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Original Research Paper

General Surgery

NO ZONE APPROACH FOR MANAGEMENT OF PENETRATING NECK INJURIES-A CASE SERIES

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ABSTRACT **Purpose:** The assessment and management of penetrating trauma to the neck has traditionally centered on the anatomical zone based classification over the previous four decades has evolved considerably towards "NO ZONE APPROACH" a more selective option. The purpose of this study was to assess the effectiveness of the "NO ZONE APPROACH" in penetrating neck injuries. **Materials And Methods:** Case series of 6 patients with penetrating neck injuries admitted in department of general surgery in government Kilpauk medical college and government Royapettah hospital, Chennai. All 6 cases have been analyzed for this descriptive study during a period of 1 year. No specific exclusion criteria applied. **Results:** All 6 patients survived. 1 patient had nerve injury and external carotid artery injury. 2 patients had tracheal injuries for which tracheostomy was done. 1 patient had avulsed a part of thyroid gland. 1 patient developed cerebrovascular accident post operatively.3 patients had primary repair& neck exploration avoided in those 3 patients by application of NO ZONE APPROACH. **Conclusion:** Penetrating neck injuries are complex injuries with no single definitive approach. Surgical intervention is mandatory for unstable patients but rapid swift clinical and logical reasoning helps in determining the outcome of the patient. The 'no zone approach' to penetrating neck trauma is a selective approach with superior patient outcomes in comparison with traditional method of zones of neck injuries in which zone 2 and zone 3 warrants definitive exploration. No zone approach mandates thorough clinical examination. Penetrating neck injuries classified as having hard signs based on the no zone approach may be correlated with internal organ injuries of the neck.

KEYWORDS : Penetrating neck injuries, No zone approach, management , selective approach, neck trauma, hard signs, soft signs.

2. INTRODUCTION

Platysma considered as an anatomical landmark. The wounds that breach/penetrate are considered as penetrating neck injuries. Penetrating neck injury represents 5–10% of all trauma cases(1). It is important for clinicians to be familiar with management principles, as mortality rates can be as high as 10%-20%.As there are no international consensus guidelines and recent improvements in imaging modalities have altered the way in which such are now approached(3,4). Anatomical features like the trachea, oesophagus, great vessels, and nerves are crowded in small space and relatively unprotected. Therefore, mandatory exploration is generally performed in casesof zone II injuries, according to the classification of the anatomical zones of the neck: zone I spans from the clavicles to the cricoid; zone II spans from the cricoid to the angle of the mandible; and zone III ranges from the angle of the mandible to the base of the skull [9]. This approach has been referred to as the zone-based algorithm and has been used as a traditional assessment for penetrating neck injuries. However, routine neck exploration in hemodynamically stable patients is reportedly known to result in a high rate of negative exploration, longer hospital stay, and an increased rate of complications, such as surgical site infections and sepsis [10]. Therefore, the management of neck injuries has changed from a mandatory exploration of all wounds that penetrate the platysma to a more selective approach based on patient symptoms. This selective operation is based on the "NO ZONE" approach in which one determines the treatment method based on the classification of the symptoms that may have resulted from damage to the major vascular, digestive, and respiratory systems. If the patients are hemodynamically unstable or indicate confirmed hard signs proceeds for surgical exploration. In contrast, the decision to perform a surgical treatment in hemodynamically stable patients is controversial patients maybe be subjected to subsequent examination and radiological imaging to assess the nature of injury and managed accordingly. The purpose of this study was to evaluate the efficacy of the no zone approach in penetrating neck injuries. We hypothesized that hard signs in symptomatic approaches may be useful for predicting internal organ injuries in the neck and may help make a more informed decision regarding an operation.

3. AIM AND OBJECTIVES

The aim of this study was to assess the effectiveness of the "NO ZONE APPROACH" in penetrating neck injuries. Objective: To understand the basic resuscitation manners in cases of penetrating neck injuries, thorough scrutiny of hard and soft signs which are mostly evident by keen monitoring then triage the patient for further management.

