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# Evaluation of Frequency and Properties of CT Angiographic Findings and their Influence on Management in Patients Suspicious to Traumatic Arterial Injuries Referred to CT Scan Department of Imamreza Hospital

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**ABSTRACT**

**Introduction:** Peripheralvascular injuriesinclude about 80% of allvascular injuries andthe studiesperformed so farin this areashowedthat the prevalence ofvasculartrauma is higher in menthanwomen.The aim ofthis study was to evaluate the frequencyandtypesof traumatic arterial injuries in patientsreferred toComputed Tomography (CT)department of Imam Reza Hospital.

**Materials and Methods:** This cross sectional study was approved by the ethics committee of Mashhad University of Medical Sciences. Patients' information were recorded in a checklist, all patients who were referred to CT scan department of Imam Reza Hospitalfor Computed Tomography angiography (CTA) because of traumatic vascular injuries were enrolled the study. Data were recorded aboutpatients' demographic characteristics (age and sex), mechanism of traumasuch ad accident (motorcyclist, pedestrian, car-rider), assaults, falls and so on, clinical symptoms at admission, type of arterial injury, and the report of CTA and the existence ofmusculoskeletal or neurologic comorbities. Patients' management details were also evaluated. Data were coded and analyzed by SPSS Version $_{16}$.

**Results:** 200 patients were evaluated in this study. The most common sites of involvement were the lower limbs (76%), thorax (16%), and upper limbs (8%). The most common abnormal angiographic pattern was run-off/ cut-off (52%), hematoma (15%), and aneurysm (5.5%). There was also nerve damage in 19% of patients. Surgical management was performed and included, end to end anastomosis in 32% of patients, thrombectomy in 23%, amputation in 18%, and ligation in 4% and vascular graft in 7%.

**Conclusion:** In ourstudy, there wasvascular injury in63.5% of patients based on the results of CTA. All vascular injuries were diagnosed by CTA were confirmed after vascular intervention and no serious vascular injury was reported in patients with negative CTA result at the follow-up period. So, CTA is a noninvasive and accurate diagnostic test.

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## Introduction

Arterial injuries with increasing frequency is known as an important complication of trauma. Such complications may lead to multiple pathologic lesions, and cause involvement of visceral and peripheral arteries. The peripheral arteries are especially susceptible to injuredby blunt trauma. Because they are closer to the surface and due to theirproximity to the bone, brachial and femoral arteries are more susceptible. Clinical prognosis depends on early diagnosis and repair of the injury (1, 2). The physical examination has a major role in the evaluation and treatment of patients with arterial damage. Evaluation and follow-up of this type of damages have been changed in the last decades from routine surgical exploration to selective arteriography and recently to selective evaluation based on physical examination (2, 3). Several imaging modalities have been proposed for evaluation of vascular lesions including Catheter


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Angiography (CA), duplex ultra-sonography (DUS), magnetic resonance angiography (MRA) and Computed Tomography Angiography (CTA) (4-7).

Although the gold standard for the diagnosis of traumatic vascular injuries is conventional angiography through catheter by Digital Subtraction Angiography (DSA) technique (8-11), but this modality becomes useless in vascular injuries in limbs by developing new noninvasive techniques (12-16).

Today, CTA has become an important method for initial evaluation of patients with trauma and is increasingly used for diagnosis of damages caused by blunt and penetrating trauma in the neck and limbs (17-23) and is considered as a choice method in these cases (24).

Patients withclinicalsymptomssuggestive forarterial injury such as hematoma, significant bleeding, trillorlimb ischemiashouldimmediatelyundergosurgicalexploration . Among these, there is agroup of patientswhomight benefitfromvascularradiologystudies. This group includes the patientswith clear signs ofarterial damage, severebonefracture, massivedamage of soft tissue,woundsfrombullets andgunhunting, as well as thepatients whodon't have clearsigns ofarterial damage, but have shown the symptoms of involvement in follow up(25).

In this research project, the frequency and types of arterial injuries following trauma in patients referred to the department of CT scan in Imam Reza hospital was studied. The study location was the Computed Tomography (CT) department of in Imam Reza hospital which is the main referral center for evaluating traumatic patients with CTA in Mashhad.

## Materials and Methods

This cross-sectional studywas performed on patientssuspected to arterial injury who were referredtothe department of CT scan in Imam Reza Hospital.

*Patients' selection*

Sample size was estimated about200 patients. Patientswho weresuspectedto arterial injury and were referred toImam Reza Hospital for CTA and were enrolled the study. The patients were excluded from the study if they could not undergoCTA(sensitivity to Contrast agent, etc.).

*Methods*

After approval by the ethics committee of Mashhad University of Medical Sciences, the checklist of the variables related to the research project was designed. Information on those who were referred to CTA department wasrecorded.

The information included: the characteristics of birth certificate (name and surname, age, sex), mechanism of traumalike accident (motorcyclist, pedestrian, car-rider), assaults, falls and so on, clinical symptoms of traumatic patient at admission, type of arterial injury and the CTA report, comorbidities were also recorded.Type of treatment procedures related to vascular injury was determined.

