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Selective observational management of penetrating neck injury in Northern Nigeria

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Summary

Background. The most appropriate management of penetrating neck injury (PNI) remains controversial. This study was conducted to determine the accuracy and safety of physical examination as the basis of selective observational management of PNI at our institution.

Methods. The study was conducted between 1991 and 2006. Patients whose injuries penetrated platysma were included. Following resuscitation, physical signs were utilised to select patients for exploration or observation. Investigations were based on physical signs which, with details of injured structures, treatments and outcomes, were recorded.

Results. There were 225 patients of whom 209 (93.0%) were men. Their mean age was 28 years. The majority (74.2%) of cases were stab wounds, and the balance (25.8%) were gunshot injuries. In 37.8% and 27.6% of patients, injuries were sustained during armed civilian conflicts and robberies, respectively. Patients with no signs of significant injuries (37.8%) were treated by observation. Overall, 52.4% underwent neck exploration; injuries requiring repair were found in 87.3% of these patients. Physical signs as a basis of detecting significant injury had a sensitivity of 97.2% and specificity of 87.4%. Overall mortality was 4.0%.

Conclusion. Physical examination can accurately select patients with PNI who can be safely managed by observation. Physical signs can also identify patients who require further diagnostic evaluations.

The approach to the management of patients with penetrating neck injury (PNI) has undergone significant evolution. Mandatory neck exploration (MNE) has been advocated since 1956 when Fogelman and Stewart published results that demonstrated decreased morbidity and mortality from adopting such a policy.[1] It has been argued that symptoms and signs are often absent, and unsuspected major injuries may be found on routine exploration.[2,3] The morbidity and mortality of delayed exploration is also high when significant injuries are discovered later in the course of treatment.[3] Mandatory exploration produces a high incidence of negative results.[4,5] In developed countries, sophisticated radiological and endoscopic techniques are used to select patients for exploration.[6,7] However, significant expense and morbidity is associated with these often detrimental invasive investigations. An observational approach should comprise careful physical examination to identify a subset of patients who can be managed safely without operation;[8,9] fewer unnecessary explorations would then be performed, and without an increase in morbidity and mortality. An intermediate approach between physical examination alone and sophisticated invasive studies and surgery has also been advocated;[10,11] this uses spiral computed tomography (CT) as the initial diagnostic method to accurately delineate occult injuries and quickly identify those patients in need of exploration and those who require no further workup.[10,11] However, this is limited to stable patients who have no obvious signs of injury to vascular or aerodigestive tracts in the neck.

About 20 years ago, exploration irrespective of physical signs was the norm for PNIs at our institution. Recently we have noted an increase in the number of PNI patients resulting mainly from armed robbery and civil conflicts. Owing to the unavailability of prompt rescue, many of these patients present to hospital several hours after sustaining injury. The absence of pre-hospital care also means that many patients with devastating injuries die before arrival at hospital.[12] Pressure on scarce resources leads to further delays in surgical exploration of neck wounds, and a policy of selective conservatism emerged. Scarce resources also necessitated selective investigation of patients based on careful physical examination.

This study was conducted to determine the accuracy and safety of physical examination as the basis of management of PNI as seen at our institution.

Patients and method

This retrospective study is of patients with PNI admitted to the emergency department of Ahmadu Bello University Teaching Hospital, Zaria, Nigeria, between 1991 and 2006. Patients whose injuries penetrated the platysma were included. Patients who were admitted but died before they were clinically evaluated were not included. The location of injury was classified by zones: zone I – from the clavicle to the cricoid cartilage; zone II – between the cricoid and inferior border of the mandible; and zone III – from the inferior border of the mandible to the skull base.[13]

On admission to the emergency department, the patients received airway management, control of external haemorrhaging and appropriate fluid support. Physical examination findings were used to select patients for exploration and those who required further investigation.

Fig. 1. Tracheal injury with subcutaneous emphysema.

