

Review

Arrow injury to the chest in Nigeria: a novel form of combined penetrating and chemical injury with review of Nigerian literature

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Arrow injuries are rarely seen in developed world. However, in developing and under developed countries they are still common. Arrow injuries to the chest can be devastating owing to the presence of vital organs in this region of the body. Mortality at the scene can be high due to attempts at removal. Among those that survived to the hospital, the outcome is good with reported mortality of less than 5%. Arrows are made up of metallic tip, which is edged and barbed with a wooden shaft and propelled from a bow. They were traditionally designed for hunting where poisonous substances like plant containing curarine are applied to the tip and the barb will ensure that the arrow stays in place even when the prey runs away eventually succumbing to the effect of the poisons. These have today become weapon of human assault. We report a case of arrow injury to the chest that we managed and reviewed published literature from Nigeria.

Key words: Arrow injury, chest injury, penetrating, chemical injury.

INTRODUCTION

Arrows are believed to have been invented at least 10,000 years ago. Arrows are said to have helped provide the stimulus for the growth of surgery through developments of techniques to manage the inflicted injuries (Nwiloh et al., 2010). Most hospitals in developed and developing countries receive road traffic accident victim or trauma from fire arm. In developing and under developed countries, arrow injuries are still prevalent. Arrow injuries are said to be rare worldwide but there are reports from some parts of Africa and India (Fingleton, 1987; Singh and Singh, 1985). Injuries are said to result from an arrow made up of metallic tip, which is edged and barbed with a wooden shaft and propelled from a bow. They were traditionally used for hunting but have now become a weapon of human assault (Nwiloh et al., 2010). Arrows are dipped in curare, which is a naturally occurring non-depolarizing muscle relaxant. It kills the prey by causing paralysis of respiratory muscles causing

asphyxiation. The effect of these arrows to the human chest today is as a result of injuries to vital organs in the human chest, the barbed design which makes removal at the scene impossible or if successful with fatal consequences and the effect of the curare applied to the tip which is poisonous.

Arrow injuries are classified under low velocity missile injuries. The site of injury is of utmost importance. Metallic arrowhead can easily pierce through the soft tissues and can easily damage nerves, blood vessels or any nearby soft tissue structures. Patient may appear without bleeding but removal of the arrow may open up an injured blood vessel and may precipitate torrential bleeding (Peloponissios et al., 2001; Karger et al., 1998).

In thoracic arrow injury, there is every chance of damage to the heart or any major blood vessels. Usually in such cases severe bleeding commences immediately. Damage to the lungs may be present as bronchopleural

fistula, lobar atelectasis, injury to the hilar structure or any major bronchus injury. Other mediastinal structures or nerves may be damaged as well. Long-standing complications include: septicaemia, ARDS, delayed wound healing, chronic pain syndrome, permanent disfigurement and contractures, etc (Ganguly et al., 2014). Full clinical examination with emphasis to central nervous system and examination of pupil should be carried out to exclude neurotoxins.

Management of patients with arrow injuries to the chest should follow Advanced Trauma Life Support (ATLS) protocol and immediate chest tube insertion if there is any form of collection within the pleural space. The immediate threat to life in arrow injuries to the chest is injury to the heart and great vessels. Any attempt to remove the arrow at the scene will result in exsanguinating haemorrhage (Asensio et al., 2009; Kaljusto and Tonnessen, 2012). In patients been presented with cardiovascular injury with haemodynamic derangements, volume resuscitation with blood should be started immediately and surgery should be done immediately with or without angiographic localization of bleeding vessel. If there is no immediate threat to life, various investigations can be carried out to localize the structures pierced by the arrow and plan the best surgical approach and also to determine whether a cardiopulmonary bypass machine is necessary or not. Chest radiography is the first-line diagnostic tool providing additional information in the diagnosis and evaluation of thoracic injuries (Sil and Basu, 2011). The initial radiograph includes assessment of the injury and disorders directly or potentially threatening to a patient's life. Notwithstanding the objective limitations of the methods on the basis of clinical and radiographic findings, in many cases the surgeon may decide about the appropriate surgical treatment (Murray et al., 1997; Shanmuganatha and Matsumoto, 2006).

