Value of Urgent Neck CTA in Traumatic Patients.

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Purpose

Cerebrovascular injury (CVI) is a relatively uncommon event that can be encountered as an emergency setting with reported incidence of 1.6% of all trauma patients. [1,4]

It has devastating complications with morbidity rate 60-80% and mortality up to 40%. The majority of CVI are diagnosed after the development of symptoms secondary to brain ischemia. Screening of asymptomatic patients increased the incidence of CVI from 0.1% in hospitalized trauma patient to 1% and to 2.7% if the trauma score was more than 16 [1].

Thus, proper diagnostic evaluation and management protocol is required to decrease the morbidity and mortality rate, in addition to avoid non-indicated interventions[1,6].

In the era of the advance and availability of various clinical imaging modalities, many proposed guidelines were published. Yet, there is still no international agreed protocol.

CTA is available, non-invasive and time saving method to assess vascular injury.[2]

In our center at Hamad General Hospital- Qatar, we did a study to evaluate the added value of routine neck CTA in all patients referred with history of blunt/ penetrating trauma or multiple traumatic events.
**Methods and Materials**

A combined pro- and retrospective non-randomized cohort study including all patients who underwent neck CTA on emergency basis with a history of severe blunt / multiple trauma or penetrating neck injury during the year 2015 at our institution.

Using our RIS\PACS system, data collection was done to extract patients' demographics, mechanism of injury and their imaging findings, in particular neck CTA, CT scan of brain and cervical spine and if any additional investigations done like MRA or conventional angiogram.

Standardized image acquisition protocol was performed for all patients. Neck CTA was done using bolus tracking technique on 64- and 128- slices Siemens scanners with post processing MIP/ VRT reconstruction. Images were then interpreted by senior neuro- and emergency radiologist. Data collection and review was done by senior radiology residents.

Most of the patient had prior non-enhanced brain and cervical spine CT scan prior to proceed with CTA to assess for hemorrhage or fractures.
Results

Results:

Our study has a sample size of 83 patients; with majority of patients are male patients (94%) and average age of 34 years.

Most of our sample population had suffered from multi-traumatic events as sequel of Road Traffic Accident (RTA) (67%) or from falling from height (28%). Other less common mechanisms of injury encountered in our study were assault (3%) and penetrating neck injury (2%) (Figure 1).

CTA was normal in 91% of patients with no evidence of trauma related head and neck vascular injury. On the other hand, only seven cases (8%) had an abnormal study with the abnormality affecting the in vertebral arteries 5 cases and the internal carotid arteries in 2 cases. Only one patient had an incidental not-trauma related cerebral artiero-venous malformation (Figure 2).

An associated cervical spine fracture and intra- parenchymal hemorrhage was noted in six out of the seven cases of abnormal CTA. On other hand, isolated vertebral artery injury was seen in only one patient with history of blunt trauma.

In about 62% of normal CTA studies, patients suffered from cervical spine fracture and/or head injury (i.e. Craniofacial fractures, parenchymal hemorrhage).

Discussion:

It is well established that symptomatic patients presenting following trauma with expanding hematoma, bleeding or focal neurological deficit after history of trauma must be evaluated by CTA or conventional angioiogram. However, our study targets asymptomatic patients or patients with other life-threatening conditions who are at risk for missed CVI.

Based on literature review, asymptomatic patients has a CVI incidence between (1-3%) versus (38-100%) in clearly symptomatic patients [1,2,5]. However, no established agreed protocol to suggest which patients should be evaluated using CTA.

Denver modified screening criteria were developed based on the factors associated with increased risk of CVI like (1) Glasgow Coma Scale score <6 (2) petrous fracture (3) diffuse axonal injury (4) Le Fort II or III fracture and (5) presence of cervical spine fracture.
Patients who had any of the these risk factors had a risk of 41% for CVI and this risk increased up to 93% in the presence of all 5 factors [1]. Adherence to these criteria showed increase rate of detection of CVI in the selected patients [2,4,5].

The main drawbacks of performing neck CTA as routine examination to traumatic patients were 1) extra-cost; 2) radiation dose and 3) risk of contrast induced nephropathy specially in patients with volume loss or pre-existing renal disease [2].
Fig. 1: Mechanism of Injury

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Fig. 2: Analysis of neck CTA results

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Fig. 3: Multi-traumatic patient with right vertebral artery intimal flap in axial CTA with distal non-visualization of the the right vertebral artery complicated by right cerebellar infarction on axial DWI’s MRI.

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**Fig. 4:** Multi-traumatic patient with left CCA intimal flap as seen in axial CTA and coronal MIP and VRT reconstruction. MRA and color Doppler ultrasound confirmed mural hematoma.

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Fig. 5: Left ICA dissection as seen in axial and sagittal CTA with occlusion of the petrous left ICA, complication by left cerebral infarction

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### Denver Modification of Screening Criteria

<table>
<thead>
<tr>
<th>Signs and Symptoms:</th>
<th>Risk Factors:</th>
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<tbody>
<tr>
<td>1- Arterial hemorrhage.</td>
<td><strong>High energy mechanism with:</strong></td>
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<tr>
<td>2- Cervical bruit.</td>
<td>A- Le Fort type II/III fractures.</td>
</tr>
<tr>
<td>3- Expanding hematoma.</td>
<td>B- Cervical spine fractures: Subluxation or</td>
</tr>
<tr>
<td>4- Focal neurological deficit.</td>
<td>extending to transverse foramen.</td>
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<tr>
<td>5- Ischemic stroke on secondary CT scan.</td>
<td>C. Basilar skull fracture.</td>
</tr>
<tr>
<td>6- Neurological examination incongruous with CT scan</td>
<td>D. Diffuse axonal injury with GCS ≤ 6.</td>
</tr>
<tr>
<td>findings.</td>
<td>E. Near hanging with anoxic brain injury.</td>
</tr>
</tbody>
</table>

**Fig. 6:** Denver Modification screening criteria for neck CT angiogram

Conclusion

The utility of neck CTA in diagnosing CVI is essential if used optimally. Although, routine screening of asymptomatic patients using neck CTA slightly increase CVI detection rate, its application is limited by its cost, radiation dose & contrast side effects. Thus, careful clinical evaluation of CTA candidates based on the internationally accepted criteria (i.e. Denver modification criteria) might more beneficial.
References


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