4. Review of Literature

Penetrating neck injury describes trauma to the neck that has breached the platysma muscle(6). The most common mechanism of injury worldwide is a stab wound from violent assault, followed by gunshot wounds, self harm, road traffic accidents and other high velocity objects(5,7). The neck is a complex anatomical region containing important vascular, aerodigestive and neurological structures that are relatively unprotected(7).Four anatomic injury areas: Laryngotracheal – airway Pharynx esophageal - digestive tract Vascular system Neurologic system Vascular injury may include partial or complete dissection (most common), occlusion, extravasation of blood or hematoma formation(8). Arterial injury occurs in approximately 25% of penetrating neck injuries; carotid artery involvement is seen in approximately 80% and vertebral artery in 43%.2 Combined carotid and vertebral artery injury carry both major hemorrhagic and neurological concern(8).Aerodigestive injury occurs in 23–30% of patients with penetrating neck injuries and is associated with a high mortality rate(6). Pharyngo-esophageal injuries are less common than laryngotracheal injuries but both are associated with a mortality rate of approximately 20%(7,9). Neurological structures at risk of involvement include the spinal cord, cranial nerves VII–XII, the sympathetic chain, peripheral nerve roots and brachial

plexus. Spinal cord injury occurs infrequently (less than 1%), particularly in low velocity injuries such as stab wounds(10). The assessment and management of penetrating trauma to the neck has traditionally centered on the anatomical zone based classification first described by Monson et al. in 1969 . According to this approach, mandatory exploration was performed and a surgical approach was found to be relatively easy for anatomical zone II injuries.

However, zones I and III were relatively difficult to access surgically. Advances in the technology of CT scans have shown that these examinations can be completed and images obtained without anymandatory exploration to identify internal neck injuries [11,12,15]. According to Nowicki et al the no zone approach to penetrating neck injury evaluation and management is contemporary and goes against the grain of anatomical zones management. More recently, the rigidity of this zone-based algorithm has been challenged, especially with regard to the mandatory exploration for zone II injuries. Low et al. demonstrated in 2014 a poor correlation between the location of the external wound and the injuries to internal structures. These factors have brought into question the entire foundation of the traditional zonal approach. This review outlines a selective, non-zonal approach to penetrating neck injuries, where the entire neck is treated as a single entity. Therefore, when patients arrive at the hospital, depending on their symptoms and vitality, they may be examined, undergo an operation immediately, or undergo conservative treatments.

5. MATERIAL AND METHODS

Case series of 6 patients with penetrating neck injuries admitted in department of general surgery in Government Kilpauk medical college and Government Royapettah hospital, Chennai. All 6 cases have been analyzed for this descriptive study . No specific exclusion criteria applied. This paper presents a series of 6 cases of penetrating neck injuries compiling the antecedent and subsequent events and management of penetrating neck injuries and their outcomes have been described

6. RESULTS (INCLUDING OBSERVATIONS)

Case 1:

A 16 years old male with history of Assault with metal object(hook). On examination patient is Drowsy, responding to oral commands with vitals of Bp-70/? Mm of hg, Pr-116/min, Spo2-95% in RA, Local inspection-2*2cm punctured wound about 2cm below the angle of mandible Intra oral active spurt noted (possibility of external carotid artery injury probably from one of its branches).THROAT PACKING DONE AFTER INTUBATION .Blood noted in ryles tube. Initial resuscitation carried out with blood and IV fluids but there was no improvement in patient clinical status hence the patient was not subjected to any further examination and imaging. The patient was immediately rushed into OPERATION THEATRE(mind the patient is in shock and having hard signs).

Findings:

Active ooze noted below the right submandibular gland with oropharyngeal defect noted. vascular surgery team called for intraoperative assistance. Lingual artery ligated. Primary closure of oropharyngeal defect done

Procedure:

Emergency neck exploration with ligation of lingual artery with primary repair of oropharyngeal defect.

Post Operative Period Of Case 1:

survived, Extubated on POD-2.Ryles tube feeding encouraged till pod 5.Liquid diet on pod 6 and advanced. Mild deviation of angle of mouth-because of marginal mandibular nerve injury Advised physiotherapy and on regular follow up.

Case 2:

A 23 year old male with history of assault with beer bottle to the neck. On examination drowsy responding to oral commands with vitals of BP-110/70 mm of hg,PR-108/min,spo2-85% in RA(suspect air entry injury probably tracheal injury) local examination - through and through wound noted in anterior part of neck with multiple linear lacerations drooling of saliva seen through the wound site (possible digestive tract injury possibly a rent in esophagus). The patient intubated air way secured. Initial resuscitation carried out the patient vitals kept maintaining. Since no fall in patient vitals with secured airway the patient was subjected to radiological imaging. NC-CT of neck revealed multifocal air pockets with soft tissue irregularity in anterior aspect of neck below the platysmal plane.