Another useful method is ultrasound scan of the abdomen and chest, especially for evaluation of the subdiaphragmatic space findings and when small collections of fluid in the pleural space are detected, and also for cardiac evaluation, especially when blood is present in the pericardial space. Ultrasound scan is simple, fast, non-invasive and reliable technique applicable to different body parts, such as the abdomen and thorax (evaluation of the subdiaphragmatic space including the liver, spleen, pancreas, retroperitoneal space, kidney, diaphragm; detection of the subphrenic collection; detection of small collections of fluid in the pleural space that cannot be seen in standard chest radiographs) (Sisley et al., 1998).

Echocardiography, transesophageal echocardiography (used to assess the functional state of the heart and collection of blood in the pericardial space), and Color Doppler (used for the evaluation and detection of injuries to the brachiocephalic vessels) are also in current use.

Multidetector CT scan is the investigation of choice.

Digital angiogram may be done to check for vascular damage (Ganguly et al., 2014). These investigations can only be done in patients that are stable at the time of presentation. Videothoracoscopy has also been reported in stable patients (Peloponissios et al., 2001; Manlulu et al., 2004).

Surgical treatment of these patients in form of thoracotomy should be done under general anaesthesia with or without double lumen endotracheal tube (Feliciano et al., 1986; Aihara et al., 2001; Molina et al., 2008). Care should be taken to modify anaesthetic drugs because some of the arrows may contain neurotoxins that may potentiate their action. Therefore, renal and hepatic function should be assessed. Postoperatively, some of these patients may require mechanical ventilation (Cothren and Moore, 2006).

We report a case of arrow injury to the chest and reviewed publications on the above subject. As data source, we used all available English-language articles from peer-reviewed journals in the Ovid MEDLINE and PubMed databases. The articles selected were relevant case reports, original articles and reviews focusing on the penetrating chest especially arrow injury, initial management, operative management and outcome. Emphasis was placed on publications from Nigeria.

CASE PRESENTATION

A 22-year-old farmer was presented to our accident and emergency unit with an arrow in the right chest. He was shot by a herdsman following a fight in his farm. Attempt at removal at the scene of the incidence proved abortive. At presentation, he was clinically stable. He had an arrow just below the right clavicle (Figure 1). His chest examination was essentially normal and had stable haemodynamics.

Chest radiograph shows an arrow piercing the soft tissues of the right chest wall (Figure 2). His packed cell volume was 34%, urinalysis was normal, renal function was also normal. He had exploration and removal of the arrow under general anaesthesia (Figure 3). Postoperative recovery was uneventful and he was discharged on the 5th postoperative day.

DISCUSSION

Arrows related injuries still occur in Nigeria, especially in crisis-ridden communities where it is used as a weapon, while in developed countries, it rarely occurs and it is seen in few cases of sport-related accidents (Launikitis and Viegas, 2009). Arrows were traditionally designed for hunting where poisonous substances were applied to the tips, the barbs will ensure that the arrow stays in place even when the prey runs away eventually succumbing to the effect of the poison (Madziga, 2003). They cause