*Statistical analysis*

Datawerecodedand entered intoSPSS software $Version_{16}$. Data was described usingfrequency tables andquantitative datawere compared byt-student testand datacorrelation byqualitative datawas performed through Chi-square test. $P<0.05$ was considered as significant level.

## Results

200 patientswere evaluated in this study. 188 patients (94%) were male and 12 (6%) female. The most commonsites ofinvolvementwerethe lower limbs(76%), thorax(16%),and upper limbs(8%). The damage was caused bytrauma and accident in 84.5% of patients and byconflictin15.5% of them.

The most commonagegroupswere 16to 30 years(46.5%), 31 to45 years(20%), < 15 years (12.5%), >60 years(11%), and 46to 60 years(10%).There wasfracture in66% of patients and34%of damageswerewithout fracture. 12.5% of patients (n = 25) died. Figure1: Shows the frequency ofabnormalCT angiographies.

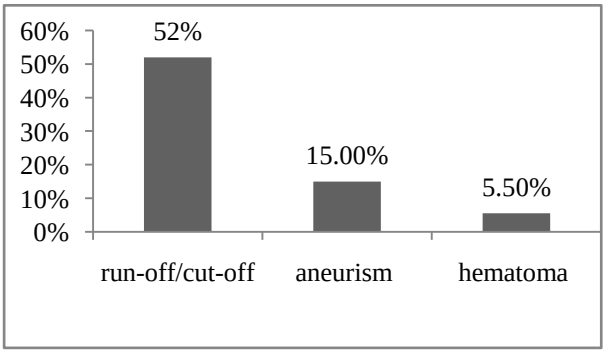


**Figure1: The frequency of abnormal CTA**

Based on the results of angiography, there was vascular injury in63.5% of patients. The most common abnormalpatternofangiographywas run-off (36%), cut-off (16%), hematoma(15%), and aneurysm(5.5%).There was alsonervedamage in 19% of patients. End to endanastomosiswas performedin 32% of patients, thrombectomy in23%, amputationin18%, ligation in 4%,and vascular graft in7%. Supportive treatments alone or inaddition toother therapieswere used for 47% of patients.

There was vascular injury in 67.8% of patientsbased onthe results of Doppler ultrasound.Table1 showed various factors relationship with arterial damage.

**Table1: Various factors relationship with arterial damage**

| | | Arterial injury | | |
|---|---|---|---|---|
| | | Negative | Positive | P value |
| Anatomic site | Lower limb | 39 (89) | 113 (54.3) | <0.001 |
| | Thorax | 32 (43.8) | 0 | |
| | Upper limb | 2 (2.7) | 14 (11) | |
| Age groups | <15 | 7 (9.6) | 18 (14.2) | 0.003 |
| | 15 to 30 | 43 (58.9) | 50 (39.4) | |
| | 31 to 45 | 11 (15.1) | 29 (22.8) | |
| | 45 to 60 | 1 (1.4) | 19 (15) | |
| | >60 | 11 (15.1) | 11 (8.7) | |
| Fracture | Positive | 49 (67.1) | 84 (66.1) | 0.877 |
| | Negative | 24 (32.9) | 43 (33.9) | |
| Mechanism of trauma | Accident | 63 (86.3) | 106 (83.5) | 0.594 |
| | Conflict | 10 (13.7) | 21(16.5) | |
| Nerve injury | Positive | 1 (1.4) | 36 (28.3) | <0.001 |
| | Negative | 72 (98.6) | 91 (71.7) | |
| Mortality | Positive | 6 (8.2) | 16 (12.6) | 0.341 |
| | Negative | 67 (91.8) | 111 (87.4) | |
| supportive treatment | Positive | 53 (72.6) | 40 (31.5) | <0.001 |
| | Negative | 20 (27.4) | 87 (68.5) | |

## Discussion

Peripheral vascular injury includes about 80% of all vascular injuries and the studies performed so far in this area show that the prevalence of vascular trauma is higher in men than women (90%) and the incidence ratio of men to women is 1/5 to 1/7. The middle-aged people are the victims of these events more than other age groups (20-40 yrs) (2, 7, 19, 22, 26, and 27).

In a previousstudyshowed that lower limbs are at more risk for developing vascular injuries followingtraumathan the upper limbs (58 vs.81%) (3). In our study also,the most commonsites werethe lower limbs(76%), thorax(16%)and upper limbs(8%), respectively.

In the present study, accidentwas the cause of 84.5% traumas and damage from conflict occur in15.5% of cases. In general population,vascular injuriesinlimbs are associated with bothblunt andpenetratingtrauma(28). The incidence ofthese complications variesin different areas, depending on the incidence oftrauma. In some studies,penetrating traumaincludes45% of cases, and inotherstudiesincludes70% to90% of vascular injuries(29, 30).

