MODE OF PRESENTATION AND MANAGEMENT OF CAROTID ARTERY INJURIES

Nauman Imtiaz, Ahsin Manzoor Bhatti*, Hafiz Khalid Pervaiz

Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan,*Combined Military Hospital Quetta/ National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To share experience of presentation and management of carotid artery injuries in tertiary care Hospitals Rawalpindi, Lahore and Quetta.

Study Design: Cross sectional descriptive study.

Place and Duration of Study: Combined Military Hospital Rawalpindi Lahore and Quetta, from Jun 2005 to Jul 2014.

Material and Methods: The data of demography, mode of presentation, associated injuries and surgical procedures performed in the patients with penetrating neck injuries were collected and analyzed descriptively.

Results: All 32 patients were male. Age ranged from 18 to 52 years (mean: 30.7 ± 7.1 years). Time of presentation to vascular surgeon ranged from 1 to 52 hours (mean: 4.4 ± 2.3 hours). Sixteen cases (50%) resulted from shrapnel injuries. Thirteen patients (40.6%) had bullet injuries and in three (9.3%), stab wounds. In only 6 cases (18.7%) carotid injury was confirmed on angiography preoperatively. Common carotid artery (CCA) was the most frequently injured artery in 15 cases (46.8%). There were 6 cases (18.7%) of External carotid artery (ECA), 4 (12.5%) cases of internal carotid artery (ICA) and 1 case (3.1%) of injury to the carotid bifurcation. Two cases (6.2%) had both ICA and ECA injuries. Four patients (12.5%) had no carotid artery injury on surgical exploration.

Conclusion: Surgical exploration of neck penetrating injuries on the basis of hard signs and platysmal penetration was found a safe procedure especially in patients who had history of hemodynamic instability.

Keywords: Common carotid artery, External carotid artery, Internal carotid artery, Polytetrafluoroethylene.

INTRODUCTION

The number of vascular trauma cases has also gone high as compared to previous decades, including a variety of carotid artery injuries. Close proximity of cranial nerves, aero digestive tract, cervical spine and risk of their concomitant damage make carotid artery injury more peculiar as compared to other vascular injuries. Many injuries are associated with head injury while in others the vessel is traumatized close to the base of skull or even in its bony pathway. Many patients of carotid artery injury present with cerebrovascular accident (CVA) due to brain ischemia[1].

Neck vascular trauma was less than 5% of total vascular injuries during World War II[2] and Vietnam War[3]. Limbs and trunksustained most of the vascular injuries at that time. Despite the fact that head and neck region is only one tenth of body surface area, it is affected by about one third of combat trauma, because modern body armorsmainly protect the torso leaving the extremities, head and neck vulnerable to injuries.

Rationale to present this study while considering the health infrastructure and health budget, CT angiography and further endovascular management in case of penetrating neck injuries are not a frequently available option to our surgeons, so relying upon platysmal penetration and hard signs of vascular injury to explore the neck wound can be a safe option.

PATIENTS AND METHODS

This cross sectional descriptive study was conducted at combined military hospitals Rawalpindi, Lahore and Quetta consecutively from June 2005 to July 2014. Irrespective of age and gender all cases of penetrating carotid artery injuries in zone II of neck managed by one

Correspondence: Dr Nauman Imtiaz, HoD Vacular Surgery, Combined Military Hospital Rawalpindi Pakistan
Email: naumanimtiazkhan@yahoo.com
Received: 27 Jul 2018; revised received: 07 Sep 2018; accepted: 17 Sep 2018

vascular surgeon were included in the study. Patients with traumatic arteriovenous fistula orpseudo aneurysms presenting later than 1 week, negative for carotid artery injury on angiography, comatose and those who succumbed to injuries before operation were excluded from the study. Thirty two cases of suspected carotid artery injuries were included in the study. All patients were initially assessed as per advanced trauma life support guide lines and then a detailed systemic examination was performed. Complete blood count, blood grouping & cross match, x-rays chest and cervical spine were ordered including ECG for the patients more than 35 years of age. Angiography was done exclusively in stable cases or in patients with soft signs of vascular injury. All hemodynamically unstable patients were resuscitated before operation. Anypatient with either platysma penetration with episode of hemodynamic instability or hard signs of vascular injury was explored surgically without preoperative angiography. Injection cefuroxime, 1.5 gm intravenous was administered in all cases preoperatively. All 32 cases were operated under general anesthesia. In every case, proximal and if possible distal control was achieved before exploring the injured site. In case of devitalized tissues, thorough debridement of surrounding soft tissue and vessel wall itself was done. Whenever possible reversed long saphenous vein was used to bridge the gap otherwise Polytetrafluoroethylene (PTFE) graft was used according to the diameter of the vessel. Primary end to end anastomosis was done with double needle proline 5/0 for common carotid artery and proline 6/0 for internal jugular vein, internal and external carotid arteries using magnifying loupes. Anastomosis was done following standard continuous full thickness suturing technique. Unilateral shattered Internal Jugular vein was ligated while small rent in the vein was primarily repaired. Personal particulars, age, gender, mechanism of injury, site of injury, associated injuries, neurological deficit, time interval between injury and operation and procedure performed were recorded on a pre-designed proforma. Each patient was regularly followed up for one month. Descriptive statistics were done with the help of IBM SPSS Statistics for Windows, version 19.0. Armonk, NY: IBM Corp.