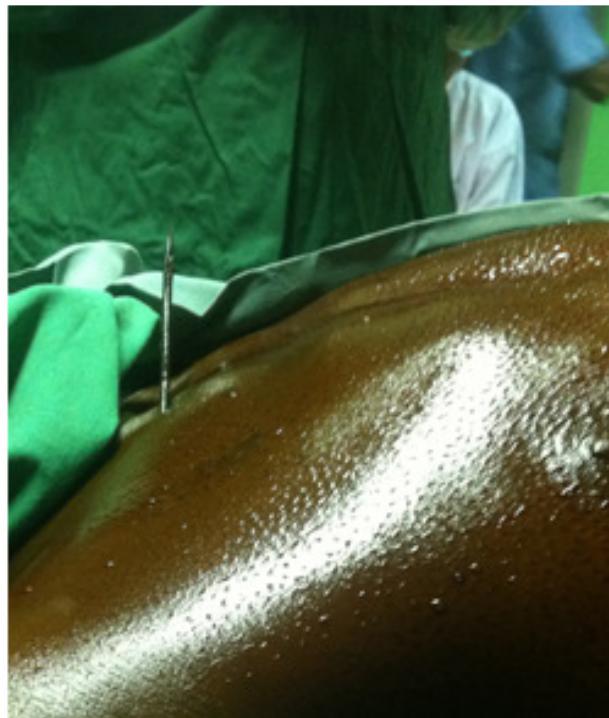


Figure 1. Arrow after removal of wooden handle (patient on the operating table).



Figure 2. Chest radiograph showing arrow in the soft tissues of the chest.

injuries by incising tissues and perforating viscera along its path (Sil and Basu, 2011).

There is no tissue shearing shock wave as there are

with bullets, leading to less tissue damage and a decreased morbidity and mortality. Despite the low kinetic energy, arrows have a high penetration force secondary



Figure 3. Arrow after removal.

to their high sectional density and the split like penetration mechanism, which limits the injuries to the direct contact surface of the arrowhead and shaft. They are able to split flat bones like ribs and shoulder blades but not weight bearing bones like vertebrae. The arrow shaft in the wound tract together with tissue elasticity may have the effect of an incomplete tamponade preventing hemorrhaging. The barbed nature of most arrows ensures difficulty in removal. Arrows should therefore not be removed in the field, but secured to prevent displacement (Vega et al., 2012). Attempt at removal may result in death of the patient. Mortality at the scene may be very high as a result of attempt by people in the community to remove arrows. Patients, who made it to the hospital alive, appeared with arrows sticking out of their chests. Our patient made it to the hospital alive because attempt at removal was abortive. Our patient did not manifest signs of curare poisoning at presentation and denied history of such. This may be related to the fact that the effect would have weared-off at the time of presentation. Most of the patients with arrow injuries appear in stable clinical state except those that had multiple arrow injuries affecting other parts of the body. The stable nature of these patients is related to the tamponade effect of the arrow along its path especially if

there was no attempt at removal. In preparation for intervention, a Chest radiograph is taken to confirm the exact location of the arrow and relationship with vital organs. Other investigations are PCV, serum urea and electrolytes, and urinalysis. Our patient had removal via exploration as the arrow was found in the soft tissue of the chest from his chest radiograph.

In Nigeria, there are several reports of arrow injuries to the chest (Table 1). To the best of our research, we were able to get a total of 57 cases of arrow injuries to the chest reported by various authors from Nigeria. The threat to life poised by arrow injuries in the chest is related to injuries to vital organs in the human chest, the barbed design that makes removal impossible and the effect of the curare applied to the tip, which is poisonous.

Ugwu (2008) in north central Nigeria reported nine (9) cases of metal tipped arrow chest injuries. Six of the patients arrived with accident and emergency alive with the arrows partly or completely in the chest. All the six had emergency thoracotomy and all survived. The left hemithorax was the most commonly involved in his series. This can be attributed to the fact that the assailant most likely aimed at the heart. Three out of nine died in the field of combat. He noted communal clashes as the major cause of arrow chest injuries and recommended

Table 1. Publications from Nigeria.

