from the United States included a significant number of patients with high-velocity injuries. In a Canadian study of 19 patients with penetrating neck injury, 16 required definitive airway control. This was achieved with orotracheal intubation using RSI in eight patients and awake intubation in eight patients.[19] In this study, the majority of injuries sustained were of low velocity.

Some studies have highlighted concerns over the use of RSI in trauma patients. These concerns relate to the loss of airway tone induced by RSI, which may lead to further airway compromise. In one retrospective review of the management of patients with laryngeal trauma, RSI was complicated by loss of airway control in 12% of cases, necessitating emergency cricothyroidotomy.[20] The authors conclude that while RSI is effective in the majority of cases, clinicians should be ready to perform a surgical airway should RSI fail.[20]

Where there is significant disruption of laryngotracheal anatomy, surgical control of the airway is advocated.[21,22] In such cases, attempted orotracheal intubation may exacerbate existing airway compromise. A low, vertical incision through skin and subcutaneous tissue is recommended, with entry into the airway at least one tracheal ring below the site of injury.[21]

When injury to the upper aerodigestive tract is suspected or identified, further evaluation with panendoscopy and bronchoscopy under general anaesthesia is often helpful.[22] Once an injury to the airway has been identified and characterised, repair is usually indicated; the exception to this may be small mucosa defects or undisplaced fractures of the laryngeal framework, which may be managed conservatively.[22]

III Keypoints on Assessment and management of suspected laryngotracheal injury

- All significant laryngotracheal injuries should be detected by clinical examination alone.
- A compromised airway following penetrating neck injury can usually be secured via direct laryngoscopy and orotracheal intubation following a rapid sequence induction.
- Significant laryngotracheal disruption warrants an emergent surgical airway.

IV *Investigation into suspected vascular injury*

The presence of a vascular injury is often suspected on the basis of physical examination, with 'hard' signs of major vascular injury (as described in section II) mandating emergent surgical exploration. 'Soft' signs of vascular injury that do not warrant immediate surgery but do require further investigation include peripheral pulse deficits (brachial or radial), the presence of a palpable thrill or audible bruit, and a non-expanding, moderate haematoma.

Catheter angiography is considered to represent the 'gold-standard' investigation for suspected vascular injury.[6] Advantages of this modality include the possibility of simultaneous endovascular treatment for certain vascular lesions. Disadvantages include the lack of availability of angiography outside of normal office hours at many district general hospitals, the length of time needed to perform the investigation and possible complications including a risk of transient ischaemic attack or stroke. The overall incidence of complications associated with catheter angiography has been quoted to be between 0.16 and 2.0%.[23]

Given the limitations of standard angiography, computed tomographic angiography (CTA) has been investigated as a possible alternative.[6,23] Advantages include its ready availability and minimal invasiveness in comparison with conventional arteriography. A CTA can also be performed rapidly, with most scans taking between 2 and 3 min to perform.[6] Unlike ultrasound, CTA is not operator dependent and produces high-quality images that can be interpreted by treating clinical staff as well as radiologists. Furthermore, CTA can demonstrate injuries to structures separate from the arterial tree such as the aerodigestive tract.[6] The trajectory a stabbing implement has taken through the neck can also often be visualised on a CTA scan to further clarify which structures may be at risk of injury and may therefore require further investigation.[6]

One study that prospectively evaluated multislice helical CTA in the initial evaluation of penetrating neck injuries demonstrated a 100% sensitivity of this modality in detecting all significant vascular and aerodigestive injuries in 91 asymptomatic patients, with a specificity of 94%.[10] A further study involving 175 patients also established a sensitivity of 100% for CTA with respect to the investigation into arterial injuries and a specificity of 99%.[23] Both studies noted that interpretation of CTA images could be limited by metallic fragments retained in the neck such as bullets.

Colour flow Doppler imaging has been advocated as a non-invasive alternative to conventional arteriography, with a sensitivity of 91% and a specificity of 99% for the detection of vascular injuries in one prospective case series of 82 patients.[24] Limitations of this modality include

the fact that adequate performance and interpretation of an ultrasound scan are operator dependent. An ultrasound is also unlikely to give useful information regarding injuries to non-vascular structures or the trajectory taken by a stabbing implement.

IV Keypoints on Investigation into suspected vascular injury

- CT angiography is widely advocated as the first-line investigation for suspected arterial injuries in the stable patient with a penetrating neck injury.
- Colour flow Doppler imaging has a high degree of sensitivity and specificity for vascular injuries but is operator dependent.
- Conventional angiography as an investigation is limited by availability and a risk of complications including stroke.
- The risks of angiography may be countered by its potential therapeutic role in the endovascular treatment for certain vascular injuries.

