Introduction

Transcatheter coil or medical glue embolization is one of the most effective treatment options for various bleeding complications that may occur during various transcatheter procedures such as coronary artery catheterization and bleeding that occurs during percutaneous nephrolithotomy (PCNL) treatment. Various other materials that could be used in embolization include coils, ethanol, sodium tetradecyl sulfate, cyanoacrylate, polyvinyl alcohol (PVA), microspheres, and gelatin sponge (Gelfoam), among others. Embolic agents are either temporary or permanent. Permanent agents are more common, and there are many applicable subsets including liquid agents, particulates, coils, and detachable plugs and balloons (see Figure 1).

Catheter embolization can be applied to almost any part of the body to control or prevent abnormal bleeding due to several causes. Some of the common problems that are treated using catheter embolization include:

i. Bleeding due to traumatic injury. Most of the abdomen and pelvis injuries that cause bleeding due to rupture of arteries can be controlled by embolization. These injuries are generally due to motor vehicle accidents.

ii. Gastrointestinal tract diseases such as ulcer or diverticular disease that results in bleeding can be treated by embolization and is the first line of treatment for gastrointestinal bleeding of any cause.

iii. Bleeding as a result of vascular malformations such as arterio-venous malformations in the lungs, brain is treated by catheter embolization.

iv. Embolization is used to treat tumor bleeding.

- Menorrhagia or heavy or prolonged menstrual bleeding due to uterine fibroids can be treated by embolization as an alternative to hysterectomy.

- Tumor embolization to decrease or cut off blood supply to tumors is another good indication of catheter embolization. This is resorted to when the tumor is difficult to reach or too vascular or impossible to remove. Embolization procedure may also be used to administer chemotherapy. Tumor reduction that occurs following chemoembolization may facilitate a tumor to shrink that enables its removal surgically.

- Elimination of an arteriovenous malformation or arteriovenous fistula (AVF) or aneurysms especially in the brain or spinal cord is another excellent indication for embolization.

- Treatment of variceoles in the scrotum by embolization is also not uncommon.

- Decreasing the size of congenital venous malformations to decrease pain, swelling and clot formation can also be achieved by embolization.

Subcutaneous fat occludes hemorrhagic blood vessels

In view of the versatility of embolization procedure, Arı et al utilized subcutaneous fat tissue taken with subcutaneous fascia from the femoral site to stop bleeding complication arising from percutaneous nephrolithotomy. Using this subcutaneous fat tissue embolization method, the authors could successfully stop bleeding in two patients and demonstrated that this is a safe and reliable treatment option for percutaneous nephrolithotomy (2). The advantages of the technique used by the authors is that the embolization could be achieved quickly without the guidewire ever being moved and the technique seems to be quickly employed to rapidly embolize the bleeding.
point. The risk of infection and allergic reaction is likely to be low due to the use of autologous subcutaneous tissue.
Furthermore, this technique is inexpensive due to the fact that it does not require any extra material in terms of the
materials needed to implement the technique.

**Vaso-occlusive action of lipids**

In this context, it is noteworthy that we a similar technique to block all and only tumor feeding vessels that results in
regression of hepatoma, giant cell tumor of the bone and renal cell carcinoma (3, 4). In this technique, we used
lithium salt of gamma-linolenic acid (GLA, 18:3 n-6), a small molecular weight lipid that has been conjugated to
iodized salt solution that is radio-opaque. This new molecule termed as LGIOC (Lithium-gamma-linolenic acid
conjugated to oily lymphographic agent) when injected close to the tumor feeding vessel completely blocked all the
tumor feeding vessels without any effect on normal blood vessels (see Figures 2-4). In this instance, the gamma-
linolenic acid used is also a lipid (fat) but is different from the subcutaneous fat used by Ari et al. It is possible that
the subcutaneous fat used by Ari et al contains some amount of gamma-linolenic acid, but this need to be
confirmed by further analysis. In general, subcutaneous fat is a mixture of several lipids such as cholesterol,
triglycerides, saturated and unsaturated fats and other lipids. How exactly the subcutaneous fat used by Ari et al and
LGIOC employed by us is able to block the blood supply is not clear.

In general, it is known that cytotoxic drugs when infused would cause vasospasticity leading to vasospasm that is of
short duration: 24-48 hours. In our study (3, 4), the occlusion of tumor-feeding vessels after infusion of LGIOC
lasted for more than 7-10 days and in one of our patients the occlusion of the tumor-feeding vessels lasted for more
than 3 months and in another for more than 15 years suggesting that the occlusion of the vessels is almost
permanent. It is possible that GLA-induced free radical generation (5, 6) act on endothelial cells of the tumor-
feeding vessels and induce their occlusion and thus, produce their anti-angiogenic and anti-vascular actions. Of more
than 170 transcripts expressed in the endothelium, 70 were differentially expressed including 46 that were
specifically increased in tumor associated endothelium (7), suggesting that there are significant differences in gene
expression profiles in endothelium derived from normal and tumor vessels. It is possible that LGIOC (and possibly,
the subcutaneous fat tissue used by Ari et al) is able to stimulate some of these genes and/or receptors in the
endothelium of the tumor blood vessels, which may have a role in the occlusion of the tumor vessels observed in our
study.

**Conclusions**

Thus, there is seems to be a significant role for subcutaneous fat and LGIOC and similar lipids in specifically
occluding abnormal vessels (be tumor feeding vessels, arterio-venous malformation or vessels that rupture and bleed
during some procedures; possibly, they are weak at these bleeding spots due to abnormalities in the endothelium and
vessels wall) that could be exploited for therapeutic purposes.

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FIG. 1. Divisions of embolic agents. PVA = Polyvinyl alcohol; GGVOD = Grifka-Gianturco vascular occlusion device.

FIG. 2. Effect of LGIOC on tumor blood supply in giant cell tumor.
A. Angiogram of a patient with giant cell tumor of the right femur just prior to LGIOC injection. Double arrows show the origin of the tumor-feeding vessels.
B. Angiogram performed immediately after the injection of LGIOC. Arrow shows the site of complete occlusion of the tumor-feeding vessel. Normal blood vessels, which were distal and in the of the blood flow and much smaller in diameter compared to the main tumor-feeding vessel, remained patent.
C. Angiogram performed 10 days after the injection of LGIOC. Single arrow shows the site of occlusion of the main tumor-feeding vessel. Double arrows show the accumulation of LGIOC in the tumor.

FIG. 3. Selective occlusion of tumor-feeding vessels.
A. Angiogram of the normal right kidney.
B. Angiogram of the same patient that shows the enlarged and distorted left kidney due to the presence of a renal tumor in the upper pole. The lateral margin of the kidney is not clear and an increase in blood supply to the tumor can be seen.
C. Angiogram of the left kidney performed immediately after injection of LGIOC. Occlusion of the tumor-feeding vessels but not those feeding the normal lower pole of the kidney, which is supplied by the two apparently normal blood vessels can be seen.