Endovascular treatment of acute hemorrhage in genitourinary system

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Learning objectives

- To indicate the significance of transcatheter embolization in genitourinary system, especially in cases of acute hemorrhage.
- To describe indications and contraindications.
- To show the technique and materials used in transcatheter embolization.

Background

The beginning of interventional radiology can be traced to the introduction of selective arteriography for the diagnosis and treatment of gastrointestinal bleeding. Since its introduction in 1963, there was a huge progression in development of new materials and significant improvements of technique which resulted in expansion of indications to genitourinary and other systems bleedings.

Indications

Regarding genitourinary system, transcatheter embolization has shown great success in managing bleeding complications of both benign and malignant gynecologic processes including advanced-stage cancers, as well as bladder hemorrhage following radiation therapy, severe postpartum hemorrhage and uterine arteriovenous malformation [1,2,3,4,5,6,7]. Besides its frequent usage in hemorrhage control, this procedure is also useful in elective treatment of uterine fibroids [8,9], pelvic congestion syndrome [17,18] and varicocele [10].

Contraindications

There are no contraindications to transcatheter embolization for treatment of intracable hemorrhage. Regarding elective embolization on the other hand, contraindications are severe allergic reaction to contrast, advanced stages of chronic kidney insufficiency, refractory coagulopathy, acute and chronic pelvic infections, previous pelvic irradiation, use of gonadotropin-releasing hormone analogues and nonbleeding uterine malignancy [13].
Fig. 4: Female patient age 35. Primary illness: carcinoma of uterine cervix st. Ib treated with radical radiation and chemo therapy. After one year of treatment a progression of the disease occurred and the patient underwent Wertheim Meigs surgical procedure. Soon after she underwent MSCT due to the severe vaginal hemorrhage. MSCT results showed contrast extravasation from anterior division of right iliac artery.

Fig. 5: Picture a. Selective catheterization of right internal iliac artery show exact site of contrast extravasation. Picture b. Three Azure Hydrocoils are placed in anterior division of internal iliac artery. Picture c. Control angiogram shows complete occlusion of artery without contrast extravasation.
Findings and procedure details

Transcatheter embolization is a procedure based on Seldinger technique, consisting of diagnostic digital subtraction angiography followed by selective and supraselective catheterization of a blood vessel to be embolized, and its occlusion.

Before every embolization procedure, CT Angiography of the pelvis may be useful in revealing the site of bleeding and vascular anatomy and therefore experienced interventionalists can adapt embolization procedures to the given clinical situation [11]. Magnetic Resonance Imaging is the most accurate imaging technique for detection and evaluation of leiomyomas, hence it has become the imaging modality of choice before and after fibroid embolizations [12]. Digital Subtraction Angiography is still a gold standard for disclosing anatomy of blood vessels, exact site of bleeding and represents an introduction in embolization procedure.

Basic technique

After sterile preparation of the groin the common femoral artery is accessed with singlewall puncture technique. A 5- or 6-F sidearm sheath is then inserted to obtain coaxial access to facilitate catheter exchange.

The procedure starts with diagnostic aortography which allows imaging of the ovarian artery origin, as well as pelvic arteries.

After the basic arterial anatomy is demonstrated, selective and supraselective arteriography are performed to identify the location of the bleeding site and tumor blush in order to plan the treatment. In most cases, the next step after aortography is the assessment of the internal iliac arteries. The choice of catheters and guidewires depends more on operator preference than on procedural requirements. We usually use 4F or 5F Cobra 1 or Simmons 1 for selective catheterizations of the internal iliac arteries and Progreat coaxial microcatheter system 2,7-2,9 F for supraselective catheterizations of small-lumen branches. When extravasation or another pathologic condition is identified and the catheter is appropriately positioned for treatment, the embolization phase of the procedure begins.

Embolization technique

Embolic materials can be classified into two general categories, according to whether they provide permanent or temporary occlusion. The prototypic temporary embolic agent is absorbable gelatin sponge - a waterinsoluble gelatin that allows vessel recanalization within several weeks after placement. Permanent embolic materials include particulate
agents (polyvinyl alcohol [PVA] foam and microspheres), metallic coils and plugs, and liquid polymers. They act by mechanical occlusion and may also activate thrombin and promote fibroblast growth. There are variety of spherical particulate embolic agents which are currently available: tris-acryl gelatin microspheres (Embosphere; BioSphere Medical, Rockland, Mass), PVA-based microspheres (Contour SE; Boston Scientific, Natick, Mass), PVA-based hydrogel microspheres (BeadBlock; Biocompatibles, Farnham, England), superabsorbing polymer microspheres (Quadrasphere; BioSphere Medical), and hydrogel microspheres covered with a polymer coating (Embozene; Celo-Nova BioSciences, Newnan, Ga).

Absorbable gelatin sponge and particulate agents are not radiopaque but are injected as a slurry with iodinated contrast material. The end-point for embolization with these materials is visualization of marked pruning of the arterial tree or contrast material stasis at fluoroscopy.

