

Transcatheter arterial embolization of acute gastrointestinal tumor hemorrhage with Onyx

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Abstract

BACKGROUND: Endovascular embolization has been used to control gastrointestinal tumor bleeding. Lots of embolic agents have been applied in embolization, but liquid embolic materials such as Onyx have been rarely used because of concerns about severe ischemic complications. **AIM:** To evaluate the clinical efficacy and safety of transcatheter arterial embolization (TAE) with Onyx for acute gastrointestinal tumor hemorrhage. **MATERIALS AND METHODS:** Between September 2011 and July 2013, nine patients were diagnosed as acute gastrointestinal tumor hemorrhage by clinical feature and imaging examination. The angiographic findings were extravasation of contrast media in the five patients. The site of hemorrhage included upper gastrointestinal bleeding in seven cases and lower gastrointestinal bleeding in two cases. TAE was performed using Onyx in all the patients, and the blood pressure and heart rate were monitored, the angiographic and clinical success rate, recurrent bleeding rate, procedure related complications and clinical outcomes were evaluated after therapy. The clinical parameters and embolization data were studied retrospectively. **RESULTS:** All the patients (100%) who underwent TAE with Onyx achieved complete hemostasis without rebleeding and the patients were discharged after clinical improvement without a second surgery. No one of the patients expired during the hospital course. All the patients were discharged after clinical improvement without a second surgery. Postembolization bowel ischemia or necrosis was not observed in any of the patients who received TAE with Onyx. **CONCLUSIONS:** TAE with Onyx is a highly effective and safe treatment modality for acute gastrointestinal tumor hemorrhage, even with pre-existing coagulopathy.

Key Words: Acute, arterial embolization, gastrointestinal hemorrhage, Onyx

Introduction

Transcatheter arterial embolization (TAE) has gained widespread acceptance as first-line treatment for acute arterial bleeding due to gastrointestinal tumors, and it is generally preferred over surgery, especially in high-risk patients. A variety of embolic materials has been used for embolization, and the most commonly used agents are gelatin sponge, coils and polyvinyl alcohol (PVA) particles.^[1] These methods, although effective in the majority of cases, fail to achieve adequate hemostasis in some situations as a result of inability to reach the entire bleeding site, the presence of collateral blood flow to the bleeding site, coagulopathy or multiple bleeding points or re-canalization of the embolized vessels. Onyx (ev3, Irvine, CA, USA) is a new liquid polymerizing embolic material for use in cerebral arteriovenous malformations. Because of its low viscosity, it can be injected via a narrow-lumen catheter to embolize small arteries and collateral vessels, which are difficult to embolize with coils, gelatin sponge PVA. Few case reports have described the treatment modalities for gastrointestinal bleeding with Onyx. This is attributed to the reluctance of many practitioners to use such a tissue-adhesive, liquid embolic agent such as Onyx to treat acute gastrointestinal tumor hemorrhaging due to the concern of ischemic injury and the difficulty in handling the material. We performed a retrospective survey of nine patients treated with Onyx and evaluated the clinical efficacy and safety of embolization with Onyx for acute gastrointestinal tumor hemorrhage.

Materials and Methods

Patients and demographics

Between September 2011 and July 2013, nine patients with acute gastrointestinal tumor hemorrhage were selected

for curative embolization with Onyx at our institution. We retrospectively evaluated the medical records of nine patients treated at the Affiliated Hospital of Qingdao University, China. There were six men and three women, with the age ranged from 47 to 71 years. Upper gastrointestinal hemorrhage and lower gastrointestinal hemorrhage were found in seven patients and three patients respectively. All patients were diagnosed as acute gastrointestinal tumor hemorrhage by clinical symptoms and signs combined with the imaging examination. In the nine patients, Onyx embolization was performed first because we considered that the hemostasis would not be possible using coils and/or embolization particles, there was insufficient time to perform coil embolization because of severe shock. Six patients were diagnosed as coagulopathy at the time of embolization. Written informed consent for transcatheter embolization was obtained from each patient or a family member before the treatment.