Findings:

on exploration the right lobe of thyroid avulsed(soft tissue irregularity in CT) hence right hemithyroidectomy was done. Tracheal tear and esophageal tear noted along the right anterolateral aspect. Tracheal injury primarily repaired using prolene continuous suture. Esophageal injury repaired in two layers. Tracheostomy done in the below the tracheal rent.

Post Operative Period Of Case 2:

survived,tracheostomy done and extubated on pod-5,ryles tube feeding encouraged. Developedslurred speech and trouble in getting up from bed. MRI revealed thrombus in right middle cerebral arterial system. Started on antiplatelets and physiotherapy. On regular follow up patient doing well. There are two possible reasons one being injury to carotid during surgery by aggressive retraction and other being the impact of trauma both these would have caused intimal tear which triggered thrombus formation. This on entering the cerebral circulation must have been trapped in middle cerebral artery resulting in cerebrovascular accident.

Case 3:

A 50 years old male history of assault with hacksaw blade. On subsequent evaluation irritable responding to oral commands with the following vitals BP-110/70 mm of hg, PR-98/min,spo2-95% in RA(patient hemodynamically stable) laceration over anterior aspect of neck with partial rent in trachea. Patient had stridor on attempting to speak(a soft sign of neck injury). The patient was subjected to further examination and radiological imaging. The patient was not intubated because the was maintaining the saturation even though the patient had rent in trachea. CT showed multiple air pockets no soft tissue density/per oral bleed not intubated since maintaining spo2.tracheostomy done below the rent site. Primary closure of trachea with prolene. continuous closure of deep fascia. subcutaneous and skin closed in layers. post operative period uneventful. no further complication on further follow up.

Case4:

A 47 year old male with history of bull gore injury to neck. On evaluation comprehensive BP-100/70 mm hg, PR-102/min spo2-97% in RA(hemodynamically stable) with a laceration in neck with trachea and part of floor of mouth exposed and ooze along the lateral aspect of wound with tissue loss(zone 2 injury). As the patient vitals were stable.

Patient was subjected to NCCT neck. CT NECK revealed large cutaneous laceration with soft tissue loss with no major abnormality. Primary repair done with drain insitu (IFT) under local anesthesia. No specific events in follow up.

Case 5: A 35 year old male came with history of assault by unknown person with knife. On subsequent evaluation BP-130/80 MM hg ,PR-104 / MIN ,SPO2-98 WITH RA (hemodynamically stable).on examination patient had

laceration over right anterolateral aspect of neck, diffuse ooze from the wound site (zone2 injury). Patient subjected to CT NECK- Soft tissue loss with breach in platysma no evidence of intramuscular organized hematoma/ strap muscle injury no involvement of carotid and jugular vessels .Patient proceeded with primary repair with drain insitu (IFT) under local anesthesia. No adverse events in follow up.

Case 6:

A 56 year old male with history of assault with blade .On examination patient vitals BP-140/90 mm hg PR-99/ MIN , SPO2-98 in RA (hemodynamically stable).on local examination-laceration over anterior of the neck with exposed trachea with active ooze over the site (zone 2 injury).patient advised NCCT NECK-no abnormality detected. Patient proceeded with primary repair with drain insitu(IFT) under local anesthesia .No adverse events in follow up. Things encountered in this case series vascular injury-1 nerve injury-1 tracheal injury-2 cva-1 thyroid injury-1 speciality advise-1 Primary repair -3 Resuscitation in common for this case series Intubation done to maintain airway and breathing.2 wide bore iv lines secured. Blood grouping and blood products arranged. Blood transfusion initiated at the earliest. High risk informed consent obtained including on table death. Help sought to speciality departments by prior intimation

7. DISCUSSION

Historically, the anatomical zone approach was applied for assessment of traumatic neck injuries. There are several limitations to the zone-based approach; (i) Exclusion of posterior neck injuries, (ii) limited correlation between the location of the external wound and internal injury (iii) situations where the injury is in more than one zone, and (iv) in patients with multiple sites of injury. These limitations along with over emphasized surgical exploration without any necessary indications raise objection to anatomical zonal approach. In this series a more selective method of "NO ZONE APPROACH" is adhered. In this approach based on patient hemodynamic status, symptoms the management of the patient is tailored individually. This selective approach thereby reduces the unnecessary neck exploration. Patients with penetrating neck injuries can decompensate rapidly andshould be transported immediately to the nearest trauma center. Impaled objects should not be removed in the field. A systematic approach to the management of penetrating neck trauma is critical.