Patients with findings not suggestive of major injuries were observed. The physical signs associated with surgically significant injuries included severe active bleeding, shock, massive or expanding haematoma, pulse deficit, subcutaneous emphysema (Fig. 1), respiratory distress, air bubbling through the neck wound, and neurological deficit. Plain neck radiographs of stable patients were requested. A barium swallow examination was requested on suspicion of oesophageal injury. Angiography was performed when major vascular injury was suspected in a stable patient with zone I or zone III injury. Direct laryngoscopy, bronchoscopy and oesophagoscopy were performed before operating if injuries to the respiratory or food passages were suspected. Patients were treated with antibiotics, analgesics and tetanus prophylaxis. Major arterial injuries were repaired primarily. Minor injuries to the jugular veins were repaired. Transected jugular veins and minor blood vessels and injured thoracic ducts were ligated. Injuries to aerodigestive tracts were treated by primary repair and drainage. Observational management was defined as local wound care including repair of simple lacerations in the emergency department. Positive neck exploration was defined as an injury requiring repair by the surgeon.

Five separate patient groups were identified, based on their physical and investigation findings as well as their operative or non-operative treatment (Table I). Demographic characteristics, physical signs and injured structures were recorded. Diagnostic studies, treatment and its outcome were also noted. The intervals between injury and presentation to hospital, and between injury and surgical intervention, were also studied.

Data were entered into SPSS (version 13.0, SPSS, Chicago, Ill.) statistical software. Frequencies, means and standard deviations were determined. Groups were compared using Student's *t*-test, while proportions were compared by chi-square and Fisher's exact test when indicated. A *p*-value of <0.05 was taken as significant.

Results

During the period of study, PNI accounted for 3.6% of trauma admissions. Of the 225 patients with PNI, 209 (93%) were males and 16 (7%) females. Their mean age was 28±6.5 years. The mechanisms of injury are shown in Table II. In 85 (37.8%) and 62 (27.6%) patients, injuries were inflicted during civilian conflicts and armed robberies, respectively. Of all the injuries, 119 (53%) were located on the left, 72 (32%) on the right, 20 (8.9%) on the midline, and 14 (6.1%) on both sides. There were 152 (67.6%) wounds in zone II, 25 (11.1%) in zone III, and 18 (8.0%) in zone I. In 30

TABLE I. DESCRIPTION OF MANAGEMENT GROUPS

Group	No.	%	Description	Management
1	**40**	**17.8**	**Haemodynamically unstable, in shock or respiratory distress**	**Immediate neck exploration**
2	**61**	**27.1**	**Stable patients with signs of surgically significant injuries**	**Neck exploration after resuscitation**
3	**17**	**7.6**	**Stable patients with signs of surgically significant injury and positive investigation results**	**Neck exploration after resuscitation**
4	**12**	**5.3**	**Stable patients with signs of significant injury but negative investigation results**	**Observation after resuscitation**
5	**95**	**42.2**	**Stable patients with no signs of significant injuries**	**Observation after resuscitation**

TABLE II. STAB WOUNDS

Mechanism of injury	No.	%
Non-accidental	**151**	**67.1**
Knife	**122**	
Razor blade	**10**	
Broken bottle	**9**	
Broken glass	**6**	
Arrow	**4**	
Accidental foreign body	**16**	**7.1**
Road traffic accident	**10**	
Farm implement	**4**	
Industrial accident	**2**	
Gunshot	**58**	**25.8**
Total	**225**	**100**

(13.3%) patients, the wounds involved multiple zones. The time between injury and admission ranged from 11 minutes to 28 hours, while that between injury and surgical intervention ranged from 19 minutes to 18 hours. About 56% of the surgical interventions took place within 3 hours of injury. Ten of the 18 patients who presented more than 24 hours after injury were admitted and resuscitated at other hospitals. Investigations performed included 7 angiography, 9 barium swallow, 7 oesophagoscopy, 8 laryngoscopy and 4 bronchoscopy.

Overall, 118 (52.4%) patients had neck exploration (Table III). Surgically correctable pathology was identified in 103 (87.3%) of the explored patients, giving an incidence of 45.8% major injuries for the entire series. There were 78 vascular and 63 non-vascular injuries (Table IV). In 85.6% of patients with major injuries, diagnosis was easily established on the basis of symptoms, signs and plain radiographs.