V Management of vascular injury

Although the first documented ligation of a carotid artery is said to have saved the life of a soldier over 400 years ago, further military experience from the two World Wars noted that this practice resulted in a high incidence of irreversible neurological deficit.[15] Techniques permitting the surgical repair of injured carotid arteries were therefore developed, with subsequent improvement in neurological outcomes.[15]

Prior to any surgical or radiological intervention on an injured cervical artery, temporary control of haemorrhage should ideally be achieved. In the event that simple external compression is ineffective, one intervention that can be attempted is Foley balloon catheter tamponade.[25,26] This involves the insertion of an 18- or 20-gauge Foley catheter into a bleeding neck wound along the path of the wound tract. The balloon is then inflated with 5 mL of water or until resistance is felt, and the proximal end of the catheter is clamped or tied in a knot to prevent bleeding through the lumen. The more superficial neck wound can then be packed or closed with sutures.[26] Failure of this intervention to control bleeding requires immediate operative exploration.

If compression or balloon tamponade successfully controls the haemorrhage from a penetrating neck wound, appropriate investigations to identify the source of the bleeding can be arranged. A positive angiogram (CT or conventional) usually requires operative or endovascular intervention, while a negative angiogram is taken to signify a venous injury that some centres manage conservatively in the first instance. Navsaria *et al.*,[26] for example, advocate maintaining balloon tamponade *in situ* for 48–72 h if an angiogram is negative, followed by a planned removal in the operating theatre; a neck exploration is performed at this stage if bleeding recurs. This approach is reported to have been successfully employed at a Trauma Unit in Cape Town, where neck catheters were electively removed from 13 of 14 patients without further bleeding.[26]

When a common or internal carotid artery injury is identified during a neck exploration, the consensus from the literature is that repair of the artery is generally preferable to ligation, irrespective of whether a preoperative focal neurological deficit was present or not.[27] The benefit of this approach was first demonstrated in a case series of 40 patients with preoperative neurological deficits secondary to penetrating neck trauma (monoplegia, hemiplegia or aphasia): 85% of patients undergoing revascularisation had a favourable outcome, compared to 50% who underwent ligation.[28] Ligation of an injured carotid artery is only indicated in patients with preoperative coma (Glasgow Coma Scale score <8), who are likely to have an adverse outcome with either revascularisation or ligation.[29]

Any attempt at arterial repair is clearly best performed in conjunction with an experienced vascular surgeon, but increasing centralisation of vascular services means that such expertise may not be readily available at the level of a district general hospital. Under these circumstances, the concept of 'damage-control' surgery may be applied as a temporising measure.[30] This refers to a phase of temporary control of injuries, a subsequent phase of resuscitation in the intensive care unit and a final phase of definitive control and repair of injuries. Packing of wounds with no attempt to reconstitute vascular continuity provides the mainstay of initial management. Such a concept has been successfully applied in a case of penetrating neck trauma with severe bleeding from an injured vertebral artery, surgical access to this structure being notoriously challenging.[30]

The optimum management for stable patients who are found to have an arterial injury on radiological investigation remains to be established. Consultation with a vascular surgeon and/or an interventional radiologist is therefore recommended to determine the most appropriate management for each individual case. The role of the interventional radiologist is especially pertinent in the situation of penetrating trauma to the vertebral or subclavian arteries, given the difficulty of surgical access to these structures and excellent outcomes obtained through endovascular intervention.[31,32]

Most of the isolated jugular venous injuries are believed to be unrecognised – it is claimed that this low-pressure system usually tamponades or occludes without a major haemorrhage.[33] Prospective case series data also appear to confirm that penetrating jugular venous injuries can be safely managed without operative intervention.[34] In the event of significant haemorrhage from an injury to the jugular venous system or discovery of a jugular venous injury at neck exploration, the consensus is that ligation of the affected vein can be performed without fear of complications.[33] The exception to this general rule would be the rare occasions when the internal jugular venous system sustains bilateral injuries. In this situation, an attempt to repair one vein should be undertaken if possible to minimise the risk of subsequent cerebral venous hypertension and oedema.[33]

V Keypoints on Management of vascular injury

- In the Emergency Department, Foley catheter balloon tamponade may obtain temporary control of haemorrhage from a penetrating neck injury if manual compression is unsuccessful.
- Damage-control surgery may have a role in the context of unrelenting haemorrhage from a penetrating neck injury that is not amenable to routine surgical manoeuvres.
- Injuries to the common or internal carotid artery should be treated with operative repair rather than ligation, unless the patient has a Glasgow Coma Scale score of less than eight preoperatively.
- Vertebral and subclavian artery injuries are ideally managed with endovascular techniques.
- Unilateral injuries to the internal jugular venous system can be treated with ligation, but an attempt at unilateral surgical repair should be performed in the context of bilateral injuries.