The initial evaluation and assessment involves resuscitation in accordance with the Advanced Trauma Life Support (ATLS) principles .The first step in evaluation of a patient with trauma to the neck begins with A,B,C,D of primary survey{A= Airway,B= Breathing, C=Circulation,D=Disability} with special attention given to airway given its location within the central neck. Signs of overt respiratory distress should prompt rapid orotracheal intubation which if unsuccessful, necessitates a surgical airway. Following airway stabilization and completion of primary survey the physical examination should be focused on signs of vascular and aerodigestive injury. Early inspection of a neck injury is advised to determine if the platysma muscle has been breached. Use of local anesthesia facilitates a more accurate assessment of the wound. If the platysma is intact then, by definition, the wound is superficial hence manage conservatively. If the platysma is violated then it is a penetrating neck injury and the patient's signs and symptoms govern how to proceed with management. HARD AND SOFT SIGNS are looked carefully with simultaneous resuscitation with IV fluids and blood if arranged. If hard signs are identified the patient is subjected to upfront surgical exploration. If only soft signs are seen and if the vitals are stable the patient is advised for imaging (CT) then the management is individualized. Multidetector helical computed tomography with (MDCT) in the evaluation of patients who do not require immediate operative intervention. This imaging modality has been recognized to be both highly sensitive and specific in detecting vascular, laryngotracheal and pharyngo-esophageal injuries. It can also provide information on the trajectory of the wound track and suggest whether imaging of the thorax is also required. MDCT has resulted in in a significant decrease in formal neck explorations and a virtual elimination of exploratory surgery. Further more CT- Angiography aids in accurate narrowing of anatomical vascular injury. CT-Angiography also aids in embolization further reducing the neck exploration.

8. SUMMARY AND CONCLUSION

Penetrating neck injuries are a severe and common presentation in the emergency department.

They should be addressed early due to their increased morbidity and mortality. "NO ZONE APPROACH" which employs MDCT for clinicians to use in the evaluation and management of penetrating neck injuries. The IMAGING retains a critical role in the acute setting due to its high sensitivity, fewer contraindications, rapid image acquisition, and availability in most institutions. The no zone approach can make it easier to determine whether exploration of the neck should be considered. Selective management(no zone approach) of penetrating neck injuries based on physical examination and selective use of investigations is safe and simple with low negative exploration rate. In this case series out of 6 patients 4 had zone 2 injuries. 1 patient vitals unstable and had hard signs hence proceeded with neck exploration. 3 patients in zone 2 injuries who were hemodynamically stable were subjected to imaging. CT showed no significant abnormality. Hence in these 3 patients only primary closure was done under local anesthesia. 3 patients averted neck exploration due to the application of principles of NO ZONE APPROACH. 2 patients had zone 1 external injuries and their vitals were stable. These 2 patients were subjected to CT imaging. For 1 patient it revealed soft tissue irregularity (case 2) and for the other it showed few air pockets (case 3). These two patients were subjected to primary repair of their injuries under general anesthesia.

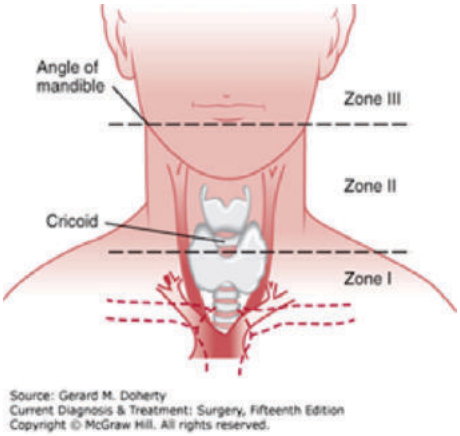
Thus preoperative CT was helpful with understanding the injury also it helps in explaining the attenders how and what exactly the injury had occurred way in advance. In this study by applying the HARD AND SOFT SIGNS the injury to vascular, esophageal, tracheal and neurological compartment can be assessed to an extent. Therefore by applying no zone approach unnecessary neck explorations can be reduced, HARD AND SOFT SIGNS help to localize the injury to an extent, idea and nature of injury can be ascertained by imaging. NO ZONE APPROACH is superior totraditional anatomical zonal approach by the above mentioned ways.