No unsuspected major injuries were discovered at exploration. Injury to the brachial plexus was missed in a patient with vascular injury who had immediate neck exploration. Two oesophageal injuries were missed at exploration in zone II patients. Two patients had delayed diagnosis of salivary and thoracic duct fistulas, respectively. Both fistulas healed on conservative treatment. Associated injuries seen in 56 (25.0%) patients included 7 head, 13 abdominal and 19 thoracic injuries. Twenty-seven of these had additional surgical procedures in areas other than the neck. Infection was seen in 11 (9.3%) explored and 15 observed (14.0%) patients. Overall infection rate was 11.6%. Residual effects at discharge from hospital include hemiplegia in 2 patients and brachial plexus and facial nerve palsy in 1 patient each. Nine patients died, giving a mortality of 4% (Table V). Hospital stays ranged from 1 to 38 days, with a mean of 5 and 7 days for observed and negative neck exploration patients respectively. Follow-ups ranged from 3 days to 19 months. Eighty-six (38.2%) patients were followed up for more than 3 months.

Discussion

During the period of this study, PNI accounted for 3.6% of trauma admissions at our hospital, compared with 5 - 10% in developed countries.[14] This is probably because road traffic accidents (RTAs), which are the leading cause of trauma admission in our patients, are an infrequent cause of PNI. The negative and non-therapeutic outcomes of MNE, together with negative invasive studies that result from routine evaluation of patients, lead to morbidity and mortality.[4,5] Similarly, an investigation or operation that does not treat a surgically significant injury is not cost-effective.[15] In common with other centres, mandatory exploration of all wounds that penetrated the platysma was found not to be necessary.[8,9] Our indications for exploration are in agreement with those at other centres.[4,7,10] Major vascular injuries were associated with overt signs including severe bleeding, expanding haematoma, loss of carotid pulsation and neurological deficit. Neck exploration was performed in these patients without further diagnostic evaluation. Aerodigestive tract injuries are found in about 10% of PNIs and can be diagnosed by a combination of careful physical examination, barium swallow and endoscopy.[16,17] Air leaking through a neck wound, especially while coughing, is diagnostic of laryngo-tracheal injury. However, subcutaneous emphysema is the most common finding in aerodigestive tract injury.[18] In our patients, oesophageal injuries were treated by exploration. Non-operative management should be considered only in patients with small injuries and delayed presentation.[19] Of the 118 patients managed by exploration, 64.4% had injuries in zone II. This was probably because injuries in this region are often associated with major vascular injuries and blood loss because of lack of anatomical protection of the major vessels and limited tamponade.

Exploration results were positive in group 2 (82.0%) and comparable with those of group 3 (88.2%), which indicates that careful physical examination can detect patients with surgically significant injuries. Our negative exploration rate of 12.7% is less than the 30 - 89% reported by others.[4,7] Besides selective ancillary investigations, selection bias due to late presentation probably contributed to the low negative exploration incidence in our patients. Many (group 5) of our patients were asymptomatic, and the neck wound was the only pertinent sign at presentation (Fig. 2). These patients were safely managed by observation and none of them required exploration because of a missed injury, which indicates that clinical examination was a safe and reliable way to exclude significant injuries. In this study, clinical signs as predictors of major injury have a sensitivity of 97.2% and a specificity of 87.4%.

Fig. 2. Superficial neck wound with no significant injury.

Long-term disabilities were all neurological. Brachial plexus and facial nerve palsies improved at follow-up. Of the 9 deaths in this series, 4 patients were brought to the emergency room in profound shock. Their cause of death was exsanguinating haemorrhage from major vascular injury. Injury to the carotid artery, although infrequent, is associated with high mortality.[20] In other patients, mortality was a reflection of severity of neck injury and associated injuries. Small wounds to the oesophagus can be missed at exploration even when they have been identified during investigation.[21] In this study, preventable death occurred as a result of a missed oesophageal injury, which could have been avoided by pre-operative investigation and careful exploration. The mortality of 4% in this study agrees with the 3 - 6% reported by others.[4,20]

The safety and cost-effectiveness of selective diagnostic investigations remain controversial. Angiography is useful for the evaluation of vascular injuries. However, the sensitivity and negative predictive value of physical examination for detecting vascular injuries requiring operative repair are both 100%.[22] In this report, as in other reports, angiography was employed in stable patients with signs of significant vascular injury when the wound was located in zone I or III.[9,23] In these patients, angiographic findings may help in planning and preparation of operative interventions as well as providing access for angiographic embolisation.[6,23] Barium swallow and oesophagoscopy have been used to accurately exclude oesophageal injuries;[24] we also found these investigations useful. In addition, oesophagoscopy facilitates localisation of the injury at exploration. In group 4 patients, these investigations were used to exclude major injuries and avoid unnecessary exploration.

