Carotid tree changes of Maxillofacial Missile injuries by Doppler sonographay - an Iraqi study

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الخلاصه

جروح الشريان ألسباتي التي حدثت بسبب الجروح النافذة للرقبة التي نسبتها عشرة اظعاف الجروح التي تسبب بواسطة الجروح الغير نافذه ، 10% من الجروح النافذة للرقبة تؤدي الي جروح الشريان ألسباتي . أكثر من 90% من هذه الجروح الثانوية نتيجة جروح المقذوفات . الجروح الأكثر انتشارا لجروح الشريان ألسباتي العنقي هي الجروح بشكل زاوي أو قشط جزئي في الشريان كذلك انقطاع الشريان كليا هي اقل شيوعا .

المواد المستعملة وطرائق العمل اختير الجرحى من قسم جراحة الوجه والفكين في مستشفى الجراحات التخصصية – بغداد من كانون الاول2006 إلي كانون الأول عام 2007 المحالين من قسم الطوارئ . عدد الجرحى ثلاثون تسعة وعشرين ذكور وأنثى واحدة فقط .

طريقة العمل اجري فحص الموجات الفوق الصوتية السونار الدوبلر للشريان ألسباتي والمريض في وضع الاستلقاء في غرفة شبه مظلمة ، اجري الفحص في 30-60 دقيقة استعملنا فية بروب ذو تردد عالي (5.7-9) ميكا هرتزل وبعد وضع جيل (دهن) على رقبة الجريح في الجهة المصابة والجهة السليمة .

النتائج: أعمار الجرحى تتراوح بين (15-57سنه) بتوسط 36سنه أظهرت النتائج إن:

1- 60% من الجرحى نتيجة أطلاقات مقذوفه ، 40% منها نتيجة أطلاقات مسدس أو بندقية و 20% نتيجة أطلاقات رشاشات ذات سرعه عاليه و 40% نتيجة إصابات شظايا.

2- وجود زيادة السمك الطبقة الوسطى للشريان ألسباتي الخارجي (الذاهب إلى الوجه) في جهة الرقبة التي فيها الجروح مقارنه بالجهة السليمة في نفس الجريح . وزيادة سمك الطبقة الوسطى للشريان ألسباتي الرئيسي في جهة الرقبة التي فيها الجروح .

الخلاصة: فحص السونار الدوبلر غير مؤلم ،لا يستعمل فيه إشعاع وهو فحص غير مؤذي ، هنالك زيادة في الطبقة الوسطى للشريان ألسباتي الرئيسي و الشريان ألسباتي الخارجي الذاهب إلى الوجه والفكين في الجهة التي تعرضت لجروح أطلاقات أو شظايا . تبين وجود نتائج أخرى في فحص السونار دوبلر عديدة في جهة الرقبة التي تعرضت لإصابات الإطلاق أو الشظايا مقارنه بالجهة السليمة .

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Abstract

Background: Injuries of the carotid artery caused by penetrating wounds of the neck are nearly 10 times as common as those caused by non penetrating trauma [1], over 10% of all penetrating neck wounds result in significant carotid artery[2] ,and more than 90% of such injuries are secondary to gunshot wounds [3].

Injuries to the extra cranial carotid arteries from penetrating trauma is more likely to cause a dissection through intimae disruption and subsequent formation of a false channel and thrombus [4].

Patients: Patients were selected from Maxillofacial department in the Specialized Surgeries Hospital in Baghdad . thirty patients were examined , twenty nine were male (mean 96,66%) ,only one female was examined (3,34%) .

We prepared a specially designed case sheet including , life saving procedures , type of missile , clinical examination include site of missile injuries according to Saletta JD et al 1976 [5] who classified the neck Into three zones , investigation X- ray ,C T scan. .The ultrasonographic scanning of the carotid arteries was performed, the Doppler machine was -SIEMENS – sonoline ELEGRA . Using a high-frequency linear array imaging probe or transducer 7,5- 9 (MHz) with a Hewlett-packard scanner. Methods : The ultrasonographic scanning of the carotid arteries was performed with the patient in the supine position , the examination takes 30 to 60 minutes [6,7] . Using a high-frequency linear array imaging probe (7.5- 9 MHz) .