Angiographic methods

After a common femoral artery puncture, a standard 5-F angiographic catheter was used to access the sites of suspected bleeding, and it was also used as an introducing catheter.^[2] Our routine angiography protocol to identify the bleeding site included a celiac angiography and mesenteric angiography. If no evidence of bleeding was shown, a selective angiography was further performed including the duodenal artery, left gastric artery, rectal arteries, colonic arteries, and other bronchial arteries angiography. The angiographic findings were extravasation of contrast media [Figure 1] in five patients, abnormal vessels in four patients.

Embolization procedure with Onyx

Onyx is a liquid embolic agent consisting of 48-mol/L ethylene and 52-mol/L ethylene vinyl alcohol, dissolved in dimethyl sulfoxide (DMSO) and mixed with micronized tantalum powder (35% weight per volume) for radiopaque visualization and the vials must be placed on a mixer and shaken for at least 20 min to obtain a homogeneous solution consisting of the embolic component and the tantalum powder.^[3] After confirming the active bleeding,

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10.4103/0019-509X.151988

we advanced a 2.4-Fr tip microcatheter (Microferret; Cook, Bloomington, IN, USA) or 2.0-Fr tip microcatheter (Progreat; Terumo, Tokyo, Japan) as close as possible to the site of hemorrhage, sometimes microcatheter (Marathon, ev3) was advanced with the help of an 0.08-inch microguidewire (Mirage, ev3).^[4] An angiographic series through the microcatheter with a 2 ml syringe was performed to evaluate the bleeding artery, adjusting the microcatheter tip in a safe position with allowance for 1–2 cm reflux of Onyx.^[3] We opted to use Onyx when conventional embolization had failed to obtain hemostasis or when we considered that the hemostasis would not be achieved using coils and/or embolization particles. Prior to injection of the Onyx, the microcatheter was flushed with DMSO to prevent premature polymerization of the mixture in contact with catheter wall and the injection of Onyx [Figure 2] using a 1 ml syringe was started under careful subtracted fluoroscopy. In case of reflux around the catheter tip, the injection of Onyx was discontinued to form a cast around the tip of the microcatheter. The end point for the injection was extravasation of Onyx from the bleeding site or filling of the bleeding point with or without the appearance of anastomotic channels [Figure 3].^[2] The embolic arteries ranged from 1 to 4 mm in diameter.

Evaluation criterion

Next, a postembolization angiography was performed to evaluate the effectiveness of the treatment. Angiographic success was defined as when postembolic angiography demonstrated cessation of extravasation with no back bleeding from collateral flow or nonopacification of pseudoaneurysm at the end of the procedure.^[2,5] Clinical success was defined as clinical improvement with complete cessation of bleeding after embolization without the need for emergent surgery or other interventional procedures.^[5] Cessation of bleeding was defined by clearing of the nasogastric aspirate by 24 h after embolization or absence of bleeding on endoscopic examination as well as stabilization of the hemoglobin level within 48 h of the embolization procedure.^[2] Patients who met one of the following criteria were considered to have coagulopathy: A prothrombin ratio >1.5, a partial thromboplastin time >45 s or a platelet count <80,000/ μ L.^[6,7]

Postprocedural management

In the absence of complications, the patients were extubated in the operating room and kept for 48–72 h in the intensive care unit under strict electrocardiogram monitoring after the end of the procedure.

Follow-up

The patients were clinically evaluated before and after the procedure, then daily until discharge by monitoring clinical indexes such as hemoglobin and erythrocyte levels, blood pressure and heart rate, clinical signs and symptoms, and evaluating iatrogenic end-organ damage, rebleeding and sequelae after embolization with Onyx. The nine surviving patients had a mean follow-up of 10 months (ranged from 6 to 15 months). There were no new episodes of hemorrhage during the follow-up.

