Preoperative tumor embolization

Preoperative embolization has the potential to decrease intraoperative blood loss and facilitate spinal cord decompression and tumor resection.

Preoperative tumor embolization is a medical procedure used to block the blood supply to a tumor before surgical removal. This technique aims to reduce bleeding during surgery and minimize the risk of spreading cancer cells. Here are the key aspects of preoperative tumor embolization:

Purpose Reduce Blood Loss: By cutting off the blood supply to the tumor, embolization decreases the amount of bleeding during surgery. Shrink the Tumor: Depriving the tumor of blood can reduce its size, making it easier to remove. Facilitate Surgical Removal: With less blood flow, the tumor's boundaries may become clearer, aiding the surgeon in complete excision. Indications Highly Vascular Tumors: Tumors with a rich blood supply, such as renal cell carcinoma, liver tumors, and certain types of sarcomas. Inoperable Tumors: In some cases, embolization is used to make previously inoperable tumors operable. Palliative Care: For symptomatic relief in patients who cannot undergo surgery. Procedure Patient Preparation:

Preoperative assessments including imaging studies (CT, MRI, or angiography) to map the blood supply to the tumor. Routine blood tests and evaluations to ensure the patient is fit for the procedure. Anesthesia:

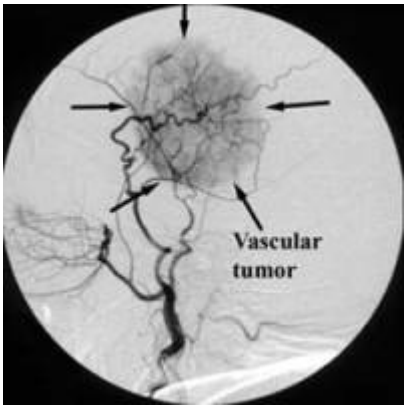
Local or general anesthesia may be administered depending on the location of the tumor and the complexity of the procedure. Catheter Insertion:

A catheter is inserted into a large blood vessel, often the femoral artery, and guided to the blood vessels supplying the tumor using fluoroscopic guidance. Embolic Agents:

Various materials can be used as embolic agents, including: Particles: Small particles like polyvinyl alcohol (PVA) or tris-acryl gelatin microspheres. Liquids: Sclerosing agents or liquid embolics like ethanol or glue. Coils: Metal coils that induce clotting and occlude the vessel. Embolization:

The embolic agent is injected through the catheter into the blood vessels feeding the tumor, effectively blocking the blood supply. Post-Procedure Care:

Patients are monitored for any immediate complications such as pain, infection, or bleeding. Follow-up imaging may be done to assess the success of the embolization. Benefits Minimizes Surgical Risks: Less intraoperative bleeding reduces the need for blood transfusions and shortens recovery time. Improves Surgical Outcomes: Clearer surgical field and potential reduction in tumor size can enhance the chances of complete tumor removal. Less Invasive: Compared to some other preoperative interventions, embolization is minimally invasive. Risks and Complications Infection: There is a risk of infection at the catheter insertion site. Non-Target Embolization: Accidental blockage of non-target vessels can lead to complications like tissue necrosis. Allergic Reactions: Some patients may react to the contrast dye used in imaging. Pain and Discomfort: Post-procedural pain, typically managed with medication. Conclusion Preoperative tumor embolization is a valuable technique in the management of certain tumors. It facilitates safer and more effective surgical removal by reducing blood loss, shrinking the tumor, and improving surgical visibility. However, it requires careful planning and execution by a skilled interventional radiology team to maximize benefits and minimize risks.



Indications

Tumor embolization is a procedure that can be performed prior to a planned surgical resection. Embolization shuts down the blood supply to a tumor reducing blood loss during surgical resection. A secondary benefit from embolization can be that tumor margins are more easily identified and a tumor can be removed more completely and with less effort. Tumors of the spine, head, and neck that can be embolized have relatively large blood vessels supplying the tumor.

- meningiomas:see Preoperative embolization of intracranial meningioma.
- hemangiopericytomas
- juvenile nasopharyngeal angiofibromas
- paraganglioma's (carotid body tumor, glomus vagale, glomus jugulare),
- aneurysmal bone cyst
- hemangioblastomas
- vascular metastases from renal cell, thyroid, and chorio cancers.

Technique

A sheath is placed in the femoral artery and a guide catheter is positioned as close as possible to the vessels of interest e.g., in case of a meningioma the guide catheter tip is positioned in the proximal ECA. Angiography and roadmapping are performed through the guide catheter. Using fluoroscopy and road mapping, a microcatheter is advanced over wire into the branches supplying the tumor. Angiography is performed through the microcatheter to ascertain the branch supplies the tumor and no concerning collaterals with intracranial circulation exist. A blank road map is obtained and embolization commenced. PVA particles or Onyx may be used for embolization. In case of Onyx, a DMSO compatible catheter must be used. PVA may be cheaper and quicker to use for tumor embolization. However, the devascularization is not durable and the occluded ves- sels may recanalize; therefore, with PVA the surgery should be performed within a few days of the

embolization.

