Received: 2016.03.09
Accepted: 2016.03.21
Published: 2016.10.10

Authors' Contribution:

- A** Study Design
- B** Data Collection
- C** Statistical Analysis
- D** Data Interpretation
- E** Manuscript Preparation
- F** Literature Search
- G** Funds Collection

Heuber Maneuver in Evaluation of Direct Carotid-Cavernous Fistula

Rengarajan Rajagopal^{BD}, Neeraj Mehta^D, Sonal Saran^D, Pushpinder S. Khera^{DEF}

Department of Radiology, All India Institute of Medical Sciences, Jodhpur, India

Author's address: Rengarajan Rajagopal, Department of Radiology, All India Institute of Medical Sciences, Basni industrial area phase II, Jodhpur, India 342005 (Raj.), e-mail: heraghava@gmail.com

MeSH Keywords:

Carotid-Cavernous Sinus Fistula • Cerebral Angiography • Endovascular Procedures • Glaucoma

PDF file:

<http://www.polradiol.com/abstract/index/idArt/898414>

Summary

Carotid-cavernous fistulas are abnormal communications between the carotid system and the cavernous sinus. Elevated venous pressure produces congestion in the orbit with resultant transudation of fluid and increased intraocular pressure, thereby leading to secondary glaucoma which may result in visual loss. Immediate treatment is hence, warranted in these cases. The planning of endovascular management is dependent on many parameters, the most important of which are the size and location of the fistula. Since these are high-flow fistulas, assessment requires certain manoeuvres. Heuber manoeuvre is one of the manoeuvres used to demonstrate the size of the fistula.

Dear Editor,

Carotid-cavernous fistulas (CCFs) are abnormal communications between the carotid arterial system and the cavernous sinus. CCFs have been categorised into several types according to the etiology, hemodynamic features and the angiographic arterial architecture. The anatomical-angiographic classification proposed by Barrow et al. classifies CCFs into four types, with type A shunt having direct communication between the intracavernous internal carotid artery and the cavernous sinus and the other three types are associated with indirect fistulas [1]. Type A CCFs are usually associated with high flow rates. Type B fistulas, which are uncommon, have communications between dural ICA branches to the cavernous sinus. Type C fistulas have their supply only from the dural branches of ECA. Type D fistulas, with communications between dural ICA and ECA branches, and the cavernous sinus, are the most prevalent type. Tomsick subclassified type D CCFs into type D1 or D2 depending on the presence of unilateral or bilateral arterial supply [2].

CCFs can be spontaneous or post-traumatic, with the post-traumatic CCFs being the most commonly type A, showing a direct single communication between the ICA and the cavernous sinus. Blunt and penetrating head trauma may lead to direct CCFs, as well as iatrogenic causes like

trans-sphenoidal surgery. The most common site for such fistulas is the proximal segment of horizontal intracavernous segment of ICA in the vicinity of the inferolateral trunk. The other sites are the junction of the horizontal and intracavernous ascending segments, posterior ascending segment, junction of the anterior ascending and horizontal intracavernous segments, and the anterior ascending segment [3]. A spontaneous rupture of an intracavernous ICA aneurysm can also result in type A fistula. Spontaneous fistula can conform to the angiographic characteristics of any of the four types, with multiple small fistulas within the cavernous sinus wall and multiple dural feeders.

Severe intracranial haemorrhage can occur along with ocular symptoms due to the high-flow shunt seen with direct CCFs. This requires making a diagnosis as soon as possible and offering immediate treatment. The gold standard of treatment is endovascular therapy [3].