S/N	Authors and date of publication	Study	Number of patients	Treatment
1	Ugwu (2008)	Arrow chest injuries in North central Nigeria: Case series	9	6 had emergency thoracotomy while 3 died at the field
2	Ali and Gali (2004)	Pattern and management of chest injuries in Maiduguri, Nigeria	4	Thoracotomy and removal of arrows
3.	Madziga (2003)	Arrow injuries in North Eastern Nigeria	29	6 had thoracotomy while 23 had removal and chest tube insertion
4	Eni et al. (2012)	Arrow Injuries in North-Eastern Nigeria	13	1 had thoracotomy while 5 had removal and chet tube insertion
5	Nwiloh et al. (2010)	Arrow in the heart	1	Removal with the aid of cardiopulmonary bypass
6	Aliyu and Ismail (2014)	Arrow in the Heart: our experience	1	Thoracotomy
Total	6		57	

banning of the use of bows, arrows and crossbows as instruments for hunting and sport.

Ali and Gali (2004) in North-eastern Nigeria reported 78 cases of chest injuries; four had penetrating cardiac injuries from arrow shots. They attributed high incidence of chest trauma to rising rate of crime in northern Nigeria and conflict between farmers and cattle rearers. Their patients were all managed by thoracotomy and removal of the arrows.

Madziga (2003) in his 10-year retrospective review of arrow injuries in Maiduguri, North-eastern Nigeria reported 73 cases of arrow injuries on various parts of the body. Of these cases, 29 (40%) had chest injuries, six had thoracotomy, removal of arrow and repair of associated visceral injuries (4 had lung perforation and 2 had arrows in the heart). The remaining 23 had removal and insertion of a closed thoracostomy tube drain. Only 20% of the overall arrow injuries were due to communal clashes, 70% were due to armed robbery. Farmers and herdsmen battle over grazing land when animal are allegedly allow to graze on farm crops also contributed. Cattle theft is also a cause of these injuries.

Eni et al. (2012) in North-eastern Nigeria (Nguru) in their 2-year prospective study reported a total of 57 cases of arrow shot to various parts of the body. In their cases, 13 patients had arrow injuries to the chest. Five had removal and chest drain insertion for haemopneumothorax and one had thoracotomy and removal of arrow in the heart. The two mortalities recorded in their report had chest arrow injuries in addition to arrow injuries in other parts of the body. The causes of injuries in their patients are mainly from

interpersonal conflict between herdsmen and farmers over grazing land as well as armed banditry attack.

Nwiloh et al. (2010) reported a case of arrow injury to the heart, which was sustained while the patient was hunting. Arrow was removed after institution of cardiopulmonary bypass and cardiac defect repaired with pledged 3/0 prolene. He had associated ventricular septal defect that was not repaired because it was not haemodynamically significant.

Aliyu and Ismail (2014) in Kano reported a case of arrow in the heart in an 18 year old boy. Injury was sustained while fighting. He was presented 4 h after injury and had emergency anterolateral thoracotomy and removal of the arrow after application of double purse string of 2/0 prolene.

Arrow injuries in Nigeria are prevalent in northern part. This region housed the nomadic Fulani's who are herdsmen. They are commonly in conflict with farmers because the animals graze in their farmlands. Both parties use arrows to protect themselves and also to fight in the event of conflict. Cattle theft is also becoming rampant in this region, this also predisposes to arrow injuries as shown by Madziga (2003). Arrows are traditionally used for hunting and arrow injuries in the past are attributed to accidental shot during hunting. Today, the trend is changing. Only one case was attributed to hunting (Nwiloh et al., 2010).

Madziga (2003) recommended mapping out graze land in most northern Nigeria where nomadic animal rearing is a common way of life and that laws governing movement of grazing animal should be enacted and enforced in order to stem the incidence of violent clashes between

herdsmen and farmers.

CONCLUSION

Arrow injuries are still common in northern part of Nigeria. Injuries to the chest can be devastating as vital organs like the heart can be affected. They result mainly from conflict between herdsmen and farmers. Armed banditry and cattle theft are on the increase in this part of the country. Removal should be in the hospital by a specialist. We recommend enlightenment campaigns to educate the public on the dangers of hunting using these weapons in modern day and also the dangers of removal at the scene of injury. Government should map out graze land for herdsmen to enable them feed their animals without encroaching into farmlands, and enforce hunting and grazing laws that will prevent conflict between farmers and herdsmen.

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