Permanent arterial occlusion may be achieved with coils made of stainless steel or platinum wire. This coils can be covered with thrombogenic fibers or hydrogel polymer coating which expands when introduced into the bloodstream and allow better thrombus organization, and neointima formation. Coils are available in a large number of sizes and shapes and are typically used to occlude vessels larger than 2 mm in diameter.

Permanent liquid embolic agents are n-Butyl cyanoacrylate (Trufill n-BCA; Cordis Neurovascular, Miami Lakes, Fla) and Onyx (ev3 Neurovascular, Irvine, Calif). N-Butyl cyanoacrylate is a glue that is mixed with ethiodol to make it radiopaque. The admixture ratio can be adjusted to slow or speed the time to polymerization and adjust the distance of its penetration from the injection point into the circulation. Onyx is nonadhesive embolic agent, which is supplied in ready-to-use vials with a mixture of EVOH, dimethyl sulfoxide solvent (DMSO), and tantalum. Onyx is mechanically occlusive but nonadherent to the vessel wall. Its nonadherent properties allow a slow single injection of the embolic agent over a long period of time. If unfavorable filling of the normal vascular structures occurs, the injection can be stopped and resumed after 30 seconds to 2 minutes. The injection can then be restarted with Onyx taking the path of least resistance and filling another portion of the blood vesel. These agents have been used for treating AVMs or when a catheter cannot be passed to a sufficiently distal location for adequate embolization with another agent. Unlike particulate embolic agents, metallic devices and liquid embolic agents are visible on postprocedural images.

The choice of embolic material is determined by multiple factors, including the causes of symptoms, the extent of bleeding, and the number of vessels involved. Permanent occlusion is generally required for progressive disease (eg, tumors), whereas a temporary embolic agent is appropriate for self-limited processes that may heal with time (eg, traumatic lesions). Coils are most useful for occlusion of focal arterial abnormalities or injuries as well as embolization of large vessels. Coils may be used in conjunction with either a temporary or a permanent particulate agent.
Complications

Complications may be related to the angiographic procedure (e.g., groin puncture site hematoma, catheter-induced vessel dissection, and contrast medium-associated allergy or nephrotoxic effect) or complications that are secondary to embolization [14]. Necrosis or organ rupture, sepsis, abscess, and ischemia of adjacent tissue also have been reported but are rare [15]. The risks of such occurrences are minimized by knowledge of the vascular anatomy and meticulous attention to embolization technique. Postembolization syndrome, characterized by pain, fever, nausea, and leukocytosis immediately after the procedure and lasting as long as several days, is reported to have occurred in 50% of patients [16]. It is treated with analgesic and anti-inflammatory medications.

Images for this section:

**Fig. 1:** Female patient age 53 with cervical carcinoma st. IIIb underwent radical radiation therapy. After a few months, severe vaginal hemorrhage occurred and she was sent to
Intervention Radiology Department. Picture a. Selective catheterization of left IIA and angiography showed contrast extravasation from left uterine artery. Picture b. Uterine artery was occluded with two Azure Hydrocoils. Picture c. Control angiogram shows the absence of contrast extravasation. Picture d. Diagnostic angiography of right internal iliac artery shows the absence of contrast extravasation.
Fig. 2: Female patient age 43 with chronic renal insufficiency, hepatitis C and hemorrhagic pancreatitis and uterine mioma. Miaoma was diagnosed on previous cystoscopy. When admitted to hospital for hemorrhagic pancreatitis treatment, the patient experienced a severe vaginal bleeding. Pictures a. and b. Digital subtractional angiography.
from abdominal aorta shows large hypervascular tumor supplied by uterine arteries from both sides. Pictures c. and d. Selective catheterization of uterine arteries and application of Bead Block 500-700 microns. Pictures e. and f. Control angiograms of abdominal aorta show complete exclusion of blood vessels.
**Fig. 3:** Female patient age 65 in advanced stage of bladder transitional cell carcinoma was treated with radiation therapy. After few months of treatment she experienced severe hematuria followed by hypotension, tachycardia and secondary anemia. Pictures a. and b. Digital subtraction angiography from abdominal aorta shows small tumor blush in bladder. Pictures c. and d. Supraselective catheterization of inferior vesical arteries shows tumor blush enhanced more on the left side of the bladder. Tumor is embolized with Beat Block 300-500 microns. Pictures e. and f. Control angiograms show reduction of pathological vessels.
Conclusion

Transcatheter arterial embolization is a lifesaving procedure with minimum risk and unwanted effects in severe hemorrhage from genitourinary system, and it also affects the quality of life, following successful varicocele embolization, pelvic congestion syndrome embolization and embolization of fibroids. Therefore, it is clear that transcatheter embolization plays a major role in treatment of various conditions and diseases of genitourinary system.

Personal information

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