Planning of endovascular intervention in CCFs is done with cerebral angiography, which is also the gold standard for definitive diagnosis. The most important information that is obtained by the initial angiographic evaluation is the size and location of the fistula. The size and location of the fistula is important to determine the technique of endovascular therapy and the hardware that might be required during the procedure. Angiography also helps in differentiation of

Figure 1. (A, B) Lateral angiograms of a twenty-six-year-old female patient with a direct right CCF, right vertebral injection with ipsilateral CCA compression (Heuber maneuver) to demonstrate the fistulous point (arrow in B).

direct from indirect lesions as well as to identify the presence of any associated cavernous carotid aneurysm. It is also essential in the assessment of the global cortical arterial circulation, collateral flow through the circle of Willis, and presence of complete or partial steal phenomena. In endovascular therapy, it is important to first accurately identify the fistulous point, but this is often difficult because of the high-flow shunt.

Often, the fistulous point in a direct CCF can be difficult to identify because of the high-flow shunt. High-frame-rate imaging (5 frames/s) and rapid rates of injection of contrast (8 mL/s) are used. Many maneuvers have been described for identifying the fistulous point.

Manual compression of the carotid artery while injecting the vertebral artery is one of the maneuvers [3,4]. This was described by Heuber and is commonly used to demonstrate the dimensions of the fistula in our centre.

Injecting the ipsilateral ICA while compressing the ipsilateral CCA is another maneuver used. This maneuver is named after Mehlinger and Hieshima. Filming at a slow frame rate using this maneuver helps in better delineation of the fistula as this slows the rate of opacification of the fistula.

Another maneuver consists of slow injection of a contrast agent from a balloon catheter, which closes off the internal carotid artery [5]. Microcatheter angiography with interruption of the internal carotid artery flow using a HyperGlide balloon can also be performed [6,7]. These

techniques have been found to be useful in patients where the anterior communicating artery or posterior communicating artery is not patent.

Vertebral angiography while also performing manual aspiration from a balloon-guiding catheter, closing off the internal carotid artery, is a new technique that has been described when identification is difficult in patients with very rapid shunting from the collateral circulation [8]. The authors described this method with 3D-DSA which also helped to determine the working angle in their patient. This technique appears very useful for identifying the fistulous point because aspiration makes it possible to reduce early visualization of the cavernous sinus.

The other features which are noted are identification of high-risk features (e.g., cortical venous drainage, pseudoaneurysm, cavernous sinus varix), venous drainage patterns, determination of therapeutic route, associated vascular injuries (e.g., traumatic pseudoaneurysm, arterial dissection), identification of any dangerous collateral pathways and evaluation of carotid bifurcation before compression therapy.

We are also attaching images of a patient with direct right CCF in whom we used the Heuber maneuver to demonstrate the fistulous point (Figure 1A, 1B).

Conflict of interest

None.

References:

1. Barrow DL, Spector RH, Braun IF et al: Classification and treatment of spontaneous carotid-cavernous sinus fistulas. *J Neurosurg*, 1985; 62: 248-56
2. Ernst RJ, Tomsick TA: Classification and angiography of carotid cavernous fistulas. In: Tomsick TA (ed.), *Carotid cavernous sinus fistula*. Cincinnati: Digital Education Publishing, 1997; 13-22

3. Ringer AJ, Salud L, Tomsick TA: Carotid cavernous fistulas: Anatomy, classification, and treatment. *Neurosurg Clin N Am*, 2005; 16: 279–95
4. Gupta AK, Purkayastha S, Krishnamoorthy T et al: Endovascular treatment of direct carotid cavernous fistulae: A pictorial review. *Neuroradiology*, 2006; 48: 831–39
5. Huber P: A technical contribution of the exact angiographic localization of carotid cavernous fistulas. *Neuroradiology*, 1976; 10: 239–41
6. Berenstein A, Kricheff II: Balloon catheters for investigating carotid cavernous fistulas. *Radiology*, 1979; 132: 762–64
7. Gonzalez LE, Chalouhi N, Tjoumakaris S et al: Treatment of carotid-cavernous fistulas using intraarterial balloon assistance: Case series and technical note. *Neurosurg Focus*, 2012; 32: E14
8. Tsuji K, Nakagawa N, Fukawa N et al: A novel technique for identifying the fistulous point in a direct carotid cavernous fistula. *J Clin Neurosci*, 2016; 25: 152–55