However,it seems thatthe majormechanismin the cases waspenetratingtrauma like gunshot, and themore commonmechanismin the cases with blunt traumais motorcycle accident(31). Inthestudy of Safaee, the mostcases includedknife orsharppenetrating trauma(63%) and blunt trauma accounted in21% of cases. There was bothpenetrating and blunttraumain 16% of cases (32).

In thisstudy, there was fracture in66% of patients and34%of damageswerewithoutfracture. 12.5% of patients (n = 25) died. In thestudyof Nemati,86.7% of vascular injuries occurred along withfracture(33). In the studyof Qadusi, there was bone fracturein9.5% of cases with trauma (33). In general population, association of vascular injuries withbonefracturemayvaryregard totraumamechanisms.

In Haghi study, 42% of patients had simultaneous comorbitiesand the most commonaffectedsystemwascentral nervous system (CNS)(34). In our study, the frequency ofarterial injury confirmed inCTAwas not significantly different inpatients with comorbities.

In our study,end to endanastomosiswas performedin32% ofpatients, other interventions were thrombectomy (23%), amputation(18%), arterial ligation (4%), andvascular graft(7%). Supportive treatments alone or in addition to other therapies were used in 47% of patients.

In Mahmoudi study, simple vascular repair and end to end anastomosis was performed in partial and incomplete vascular injuries. Ligation was the choice option in injuries involved organswith two supplying arteries such as the radial and ulnar arteries. In this study, no cases of artificial graft were used. Vein grafts were performed in blunt and gunshot trauma (35).

In a study, typesofvascular injuries were reported as38.5% pseudoaneurysmand24.5%arterialobstruction with or withoutarteriovenous fistula (AVF)(35) .Perryandcolleagues had found 16cases of pseudo aneurysm and 4 cases of AVF in31 patientsdiagnosedwithvascularinjuries after trauma(36). In the studyof Yilmaz, 52.5% pseudo aneurysm and12.5% arterial occlusion and35% AVFhave been reported (32). In a study inEgypt, 52.6%pseudo aneurysm, 26.3%artery stenosis, and10.5% total occlusionandAVFhad been occurred (33). In our study,aneurysmswere observedin 5.5%of traumatic patientsthatcouldresult fromdifferences in theinjuredvesselandtraumamechanism.

InZafarghandi study, there was simultaneous lesionarterial trauma in 56% ofcases. 33% of patientshadprimarynerve damage(37). In our studyalso, 19% of patients hadnerveinjuries other than vascular injury. It seems that the prevalence of neurologic comorbidities can varybecause of themechanismand site of trauma.

In our study, there were vascular injuries were reported in 63.5% of patients inCTA.The results of Doppler ultrasound showed vascular involvement in 67.8% of patients. All vascular injuries in CTA were confirmed after vascular interventions and none of patients with negative CTA had experienced serious sign and symptoms of vascular injury in follow up period (at least 6 months).

In our study, 12.5% of patients (n = 25) died. In the study of Mahmoudi, the morbidity rate was 4.5% and mortality 8.6%, the cause of mortality might be the extension of vascular lesion which caused massive bleeding and other comorbities(38). In a study, type of blunt trauma, comorbities, delayed capillary filling, the distal pulse status before and after surgery, surgery duration and duration of hospital stay, were influenced morbidity and morbidity. The early diagnosis of

vascular injury, early rehabilitation and patient's transfer to the vascular center and providing appropriate care for complicated cases can effectivelyreduce morbidity (39).

In a study, vascular injury due to prolonged ischemia, despite appropriate treatment led to amputation in 30% of cases (40). In another study, amputation was performed in 8.3% of traumatic patients (38). In our study, amputation was limbwas performed in 18% of patients with vascular injury. The co-existence of neurologicdeficitmight be another probable cause for amputation. Moreover, this study was conducted in a referral center,so, the rate of complicated cases was higher. Also, some studies have shown that the incidence of nerve injurycan predict becoming handicap and the need for amputation in patients with vascular injuries (38). Streptococci infections are another common cause for limb amputation in traumatic patients (39).

Overall, CTA has numerous advantages in the diagnosis of vascular trauma. Regardless of non-invasive method, it has the ability to completely image the arterial tree in shorted time duration (which might be important in traumatic patients) and also diagnosis of associated deformities caused by trauma to the surrounding muscles and bone (20-23). In addition, other benefits compared to CA can be pointed to no need for arterial cannulation, thus avoid all the complications of arterial puncture, and there is no need to the presence of the surgery team and interventional radiologist who are required for CA. The sensitivity and specificity of CTA in the diagnosis of suspected vascular injuries is reported ranging from 95 to 100% for sensitivity and 90 to 100% for specificity (7, 28, 31, and 33).

## Conclusion

In ourstudy, there wasvascular injury in63.5% of patients based on the results of CTA. All vascular injuries were diagnosed by CTA were confirmed after vascular intervention and no serious vascular injury was reported in patients with negative CTA result at the follow-up period. So, CTA is a noninvasive and accurate diagnostic test.

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