If a tumor has a prominent blood supply then flow can be shut down to the tumor using 3 types of agents. All agents essentially perform the same task, i.e. reducing blood flow; however, they have slightly different properties and are used for different benefits.

NBCA or Onyx™ are polymer agents that consolidate over time and have similar properties to conventional superglues that are pushed through a catheter flowing forward from the catheter tip into vessels just short of the tumor itself. When forward flow stops they form a dense plug stopping blood supply to the tumor.

Microspheres or microbeads are tiny polyvinyl alcohol spheres or particles suspended in a sterile solution that are pushed through a catheter flowing forward from the catheter tip into vessels just short of the tumor itself. As they flow forward the vessel narrows and the particles lodge within the vessel forming a dam. As more particles lodge again a dense plug forms and blood flow stops.

Microcoils are tiny coils, similar to a “miniature slinky,” made from platinum or platinum like alloys that are pushed through a catheter with a special pusher rod. The coil deploys at the tip of the catheter and initially forms a mesh within the vessel being treated. More coils can then be deployed into the mesh. As coils are deployed the mesh structure reduces blood flow and when enough mesh is present, blood flow stops.

Timing

Embolization before surgical resection of tumors has been demonstrated to reduce intraoperative blood loss, but the optimal time that should elapse between embolization and tumor resection has not been established. We evaluated whether immediate surgical resection (< or =24 h) after embolization or delayed surgical resection (>24 h) was more effective in minimizing intraoperative blood loss.

Complications

Embolization for feeders other than ECA and use of liquid materials could increase the complication rate in intracranial tumor embolization [1)].

Preoperative embolization of intracranial meningioma

see Preoperative embolization of intracranial meningioma.

Preoperative embolization of intracranial hemangioblastoma

Preoperative embolization of intracranial hemangioblastoma

Case series

A retrospective case review was conducted on patients undergoing preoperative transarterial embolization of a spinal tumor between 1995 and 2012.

Twenty-eight patients met the inclusion criteria, with a mean age of 60.6 years. Twenty-eight patients had metastatic tumors. In 14 (50%) patients the metastases were from renal cell carcinomas. Fifty-four vessels were embolized using PVA, NBCA, Onyx, coils, or embospheres. Sixteen patients were treated with Onyx, 6 patients with PVA, 3 patients with embospheres, 2 patients with NBCA, and 3 patients with a combination of embolic agents. The average decrease in tumor blush was 97.8% with Onyx versus 92.7% with the rest of the embolic agents (p=0.08). The estimated blood loss was 1616ml (range 350-5000ml). Blood loss was 750cm(3) on average with Onyx versus 1844 with the rest of the embolic agents (p=0.14). The mean length of stay was 16 days. The mortality rate was zero. Pre- and post-operative modified Rankin Score (mRS) did not differ significantly in the series (3.12 versus 3.10, respectively, p=0.9) [2].

Case reports

A unique case of metastatic pheochromocytoma of the cervical spine treated with preoperative embolization and subsequent en bloc resection. A 65-year-old man with metastatic pheochromocytoma presented with two weeks of worsening neck pain, left arm and leg weakness and paresthesia, and urinary incontinence. Magnetic resonance imaging showed a metastatic osseous lesion at C6 with severe stenosis and spinal cord compression. The patient underwent successful preoperative angiographic embolization with a liquid embolic agent followed by C5-C7 laminectomy, en bloc tumor resection, and C3-T2 posterior spinal fusion. Six weeks postoperatively, the patient reported improving strength and resolving neck pain and paresthesias. While there is no standard paradigm for the treatment of metastatic pheochromocytomas of the cervical spine, preoperative embolization may minimize intraoperative blood loss and hemodynamic instability during subsequent surgical resection [3].

1)
Hishikawa T, Sugiu K, Murai S, Takahashi Y, Kidani N, Nishihiro S, Hiramatsu M, Date I, Satow T, Iihara K, Sakai N; JR-NET2 and JR-NET3 study groups. A comparison of the prevalence and risk factors of complications in intracranial tumor embolization between the Japanese Registry of NeuroEndovascular Therapy 2 (JR-NET2) and JR-NET3. Acta Neurochir (Wien). 2019 Jun 7. doi: 10.1007/s00701-019-03970-w. [Epub ahead of print] PubMed PMID: 31172282.
2)
Ghobrial GM, Chalouhi N, Harrop J, Dalyai RT, Tjoumakaris S, Gonzalez LF, Hasan D, Rosenwasser RH, Jabbour P. Preoperative spinal tumor embolization: an institutional experience with Onyx. Clin Neurol Neurosurg. 2013 Dec;115(12):2457-63. doi: 10.1016/j.clineuro.2013.09.033. Epub 2013 Oct 12. PubMed PMID: 24169150.
3)
Singh A, Santangelo G, Ellens N, Kohli G, Pranaat R, Bender MT. Preoperative embolization and en bloc resection of a metastatic pheochromocytoma of the cervical spine. J Cerebrovasc Endovasc Neurosurg. 2024 Jun 20. doi: 10.7461/jcen.2024.E2023.04.005. Epub ahead of print. PMID: 38897596.