RESULTS

All thirty two cases of clinically suspected carotid artery injuries were males. Age ranged from 18 to 52 years. Mean age was 30.7± 7.1 years. Time of presentation to vascular surgeon ranged from 1 to 52 hours (mean: 4.4 ± 2.3 hours). Sixteen cases (50%) resulted from shrapnel injuries. Thirteen patients (40.6%) had bullet injuries and in three (9.3%), stab wounds. Angio-graphy was done in only stable patients who had soft signs. In only 6 cases (18.7%) carotid artery injury was confirmed pre-operatively on angiography. CCA was the most frequently injured artery. It was affected in 15 cases (46.8%). There were 6 cases (18.7%) of ECA injury, 4 cases of ICA (12.5%) injury and 1 cases (3.1%) of injury to the carotid bifurcation. In 2 cases (6.2%) both ICA and ECA were injured. In 4patients (12.5%) surgical exploration revealed no injury to carotid arteries. Detail of surgical procedure is given in table-I. Associated injuries were seen in 16 patients (50%). Out of six internal jugular vein injuries (18.7%), the vein was ligated in 4 cases (12.5%) while in 2 cases (6.25%) a small rent was repaired. Various associated injuries and their percentages are shown in table-II.

Two patients (6.2%) presented with hemiplegia of opposite side. One had CCA shrapnel injury while other had both ICA and ECA injured. Both patients underwent repair of arteries (only ICA in the later one). One patient had significant recovery after 1 month while in other it took about 4 months for partial recovery. One patient (3.1%) who had associated extensive maxillofacial and tracheal injury had post operative hemiplegia on recovery from general anesthesia. Tracheostomy andcontrol of multiple bleeders were done before carotid artery repair. Despite high intensive care his condition deteriorated rapidly and he died on third post operative day.

DISCUSSION

Interestingly no research article from local literature could be found on internet search which studied carotid artery injuries or neck vascular trauma. However, a study conducted at Lady Reading hospital Peshawar from January 1995 to December 1998 showed a significant number of vascular injuries treated[4]. There were only ten (2.82%) neck vessel injuries out of total three hundred and thirty five vascular injuries. Another study from the same hospital from January 1995 and June 1998 showed similar results[5]. The difference in number of carotid artery injuries is mainly due to the fact that these studies encompassed only four years and three and a half year respectively while we presented data of nine years. Secondly many of our patients were military persons who were evacuated by quickest possible means to the tertiary care hospitals or civilian victims of bomb blast injuries which were immediately evacuated to our facility. As neck vascular trauma is associated with significant mortality delayed evacuation to the vascular surgery facility may have contributed to less number of cases in other local studies.

Liekweg and Green field in their study showed eighteen carotid artery injuries in ninety six patients with penetrating injuries to the neck[1]. They recommend that patients without neurological deficit and with neurological deficit less coma should have their carotid arteries repaired. In our study we followed the recommendations given by this study as far as pre-operative neurological status was concerned.

In a retrospective study of the patients in combat operations in Chechnya and then in peace time, Reva *et al* reported forty six patients of carotid artery injuries[6]. In nine of their patients carotid artery ligation was done which resulted in neurological deficit in five patients (55.5%) and four (44.4%) deaths. In our study no CCA or ICA was ligated but despite this we had a post-operative stroke in a patient which proved lethal on third postoperative day. Carotid artery repair was done in thirty seven patients out of which nine patients (24.3%) died and neurological deficit persisted in two (5.4%).