Results : Patients age ranging from 15 – 57 years and the mean was 36 years ,most cases were from age range 20-29 years (40%) .Eighteen patients (60%) were injured with bullets , twelve were injured with shell fragments (40 %) , twelve (40%) were hand gun bullets and six (20%) were rifle bullets.

Intimae media thicknesses of common carotid arteries were measured .Mean of IMT right was 0.7 mm and left side was

0.71 mm . While IMT of right external carotid artery was 0.71 mm , IMT of left external carotid artery was 0.75 mm . IMT of right internal carotid artery was 0.8 mm ,IMT of left internal carotid artery was 0.78 mm .Results reveled that mean of IMT of Ext. carotid artery at injured side was more thicker (0.79 mm) than non injured side and the mean of IMT of common carotid artery was also thicker at injured side 0.8 mm .
Conclusion: Ultrasound scanning is noninvasive, and usually painless . , there are no known harmful effects on humans , carotid Ultrasound has to be a risk free procedure . Further Ultrasound scanning gives a clear picture of soft tissues that do not show up well on X- ray images . Mean of IMT of Ext. carotid artery at injured side was more thicker (0.79 mm) than non injured side and the mean of IMT of common carotid artery was also thicker at injured side 0.8 mm .

Introduction

Penetrating injuries to vascular structures may result in thrombosis or transaction of the involved vessel or formation of an arterio venous fistula AVF or false (pseudo) aneurysm. Pseudo aneurysms are caused by injuries that disrupt partial or full thickness of the arterial wall If arterial flow is maintained blood extravasates into the surrounding tissue, producing a pulsatile hematoma. The peri-vascular connective tissue forms a capsule, which ultimately becomes the dome or sac of the Pseudo aneurysm. As hematoma liquefies, recommunication may develop between the artery and the aneurismal sac [(8)]. Injury to the carotid artery may result in signs and symptoms related to blood loss, mass effect of neck hematoma, or cerebral ischemia. Patients with a complete disruption of the artery owing to missile injury are frequently seen in the emergency room with hypovolemic shock, or sever airway obstruction due to compression of the trachea by hematoma, or symptoms of acute cerebral ischemia or infarction[(4)] .

The C T image may only provide clues that indicate a major vascular injury. Magnetic resonance (MR) imaging is gaining wider application in all areas of diagnostic imaging. M R angiography has been found in several studies to detect reliably an intramural hematoma and a false lumen, demonstrating its utility in both diagnosis and follow-up of the cases with vascular injuries[9]. More than 90% accuracy of MR angiography in the detection of cervical carotid artery dissection, carotid artery injury such as a laceration, tear, dissection, thrombosis. The carotids provide a convenient window for the assessment of the whole arterial system, their examination could also provide a method for assessing the rate of progression, or regression of disease[10].

Materials and Methods

Patients were selected from Maxillofacial department in the Specialized Surgeries Hospital in the period from December 2006 –December 2007 .They were referred from emergency unite presented with missile injuries affecting maxillofacial region .thirty patients were examined , twenty nine were male (mean 96,66%) and only one female was assessed (3,34%) .Patients with intracranial missile injuries were excluded from this study .

We prepared a specially designed case sheet including ,familial and medical history ,behavior concerning tobacco and alcohol usage , life saving procedures , type of missile , clinical examination include site of missile injuries according to Saletta JD et al classification 1976 which classified the neck Into three zones ,neck examination, entrance , exit and site of missile retained, associated injuries, investigation x-ray ,C T scan ,lab. Investigation . The ultrasonographic scanning of the carotid arteries was performed, the Doppler machine was -SIEMENS – sonoline ELEGRA . Using a high-frequency linear array imaging probe 7.5- 9 (MHz) with a Hewlett-Packard scanner .