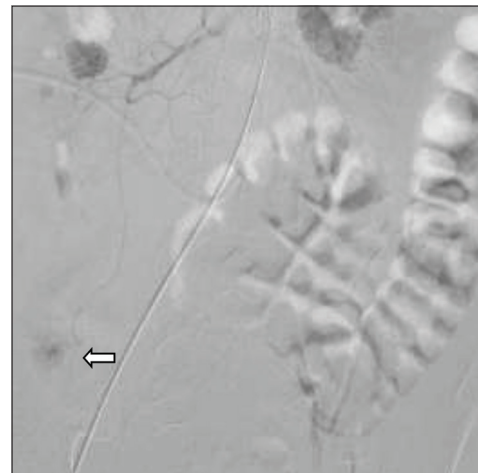


Figure 1: Selective angiography of the superior mesenteric artery showed contrast extravasation in the ileocolic artery branch (white arrows)



Figure 2: Onyx was injected after super selective microcatheterization (white arrow)

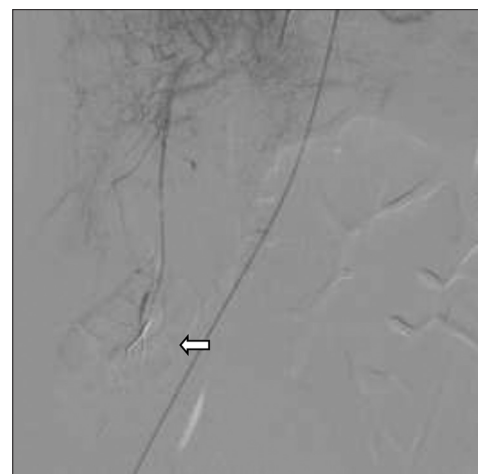


Figure 3: Postembolization angiography showed Onyx cast (white arrow) without further bleeding

Results

In all study patients, it was possible to deliver the Onyx to the bleeding site, the angiographic success rate was 100% and the clinical success was achieved in nine patients (100%). Recurrent bleeding after TAE occurred in none of these patients. The heart rates got down to a healthy level and blood pressure up to normal after embolization with Onyx in nine patients. All the

patients (100%) showed stabilization of the hemoglobin without additional transfusion after embolization before discharge. Coagulopathy was present before TAE in six patients (67%), and the clinical success rate in this patient group was 100%. There was no evidence of symptomatic bowel ischemia or infarction or severe complications directly related to Onyx embolization in any of the patients. Only four patients complained of mild abdominal pain for <2 days with spontaneous remission. All the patients were discharged after clinical improvement without reoperation.

Discussion

In 1972, Rösch^[8] firstly introduced the technique of TAE as an alternative to surgery for the control of upper gastrointestinal tumor bleeding and achieved success. Thereafter, endovascular embolization has gradually become an indispensable treatment of choice for a life-threatening arterial hemorrhage of any etiology gradually, especially in high-risk patients.^[9] It has been reported that the efficacy for acute gastrointestinal bleeding ranged from 52% to 90%, but relatively high rates of rebleeding were found.^[7] As far as our study was concerned, the clinical success rate was higher than those in other reports, and no rebleeding occurred in these patients.

Among the wide range of embolic agents, microcoils have the advantage of a good radiopacity that allows for a precise deployment permitting reduction of the arterial perfusion pressure to the bleeding site while preserving sufficient collateral flow. The wide range of coil sizes allows one to appropriately match the coil to the target vessel diameter. Each microcoil is delivered sequentially until hemostasis has been achieved. Therefore, super selective catheterization and stable catheter positioning are required for a safe release and ideal coil embolization. However, coil application is dependent upon vessel diameter, sometimes it is difficult or impossible to selectively place the catheter close to the bleeding vessels, especially in some small or tortuous vessels.^[10] Even though super selective catheterization was achieved, the proximal occlusion of a vessel may not successfully treat the bleeding lesion due to the presence of collateral vessels.