The limitations of this study include lack of long-term follow-up, which precludes detection of late complications in many patients. Delayed presentation bias means that it may be safe to observe these patients as they may be the non-seriously injured. This probably reduced negative explorations because some of these patients would have been explored if they had presented earlier. However, many of these patients had signs of significant injuries and were managed operatively. The delayed presentation and lack of pre-hospital care also mean that patients with severe injuries would have died before admission. The majority of patients in group 1 and many others with associated penetrating chest and abdominal injuries were admitted with severe injuries and were treated appropriately.

The results of this study indicate that selective observational management of PNI based on careful physical examination is practical, safe and reliable. The neck wound should be carefully examined in the emergency room. Immediate exploration is indicated in patients who have significant injury evidenced by severe blood loss or airway compromise. Stable patients with signs of significant injuries should be explored after resuscitation. Angiography should be reserved for clinically stable patients who have signs of major vascular injuries in zone I or III, while oesophagography, oesophagoscopy and bronchoscopy should be performed pre-operatively on patients with aerodigestive tract injuries. Clinically

TABLE III. OUTCOME OF EXPLORATION ACCORDING TO GROUP OF TREATMENT AND SITE OF INJURY

Site	Group 1	Group 2	Group 3
Zone I	**5 (80.0%)***	**4 (100.0%)**	**1 (100.0%)**
Zone II	**23 (95.6%)**	**42 (71.4%)**	**11 (81.8%)**
Zone III	**5 (80.0%)**	**7 (85.7%)**	**2 (100.0%)**
Multiple	**7 (85.7%)**	**8 (75.0%)**	**3 (66.6%)**
Total	**40 (95.0%)**	**61 (82.0%)**	**17 (88.2%)**

*Percentage of patients with positive neck exploration.

TABLE IV. STRUCTURAL INJURIES IDENTIFIED ON NECK EXPLORATION

Vascular injuries	No.	Other injuries	No.
Arteries	**28**	**Pharynx**	**5**
Common carotid	**3**	**Oesophagus**	**9**
External carotid	**2**	**Larynx**	**9**
Internal carotid	**1**	**Trachea**	**11**
Subclavian	**2**	**Nerves**	**13**
Superior thyroid	**3**	**Recurrent laryngeal**	**1**
Vertebral	**2**	**Spinal cord**	**6**
Thyrocervical	**2**	**Spinal accessory**	**1**
Minor arteries	**13**	**Facial**	**2**
		Brachial plexus	**3**
Veins	**50**	**Parotid gland**	**2**
Internal jugular	**8**	**Thoracic duct**	**3**
External jugular	**9**	**Thyroid gland**	**4**
Subclavian	**2**	**Thyroid cartilage**	**1**
Anterior jugular	**12**	**Cervical spine**	**6**
Inferior thyroid	**2**		
Minor veins	**17**		
Total	**78**		**63**

TABLE V. PATIENTS WITH PENETRATING NECK INJURIES WHO DIED DURING TREATMENT

No.	Zone of injury	Group	Injured structure	Associated injuries	Cause of death	Remarks
1	I	1	Subclavian artery	Penetrating chest and abdominal injuries	Hypovolaemic shock	Died during NE, chest tube insertion and laparotomy
2	I	1	Carotid artery	None	Hypovolaemic shock	Died during NE
3	II	1	Carotid artery	Penetrating chest injury	Hypovolaemic shock	Died during NE and chest tube insertion
4	II	2	Carotid artery	None	Massive stoke	Died 4 hours after repair
5	II	2	Oesophagus	None	Overwhelming sepsis	Injury missed at NE
6	III	3	Minor vessels	Severe head and penetrating chest injuries	Acute respiratory failure	Died 2 days after NE and chest tube insertion
7	III	4	Cervical spine	Spinal cord injury with quadriplegia	Acute respiratory failure	Had gunshot injuries
8	II	5	Minor vessels	Blunt chest injury	Overwhelming sepsis	Died 6 days after injury
9	I	5	Minor vessels	Severe head injury	Acute respiratory failure	Died 3 days after injury

NE = neck exploration.

evaluable asymptomatic patients should be observed without further investigations. However, they will require frequent and careful examination in order to detect injuries that may evolve over time. This policy is appropriate and effective in our setting and is recommended for surgeons practising in similar environments.

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