Methods

The ultrasonographic scanning of the carotid arteries was performed with the patient in the supine position , lied in a quite dark room , the examiner was sitting at the level of the patient & reaching over the patient s head to the neck .It 's important for the patient & the examiner to be comfortable because the examination takes 30 to 60 minutes (6,7) . Using a high- frequency linear array imaging probe (7.5- 9 MHz) .A water – soluble contact gel was placed on the skin where the transducer probe (a hand-held device that directs the high-frequency sound waves to the arteries being tested)is to be placed to help transmit the sound to the skin surface, the ultrasound turned on and images of the carotid artery and pulse waveforms obtained .

For best access to the Carotid arteries, the patient' s neck must be hyper extended. Depending on the patient, the carotid vessels could be found by scanning the neck with the chin straight or turned away from the side being examined . The carotid vessels were followed from the clavicular head cephalad to their bifurcation & 3-4 cm of the proximal internal & external carotid arteries were studied (11).

To gain maximum benefit from the combined tissue & flow imaging capabilities of Doppler U/S, it was valuable to conduct the carotid examination as follows:

Duplex U /S:

The typical duplex U/S examination of the extra cranial carotid system began with identification of the common carotid artery (CCA), external carotid artery (ECA) and internal carotid artery (ICA) ,color – flow imaging was used to assist the examiner in rapid vessel localization .Complete appreciation . of vessel wall; with careful attention for intimae thickening was performed using Gray –scale imaging (B –scan) with the color turned off .A longitudinal and transverse sections were obtained looking .

IMT Measurements:

IMT was measured on both sides. The patient's head was tilted to get the common carotid artery just proximal to the bulb placed horizontally across the screen. Setting was made to get an optimal picture of the carotid walls. IMT was measured on frozen frame of a suitable longitudinal image with the image being magnified to achieve a higher resolution of details. Only the far walls of the artery were used for calculation. The IMI was defined as the distance between the leading – edge of the luminal echo to the leading edge of the media / adventitia echo .. It was measured over a length of I cm just proximal to the bulb . this was accomplished by the use of the calipers & the trace function of the U/S system , & calculated as a mean IMI over this length (12). On a longitudinal , two – dimensional ultrasound image of the carotid artery , the anterior and posterior walls of the carotid artery are displayed as two bright white lines separated by a hypoechogenic space . The distance between the leading edge of the first bright line of the far wall – lumen intimae interface and the leading edge of the second bright line – media adventitia interface indicates the intimae media thickness.

Results

Clinical findings and analysis

1.Patients and methods :

This was a prospective study based on thirteen patients presented with missile injuries affecting Maxillo –facial region ,in the Specialized surgeries Hospital in the December 2006 -2007 . Patients age rang from 15 – 57 years and mean was 36 years ,most cases was from 20-29 years (40%) .

2.Distribution of types of missiles :

Eighteen patients (60%) were injured with bullets and six were injured with shell fragments (40 %) , twelve (40%) were hand gun bullets and six (20%) were rifle bullets table (1).

3.Distribution of type and site of injuries.

Isolated soft tissues injuries were found in one case (3.33%) while skeletal injuries were found in twenty nine (96.66) , the distribution of skeletal injuries showed that mandibles fractures were found in seventeen patients (58.62%) ,while mid face fractures were found in six patients (20.69%) and combined mandible and mid face fractures were found in six patients (20.69) table (2) . while distribution of site of injuries according to the Saletta J D et al , there was no presented with zone 1 , nine cases were presented with zone 11(30%) ,six cases were presented with zone 111 (20%) ,and fifteen patients were presented with zone 11 + zone 111(50%) table (3).

Results of B –scan sonography findings:

4.Results reveled that mean of IMT of Ext. carotid artery at injured side was more thicker (0.79 mm) than non injured side (0.67mm).

Table (1) distribution Type of missiles.