The most commonly used embolization particulate agents mainly include gelatin sponge and PVA. They are particularly suitable for applications in cases where lesions are multiple, distal in location or supplied by numerous collateral pathways. However, the lack of radiopacity and precision makes them difficult to be use with high risk of ectopic embolism. Although embolization particles are widely employed in the treatment of arterial hemorrhage and may also use successfully, they are more difficult to control than microcoils. Gelfoam is a temporary agent and often cannot easily be deployed super selectively, sometimes causing catheters obstruction. A disadvantage of PVA is that small diameters particles may reach the intramural circulation distal to the collaterals, thereby risking bowel infarction, or may reflux into nontarget arteries.

Onyx glue is a well-known liquid adhesive used in cerebral arteriovenous malformations or arteriovenous fistula

with high security and good efficacy, it is easy to be injected through an ordinary microcatheter, sometimes microcatheter (Marathon, ev3) was advanced with the help of an 0.08-inch microguidewire (Mirage, ev3), into small caliber arteries and collateral circulation, which are difficult to embolize with a coil, because of its low viscosity. For the embolotherapy, Onyx is mixed with tantalum powder making it radiopaque and thus allowing more controlled placement. Nontarget embolization can, therefore, be identified immediately. Its exact site of embolization can be observed and documented better than with embolization particulate agents due to its dense radiopacity. Vascular occlusion using Onyx is permanent and cannot be removed by reversal of vessel flow compared with the gelfoam sponge. In addition, Onyx allows rapid embolization with fast polymerization when contacted with blood. Even though the patients are in the presence of coagulopathy, Onyx polymerization can also cause rapid and complete vessel occlusion. Since its speed of polymerization, Onyx does not allow it to permeate all the way to the capillary level, thus it can decrease the risk of end-organ ischemia. Because of its low viscosity, Onyx is easy to deliver through microcatheters even if the catheters have tortuous running pathways. We determined the appropriate amount of Onyx depending on the size and shape of the vessel and its distribution after test injection with contrast material to the target of embolization. Transcatheter embolization with Onyx has the potential risk of mesenteric ischemia; however, complications related to Onyx embolization can be minimized by careful attention to the specific vascular anatomy and the information obtained from test injections with contrast material by adequately trained interventionists. In this series, none of the patients developed symptomatic bowel infarction, mesenteric ischemia or innocent vessel embolization after embolization with Onyx.

There were reports that coagulopathy in patients can reduce the success rate of embolotherapy in gastrointestinal bleeding, which ranges from 2.9% to 19.46%.^[5,9] Although all the patients in our study had coagulopathy, we achieved technical and clinical success in the six cases. It had showed that the embolization with Onyx was accompanied with a high angiographic and clinical success rate for the cases of gastrointestinal hemorrhage in patients with coagulopathy since Onyx does not require the coagulation process for its effect.

Conclusions

Our study has shown that TAE with Onyx is a highly effective and safe treatment modality for acute gastrointestinal tumor hemorrhage, especially when it is not possible to achieve hemostasis with other embolic materials. Furthermore, Onyx is also useful in patients with coagulopathy because it does not depend on the coagulation process for its therapeutic effect.

The randomized and multi-center studies with more patients are needed to be performed to confirm our findings and analyze the long-term effect of Onyx before its use for embolization of Onyx can be generally advocated.

Our study has several limitations. Firstly, it included a small number of patients, which prevented statistical analysis. Secondly, the embolization procedures with Onyx were performed by only one experienced interventional neurologist in a single center, which may bias the results.

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How to cite this article: Sun CJ, Wang CE, Wang YH, Xie LL, Liu TH, Ren WC. Transcatheter arterial embolization of acute gastrointestinal tumor hemorrhage with Onyx. *Indian J Cancer* 2014;51:56-9

Source of Support: Nil. **Conflict of Interest:** None declared.