Simmons *et al* published their seven years experience in managing traumatic vascular injuries of neck in trauma centre in 2012. In their 25 recruited patients 13 carotid artery, 5 internal jugular vein and 13 external jugular vein injuries were identified. Six carotid injuries underwent open repair, 5 had non operative management while 1 injury was managed with endovascular

Table-I: Surgical procedures performed.

Site of Injury	Primary Repair	Vein Patch Repair	Vein Graft	PTFE Graft	Ligation
CCA	2	2	6	5	-
ECA	1	-	-	-	5
ICA	-	-	4	-	-
ICA + ECA	-	-	2 ICA + Ligation of ECA	-	-
Carotid Bifurcation	-	-	1 ICA + Ligation of ECA	-	-

Table-II: Associated injuries.

Associated Injury	No. of Cases	Percentage
Internal Jugular Vein	6	18.70
Hypoglossal Nerve	2	6.20
Vagus Nerve	3	9.30
Max illofacial	3	9.30
Trachea	1	3.10
Thyroid	1	3.10

repair. No patient had decrease in Glasgow coma scale score postoperatively. Regarding carotid artery injuries, they concluded that since vascular injuries to the neck are associated with significant morbidity and mortality so the treatment of these injuries must be individualized. All carotid artery injuries should be repaired provided patient is non comatose and hemodynamically stable[7].

Weinberg *et al* conducted a comparative study between management in penetrating cervicothoracic injuries in past (1974 to 1998) and modern era (2000 to 2013) in urban trauma centre of a single hospital. They concluded that primary open repair is still the corner stone of the management in penetrating injuries of neck vessels despitethe advances in endovascular modalities[8]. Although endovascular stenting of carotid artery injuries has made its mark as a very useful modality there are certain issues that we face in our set up. Firstly, it is available in only few centers of the country. Secondly it is not available round the clock and most of our patients and institutes do not afford it. Many a times a vascular injury is diagnosed during exploration for some other injury and vascular surgeon is called for help. In mass casualty situation with many polytrauma cases it becomes even more impractical.

Feliciano DV published current concepts in penetrating neck injuries and concluded that if the platysmal penetration is present but patient is hemodynamically stable with no obvious signs of vascular and visceral injuries in neck then careful serial observation is warranted every 6 to 8 hours. If carotid artery injury is suspected in a hemodynamically stable patient then CT angiography is the investigation of choice[9]. It is the same protocol observed by us in our study. Moreover he recommended the exploration of neck and open repair of carotid artery injury.

Yasa *et al* reported CCA to be injured in 9/18 cases (50%), ECA in 4/18 cases (22.2%), ICA in 3/18 cases (16.6%) and brachiocephalic artery in 2/18 cases (11.1%)[10]. In our study CCA, ECA and ICA were affected in 46.8%, 18.7% and 12.5% respectively. In 6.2% of our cases both ICA and ECA were involved and in 3.1% injury was at carotid bifurcation. Sixteen of our patients (50%) had associated cranial nerve, IJV, trachea and Faciomaxillary trauma while they reported 12/18 (66.6%) associated injuries.

Lee *et al* in their publication regarding management of carotid injuries emphasize on a unified criterion for the use of investigations in the diagnosis of these injuries in stable patients. They included both blunt and penetrating injuries in their study, advocating DSA to be more superior investigation as compared to CTA in screening these injuries. Though endovascular management is an option in carotid artery injuries, but open surgical repair is still required in the injuries unfavorable to endovascular repair andin extra cranial carotid injuries[11]. Their recommendations are pretty much in line to our management strategy.

Karaolanis *et al* published their work on contemporary strategies in managing civilian neck zone II vascular trauma favoring the conventional open vascular repair for all the penetrating injuries unsuitable for endovascular repair. They recommended anticoagulation and antiplatelet therapy in cases of blunt injuries and endovascular repair if GCS deteriorates[12]. It is similar to our approach in penetrating carotid injuries.

Islam *et al* measured the outcome of cervicomediastinal vascular injuries managed in vascular subspecialist led vascular trauma centre. In 93 recruited patients there were 107 vascular injuries. Most common injuries were subclavian artery 24% followed by carotid artery 22%. Open vascular repair was done in 64%, ligation in 12%, endovascular repair in 8% cases were performed[13]. Despite the advances in endovascular modalities, open repair is still the favorable option even in vascular sub specialist led vascular trauma centre.

In a study published by Greve *et al* discussing life threatening potential of pene-

trating neck injuries, they concluded that rapid interdisciplinary approach and specialized vascular centers are required to manage these injuries. Ten out of total 11 patients underwent angiography while only 2 carotid injuries were repaired[14].