Type of missiles	No. of patients	Percentage (%)
Fragments	12	(40%)
Handgun bullet	12	(40%)
Rifle bullet	6	(20%)
total	30	(100%)

Table (2)distribution skeletal and soft tissue injuries

Site of injuries	No. of patients	Percentage (%)
Soft tissues injuries	1	(3.34%)
Mandible fracture	17	(56.66%)
Mid face fracture	6	(20%)
Mandible + Mid face fracture	6	(20%)
Total	30	(100%)

Table (3) distribution site of injuries according to Saletta J D et al classification.

site of injuries	No. of patients	Percentage (%)
Zone I	0	(0%)
Zone II	9	(30%)
Zone III	6	(20%)
Zone II+III	15	(50%)
Total	30	(100%)

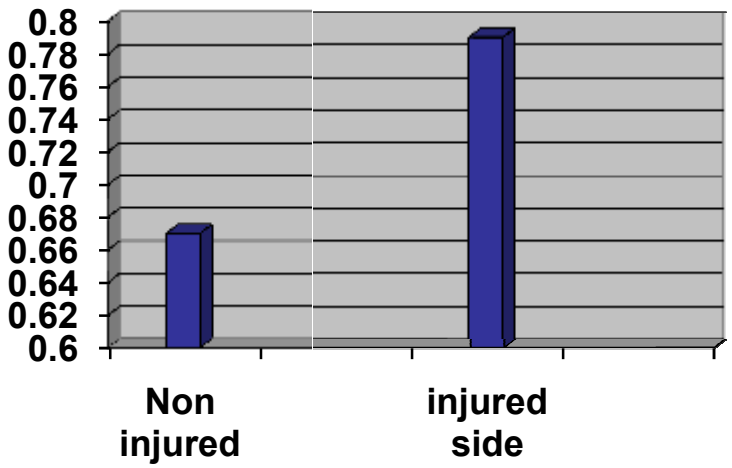


Fig .(1) Comparison between Mean of IMT of Ext. carotid artery at non injured and missiles injured side at the same patient .

Result showed that zone 1 zero ,zone II was nine cases with mean IMT 0.72 mm ,zone III was six cases with mean IMT 0.78 mm and zone II+ III was fifteen cases with mean IMT 0.78 mm .

5.The relation between mean IMT of external carotid artery at injured side with site of wounds according to Saletta J D et al classification .

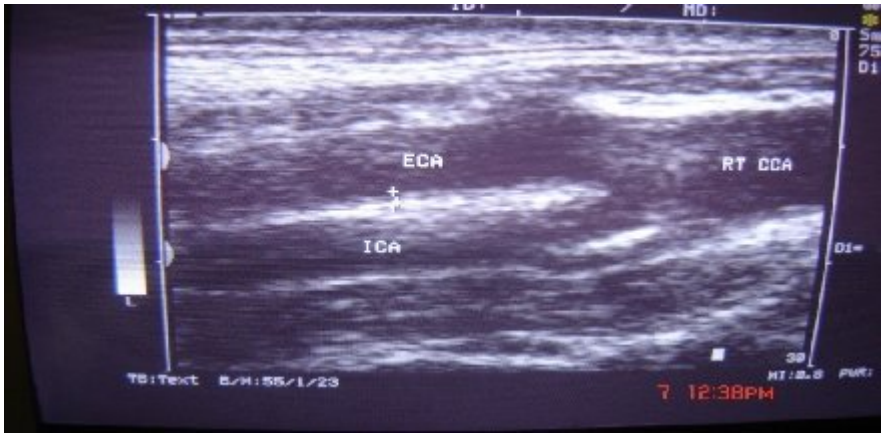
Table (4) site of wounds as Saletta J D classification and mean IMT of external carotid artery .

Site of wounds	No. of patients	Mean of IMT of ECA
Zone I	0	0
Zone II	9	0.72 mm
Zone III	6	0.78 mm
Zone II+III	15	0.78 mm

A. Comminuation of the mandible and laceration
B. Orthopantomogram showing multiple transosseus wires .

C. One month post operatively .

D. B –scan US of the RCCA .



B

E. B –scan US of the ECA , measurement of IMT.

Discussion

Missile injures by their special nature have lessons applicable to the general understanding of facial trauma (13) , war continues to be the best school for surgeons .Historically ,military conflicts had provided significant opportunities for the advancement of trauma surgery . Injures of the carotid artery caused by penetrating wounds of the neck are nearly 10 times as common as those caused by non penetrating trauma [(1)] .