HARD SIGNS OF NECK INJURY	SOFT SIGNS OF NECK INJURY
Hypotension in ED	Hypotension in field
Active arterial bleeding	History of arterial bleeding
Diminished carotid pulse	Unexplained bradycardia
Expanding hematoma	Non expanding hematoma
Thrill / Bruit	Apical capping on chest xray
Lateralizing signs	Stridor
Hemothorax >1000ml	Hoarseness
Hemoptysis	Vocal cord paralysis
Haemetemesis	Subcutaneous emphysema
Air or bubbling in wound	Seventh cranial nerve injury
Tracheal deviation	

12.1 Table Signs Of Neck Injury

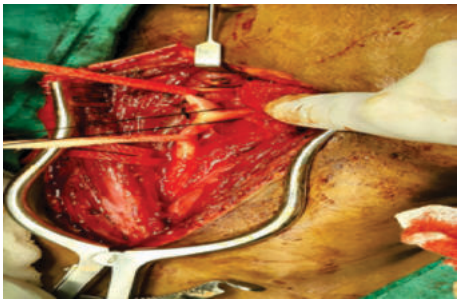
.NO	VITALS	ENTRY WOUND[ZONE]	NCCT	ACTUAL INJURY	MANAGEMENT
CASE 1	UNSTABLE	ZONE 2	NO	ZONE 3	EXPLORATION
CASE 2	STABLE	ZONE 1	YES	ZONE 2	REPAIR(GA)
CASE 3	STABLE	ZONE 1	YES	ZONE 2	REPAIR(GA)
CASE 4	STABLE	ZONE 2	YES	ZONE 2	REPAIR(RA)
CASE 5	STABLE	ZONE 2	YES	ZONE 2	REPAIR(RA)
CASE 6	STABLE	ZONE 2	YES	ZONE 2	REPAIR(RA)

12.1 Table observations

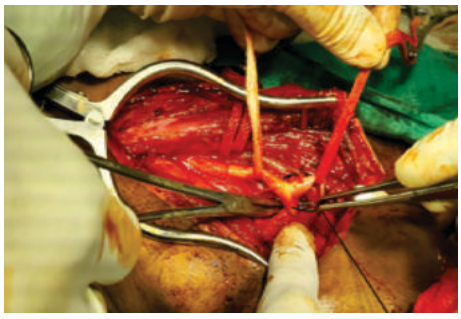


13.1 Figures Zones Of Neck Injuries

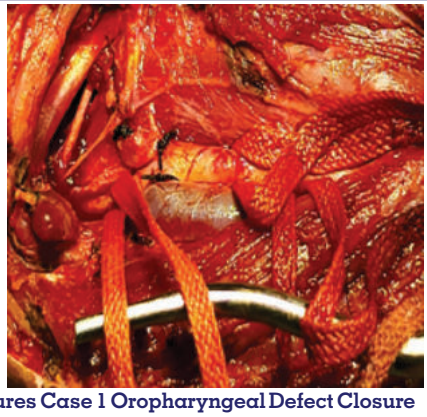
13.2 Figures Case 1 Preop Image



13.3 Figures Case 1 Lingual Artery Ooze Site



13.4 Figures Case 1 Lingual Artery Ligated

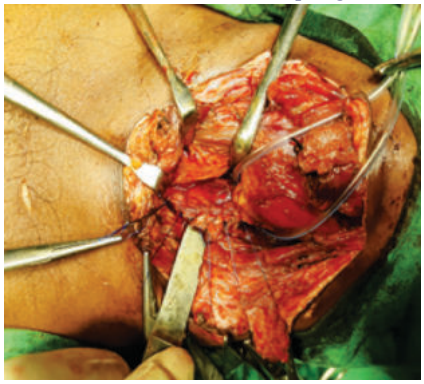


13.5 Figures Case 1 Oropharyngeal Defect Closure

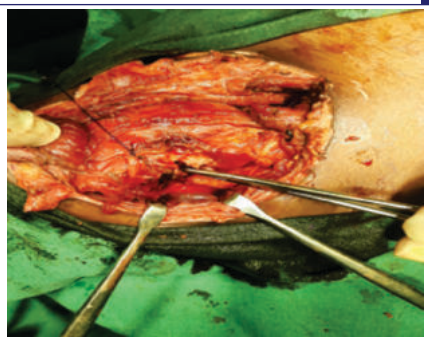
13.6 Figures Case 1 Post Op

13.7 Figures Case 2 Preop

13.8 Figures Case 2 Tracheal And Oesophageal Rent



13.9 Figures Case 2 After Tracheal Closure



13.10 Figures Case 2 After Oesophageal And Tracheal Repair

13.11 Figures Case 3 Preop

13.12 Figures Case 3 Post Op

13.13 Figures Case 4

13.14 Figures Case 5 Entry Wound

13.15 Figures Case 5 Closure

13.16 Figures Case 6 Entry Wound

13.17 Figures Case 6 Closure

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