VI *Investigation into suspected pharyngo-oesophageal injury*

Injury to the oesophagus is uncommon in penetrating neck trauma owing to its central position and relative protection by surrounding structures. Studies show its incidence to be approximately 5% in cases of penetrating neck trauma.[35,36] This low incidence can lead to a low index of suspicion and subsequent delay in diagnosis. A delay from 12 to 24 h can lead to increased extravasation of saliva, bacteria and gastric reflux, resulting in necrotic

inflammation of surrounding tissues, failure of surgical repair and prolongation of leak.[37]

A thorough history and examination are key to raising clinical suspicion of injury. Odynophagia or haematemesis in the presence of penetrating neck trauma should always be investigated, with the site and trajectory of penetrating wounds guiding the surgeon to the level of possible visceral injury. Examination should include palpation of the neck for surgical emphysema and evaluation of the upper aerodigestive tract with nasendoscopy.

Evidence of pre-vertebral air on lateral cervical spine X-ray should prompt a water-soluble contrast swallow for confirmation of a leak. This investigation can also be performed if the history or examination findings raise the suspicion of a pharyngo-oesophageal injury. The quoted sensitivity of a contrast swallow ranges from 48 to 100%, with poorer results for higher lesions including the hypopharynx.[38,39] Flexible or rigid oesophagoscopy has better accuracy for these higher lesions with a sensitivity of up to 100%.[39,40] In addition, direct oesophagoscopy is less technically challenging to perform than a contrast swallow in patients who are intubated and can also be undertaken in unstable patients or performed intra-operatively. One advantage of a contrast swallow over oesophagoscopy, however, is that the size and extent of a pharyngeal or oesophageal leak can be assessed; this information has been used in some centres to determine how oesophageal injuries are managed.[35]

VI Keypoints on Investigation into suspected pharyngo-oesophageal injury

- A high index of suspicion is needed for pharyngo-oesophageal injury.
- Odynophagia, haematemesis, subcutaneous emphysema, or pre-vertebral air on a lateral neck X-ray requires further investigation.
- Direct pharyngo-oesophagoscopy (flexible or rigid) has a high sensitivity with respect to detecting injuries.
- Contrast swallows are potentially less sensitive than oesophagoscopy but provide information about the size of pharyngo-oesophageal leaks, which can in turn influence management.

VII *Management of pharyngo-oesophageal injury*

All patients with suspected penetrating oesophageal trauma should receive intravenous antibiotics and be

placed nil by mouth; nutrition should be provided via either a nasogastric tube or total parenteral nutrition. Beyond these measures, debate remains regarding the most appropriate ongoing management of pharyngo-oesophageal injuries.

Mandatory exploration for suspected oesophageal trauma has traditionally been advocated as delays while investigating can lead to increased morbidity when a lesion is found.[41] This argument holds true in trauma centres where immediate exploration is possible, but such a policy is unlikely to be feasible in a smaller district general hospital. More recently, large case series from South Africa have adopted a more selective approach to exploration.[35,36] These groups advocate early investigation into suspected cases with water-soluble contrast swallow studies. Identified leaks should be graded, with large defects associated with extravasation of contrast into the mediastinum requiring immediate exploration but small contained leaks deemed suitable for a trial of conservative management. 94% of patients managed non-operatively on the basis of this approach recovered without complication in the series reported by Madiba *et al.*[35] The need for close monitoring in hospital is emphasised, however, with early intervention if a patient deteriorates.

> ### VII Keypoints on Management of pharyngo-oeso-phageal injury
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> - Patients with suspected or proven pharyngo-oesophageal injuries should receive intravenous antibiotics and be provided with nutrition via non-oral routes (nasogastric or total parenteral).
> - Small, contained pharyngo-oesophageal leaks can be treated with conservative measures alone.
> - Significant pharyngo-oesophageal injuries require urgent surgical exploration and repair.

Conclusion

The assessment and management of penetrating neck trauma remains a challenge and has historically been fraught with controversy. Consensus slowly appears to be evolving with regard to certain aspects of this topic: most centres have now moved away from a policy of mandatory exploration for all injuries deep to the platysma, and there also appears to be increasing acceptance of the role of CT angiography to investigate potential arterial injuries. A care pathway summarising the areas of controversy reviewed in this article is presented in Figure 2.

The heterogeneous nature of cervical trauma means that no one approach will be appropriate for all patients with penetrating neck injuries. The evidence nevertheless suggests that the two fundamental principles of trauma surgery – urgent operative intervention for unstable patients and a careful clinical workup of apparently stable patients to determine the requirement for further investigations or interventions – appear to hold true in the case of penetrating trauma to the neck.

Conflict of interest

None to declare.

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