Over 10% of all penetrating neck wounds result in significant carotid artery injury [2] and more than 90% of such injuries are secondary to gunshot wounds [3] .

The penetrating injuries of the neck are more frequently associated with injury to the common carotid artery .

In our study thirty patients were treated in period of one year with missile injures affecting maxillofacial region ,this series outnumber the reports that deal with civilian injures . The most important factor in the successful care trauma patient is the initial assessment and resuscitation performed in the emergency department . Injuries to the extra cranial carotid arteries from penetrating trauma can occur via two basic mechanisms. In the first type, the projectile, or weapon, can directly penetrate the vessel wall and interrupt continuity of the wall to various degrees. This type of injury typically results in dissection or transaction of the artery with thrombosis. In the other type , the percussive force of the projectile interacts with the tissue and can disrupt the vessel wall in varying degree, without directly striking the vessel itself. This mechanism is more likely to cause a dissection through intimal disruption and subsequent formation of a false channel and thrombus [4]. The most common injury to the cervical carotid artery is a tangential or partial laceration of the artery and total transactions is less frequent [14] .

1.patients population

Patients age rang from 15 – 57 years and mean was 36 years ,most cases was from 20-29 years (40%) , which was represent the age of students ,workers ,military members and officer man .This finding is consistent with other studies [15, 16].

2.Distribution of types of missiles :In our study missile were classified into : low velocity missiles (handgun bullets, air gun bellite , shotgun) ,high velocity missile (rifle bullets) and fragments may be low or high velocity . Eighteen patients (60%) were injured with bullets this can explain the predominance of bullet injuries in our study may be the availability of firearms that are easily accessible to population, bullet wounds are a feature of terrorist or guerilla war , our results in agreement with (17, 13)

they reported bullets produced more wounds because of the nature of the conflict .

3.Distribution of type and site of injuries.

Injuries were classified into two type , isolated soft tissue injuries and skeletal injuries . Skeletal injuries were further divided according to the involved bones into :Mandible fracture , fractures of the middle third of facial skeleton and both mandible and middle third fractures . the distribution of skeletal injuries showed that mandibles fractures were found in seventeen patients (58.62%) ,while mid face fractures were found in six patients (20.69%) and combined mandible and mid face fractures were found in six patients (20.69) .Our result represented that mandibles fractures was the most common , in consistent with other studies [18 , 19] .

4.distribution of site of injuries according to the Saletta J D et al 1976 .

there was no presented case with zone 1 , nine cases were presented with zone 11(30%) ,six cases were presented with zone 111 (20%) ,and fifteen patients were presented with zone 11 + zone 111(50%) .Our result represented that zone 11 + zone 111(50%) and zone 11(30%) represented the most common site of injuries may be due to the war in Iraq was terrorist attacks ,guerrilla and street fighting , the face and neck was the prominent part of the body , the head is rarely protected in victims of terrorist activity or may be the head and neck region was a preferential target for terrorist.

5.The relation between mean IMT of external carotid artery at injured side with site of wounds according to Saletta J D et al 1976 classification , result showed that zone II was nine cases with mean IMT 0.72 mm ,zone III was six cases with mean IMT 0.78 mm and zone II+ III was fifteen cases with mean IMT 0.78 mm . Our result represented that mean of IMT of Ext carotid artery at zone 111 and zone (11 + 111) was higher than other zone may be that these two zone have more number of arteries and veins and missile transmitted well done fluid filled structures ,or due to missile cause the expansion and collapse of the cavity lead to

laceration of tissues causing the damage to endothelial cells lining blood vessels .

Conclusion

1. Ultrasound scanning is non invasive and usually painless .
2. Ultrasound scanning gives a clear picture of soft tissues that do not show up well on X- ray images .
3. Check the state of carotid artery after surgery to restore normal blood flow .
4. A combination of technology including MRA ,CTA and Doppler study should be utilized appropriately to improve diagnosis , early identification of the vascular injury and prompt treatment can prevent major stroke .
5. mean of IMT of Ext. carotid artery at injured side was more thicker (0.79 mm) than non injured side.

