Balloon occlusion test of internal carotid artery - role in preoperative assessment of head & neck tumors

Poster No.: C-1861
Congress: ECR 2012
Type: Educational Exhibit
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Keywords: Obstruction / Occlusion, Haemodynamics / Flow dynamics, Balloon occlusion, SPECT-CT, Catheter arteriography, Interventional vascular, Head and neck

DOI: 10.1594/ecr2012/C-1861

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Learning objectives

To describe principles of balloon test occlusion in pre operative assessment of head and neck tumors. To describe the techniques used to perform the test. To list the implications on surgical procedures performed.

In this poster we will review the importance of assessment of the vascular reserve of internal carotid artery territory before arterial sacrifice which will be helpful in predicting the outcome after the sacrifice and in deciding the further course of management of the patient.
Background

Carotid artery ligation is used for a variety of indications with a variable incidence of stroke. Commonly encountered head & neck tumors which may require internal carotid artery sacrifice while excision are squamous cell carcinomas, nasopharyngeal angiofibromas, carotid body tumors/paraganglioma, skull base tumors.

There is risk of intraoperative bleeding during treatment of head and neck tumors adjacent to internal carotid artery. The knowledge of flow and perfusion dynamics of intracranial vasculature in particular patient allows the surgeons to predict the neurological outcome after intraoperative internal carotid artery ligation.

Various methods have been historically used to solve the purpose with variable success rates. The first described was intraoperative carotid occlusion with removable band under local anaesthesia. Others are percutaneous manual pressure occlusion of carotid artery & endovascular balloon occlusion of carotid artery with neurological monitoring with or without hypotensive challenge. These tests were considered negative if patient did not become symptomatic during the occlusion for short duration of time. However, late onset neurological deficits have been consistently reported in these patients due to subtle inadequacies of the collateral circulation which do not manifest symptomatically within this short duration.

The advent of various methods of cerebral blood flow measurement led to the use of combined balloon test occlusion with these studies to evaluate these subtle inadequacies in collateral circulation. One such method widely used now a day is balloon test occlusion with measurement of cerebral blood flow with SPECT imaging using HMPAO or Tc ECD.

The results of these tests may help surgeons to

1. Evaluate risks associated with carotid sacrifice.
2. Determine further course of management.
3. Decide how aggressively the lesion is to be treated.
4. Determine if revascularization procedure is to be done.
Imaging findings OR Procedure details

Preprocedure evaluation and medication

Baseline Tc ECD brain perfusion map using SPECT is obtained before procedure which can be compared with one after the procedure. It also helps to detect any preexisting perfusion defect. (Fig 1).

General neurological examination is important as is the history of previous neurovascular disease. History of transient ischemic attacks is a relative contraindication for the procedure.

Routine blood tests including complete blood counts, coagulation profile, renal function tests should be performed and any abnormality should be corrected first.

Adequate heparinization is necessary to reduce thromboembolic complications. Mild anxiolytics are useful in apprehensive patients. General anaesthesia is not used as patient needs to be monitored throughout the procedure for onset of neurological symptoms.

Procedure

The endovascular balloon catheter is introduced into femoral artery through a 6F introducer sheath. Non detachable double lumen balloon catheters are used which may be flow directed into the appropriate ICA or positioned over an exchange wire. The end hole of the catheter is continuously infused with saline drip.

The balloon is inflated with contrast media under fluoroscopic control. The occlusive position is determined by the slight elongation of balloon along the course of the artery (Fig 2). The patient is continuously monitored for any symptoms. If there is any change in neurological status, the balloon is immediately deflated.

The contralateral ICA and bilateral vertebral angiograms are done first to evaluate the patency of circle of Willis. The anterior and posterior communicating arteries are assessed in particular. Temporal symmetry of opacification of cerebral cortical veins is also checked.(Fig 3 & 4)
Tc ECD is then injected through a peripheral vein while balloon is kept inflated. The balloon is kept inflated at least for 10 minutes after the injection. The balloon catheter is removed after 10 minutes. The patient is stabilized. The introducer sheath is kept in situ as it may be required for further intervention if complications like thromboembolism or dissection of the artery occur.

The patient is shifted to the SPECT department. SPECT scan is done within 2 hrs after injection of the tracer. Multiple axial slices are obtained at various levels. Various regions on the side of the occlusion are compared with corresponding regions on contralateral side.

**Results & Implications on management**

Any asymmetry in cerebral blood flow on SPECT images which was not seen on baseline scan is considered positive balloon test occlusion, which may necessitate to perform revascularization procedure like extracerebral to intracerebral graft or revise the decision to treat the tumor aggressively. (Fig 5)

In patients with symmetrical brain perfusion maps, the chances of occurrence of neurological deficit are low. However symmetrical brain perfusion map does not completely rule out this possibility which may particularly occur due to thromboembolism from the distal arterial stump of ligated artery or due to global ischemia.

**Complications**

The complication rate for this procedure is low if necessary precautions like adequate heparinization and meticulous technique are used. The main complications are carotid artery dissection which may be asymptomatic or symptomatic and thromboembolism which may require intraarterial thrombolysis. Carotid angiogram should be performed once the balloon is deflated and removed to detect these complications.
Images for this section:

**Fig. 1:** Symmetrical brain perfusion

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**Fig. 2:** Inflated balloon in occlusive position

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Fig. 3: Right ICA angiogram after occlusion of left ICA

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Fig. 4: Right vertebral angiogram showing good cross circulation

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**Fig. 5:** Post BTO Tc ECD SPECT scan showing hypoperfusion on right side.

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Conclusion

Balloon occlusion test is useful to predict the neurological outcome in patients in whom internal carotid artery ligation is contemplated during head and neck surgery.
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References