Łochowski *et al* published their work on penetrating injuries in which there were total 10 patients, out of which 9 had stab wound while one had gunshot wound in the neck. Three patients had carotid artery while rest have other structures injuries including trachea and esophagus. Main indication of exploration of neck was expanding hematoma and bleed from the wound. Similar approach of exploring neck on the basis of hard signs of vascular injury is emphasized in our study as well[15].

Martinakis *et al* published a systematic review to assess the role of endovascular modalities in the management of carotid artery injuries. They deduced that endovascular has role in the management of carotid artery injuries in specific circumstances and certain indications[16]. But open repair is still widely practiced and opted option in such injuries as is the case in our study as well.

CONCLUSION

Vascular injuries as a result of shrapnel were the most common cause of carotid artery trauma in our study. Surgical exploration of neck penetrating injuries on the basis of hard signs and platysmal penetration is a safe procedure especially in patients who had history of hemodynamic instability.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

REFERENCES

1. Liekweg W, Greenfield L. Management of penetrating carotid arterial injury. Ann Surg 1978; 188(5): 587-92.
2. DeBakey ME, Simone FA. Battle injuries of the arteries in World War II; An analysis of 2,471 cases. Ann Surg 1946; 123(4): 534-79.
3. Rich NM, BaughJH, Hughes CW. Acute arterial injuries in Vietnam: 1,000 cases. J Trauma 1970; 10(5): 359-69.
4. Khan J, Aslam S, Anwar R, Ahmad T, Rehman K, Waseem N, et al. Vascular trauma experience at lady reading hospital peshawar. JPMI 2000; 14(1): 26-35.
5. Hussain ST, Aslam S, Khan RA, Mannan P, Khan J, Collin J. An observational study of 256 cases of vascular trauma in the north western province of Pakistan. Ann R Coll Surg Engl 2001; 83(6): 388-91.
6. Reva VA, Pronchenko AA, Samokhvalov IM. Operative management of penetrating carotid artery injuries. Eur J Vasc Endovasc Surg 2011; 42(1): 16-20.
7. Simmons JD, Ahmed N, Donnellan KA, Schmieg RE, Porter JM, Mitchell ME. Management of traumatic vascular injuries to the neck: A 7-year experience at a Level I trauma center. Am Surg 2012; 78(3): 335-8.
8. Weinberg JA, Moore AH, Magnotti LJ, Teague RJ, Ward TA, Wasmund JB, et al. Contemporary management of civilian penetrating cervicothoracic arterial injuries. J Trauma Acute Care Surg 2016; 81(2): 302-6.
9. Feliciano DV. Penetrating cervical trauma. "Current concepts in penetrating trauma", IATSIC Symposium, International Surgical Society, Helsinki, Finland, August 25-29, 2013. World J Surg 2015; 39(6): 1363-72.
10. Yasa H, Ozelci A, Yetkin U, Gunes T, Gokalp O, Yilik L, et al. Our experiences in the management of carotid artery injuries. Internet J Thoracic and Cardiovascular Surg 2007; 11(2): 1-5.
11. Lee TS, Ducic Y, Gordin E, Stroman D. Management of carotid artery trauma. Craniomaxillofac Trauma Reconstr 2014; 7(3): 175-89.
12. Karaolanis G, Maltezos K, Bakoyiannis C, Georgopoulos S. Contemporary strategies in the management of civilian neck zone II vascular trauma. Front Surg 2017; 4: 56.
13. Islam J, Laing GL, Oosthuizen GV, Clarke DL, Robbs JV. Outcomes for cervicomediastinal vascular trauma managed by a vascular subspecialistled vascular trauma service. S Afr J Surg 2016; 54(2): 15-19.
14. Greve J, Schuler PJ, Mandapathil M, Dominas N, Veit J, Bas M, et al. Penetrating injuries of the head and neck region - A potentially life threatening situation. Laryngorhinootologie 2014; 93(10): 671-6.
15. Lochowski M, Kaczmarski J, Brzeziński D, Cieślik-Wolski B, Kozak J. Penetrating neck traumas. Kardiochir Torakochirurgia Pol 2014; 11(1): 30-3.
16. Martinakis VG, Dalainas I, Katsikas VC, Xiromeritis K. Endovascular treatment of carotid injury. Eur Rev Med Pharmacol Sci 2013; 17(5): 673-88.