References

1. Ledgerwood A M, Mullins R J, Lucas C E.: Primary repair vs ligation for carotid artery injuries . Arch Surg. 115;488-93.1980.
2. Calcaterra TC, Holt CP. Carotid artery injuries. Laryngoscope 1: 849-53. 1972.
3. Unger S W, Tucker W S jr, Mrdeza M A, Wellons H A jr, Chandler J G.: Carotid arterial trauma.Surgery.87: 477-87 1980.PUBMED.
4. Sankhla Suresh K: Acute carotid artery injury . J Pediatr Neurosci , 1:27-30.2006. ssankhla@ vsnl.com.
5. 5. Saletta J D, Lowe R J , Lim LT, et al : penetrating trauma of the neck , J Trauma 1976. 16: 579-587.
6. Lee V , Hertzberg B , kliewer C , et al : Assessment of stenosis : Implication of variability of Doppler measurement in normal appearing carotid artery . Radiology 1999 ;212: 493-498 .
7. Sanders R C., Topper I W : Carotid artery disease . In : Rogger C Sandrs . Clinical ultrasonography , 3th ed . Lippincott : philladelphia , 1998; 390-402 .
8. Schwartz H C , Kendrick R W, pogorel B S: False aneurysm of the maxillary artery . An unusual complication of closed facial trauma . Arch Otolaryngol 109:616-618, 1983 .

9. Liu J S , Tsai T C , Chang Y Y : Extra cranial internal carotid artery dissection secondary to neck massage visualization of mural hematoma by MR. Kao- Hsiung I Hsueh Ko Hsueh Tsa Chih (Kaohsiung J Med Sci) 9; 322-7,1993 .
10. Paul L Allan, Paul A , Dubbins , Myron A Pozniak, W Norman Mc Dicken ; Clinical Doppler Ultrasound , Churchill Livingstone , P 39, 2002 .
11. Jadhav UM . Non – invasive early prediction of atherosclerosis by carotid intimae – medial thickness . Asian J Clini . Cardiol . 4 : 24-28 , 2001 .
12. Hoomma . S , Hirose N , Ishida H , Ishii T , Araki G : Carotid plaque & intima-media thickness assessed by B- mode Ultrasonography in subjects ranging from young adults to centenarians . Stroke 2001 ; 32: 830- 835 .
13. Banks P . Meiier S , Hay wood I R , Wilson SP, Sander R . Gunshot wounds . In : Williams J L I (ed) . Rowe and Williams . Maxillofacial injures , 2nd edition . London , England . Churchill livingstone 1994 : p 665 .
14. Rubio PA , Reul GA Jr , Beall AC Jr , Jordan GL Jr , DeBakey ME , Acute carotid artery injury , 25 years experience . J Trauma 1974 , 14 : 967 – 73 .
15. Kassan A H , Lalloo R , kariem G . : A retrospective analysis of gunshot injuries to the maxillofacial region . S A D J . 2000 , 55 (7) , 359- 63 .
16. Odhiambo W A , Guthua S W , Macigo F G , Akama M K : Maxillofacial injuries caused by terrorist bomb attack in Nairobi ,Kenya , J. Oral Maxillofaci . Surg . 2002 31 : 374 -377 .
17. Raja Kummoona , Aliaa Muna : Evaluation of immediate phase of management of missile injuries affecting maxillofacial region in Iraq . The journal of craniofacial surgery . March 2006 , Vol . 17 , (2) .
18. Bizhan Aarabi , Howard H. Kaufman , T. Forcht Dagi , Eugene D. George , Michael L. Levy , : Missile Wounds of the Head and Neck , Vol. II . The American Association of Neurological Surgeons . page . 315 , 1999 .
19. Taher A A . : Management of weapon injury to the craniofacial skeleton . J. Craniofac . Surg . 1998 , 9 (4) : 371-82 .