CLINICAL STUDY

Endovascular Embolization of Visceral Artery Pseudoaneurysms Using Modified Injection Technique with N-Butyl Cyanoacrylate Glue

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ABSTRACT

Purpose: To evaluate the indications, feasibility, safety, and effectiveness of *N*-butyl cyanoacrylate (NBCA) with modified injection technique in embolization of visceral artery pseudoaneurysms (PSAs).

Materials and Methods: A retrospective evaluation was performed of 31 patients (26 men, 5 women; mean age, 32.6 y) with visceral artery PSAs that were treated with embolization using NBCA with modified sequential injection and flushing technique. The most common indication for using NBCA was preservation of a major feeding artery (n = 18), followed by difficult catheterization secondary to arterial tortuosity (n = 5), failed previous coil embolization (n = 4), and short landing zone for coils (n = 4). NBCA alone was used in 25 patients, and NBCA with coils was used in 6 patients. The patients were followed clinically until discharge and 1 and 3 months after discharge.

Results: The mean amount of NBCA–ethiodized oil (Lipiodol; Guerbet LLC, Villepinte, France) mixture injected was 0.24 mL (range, 0.1–1.1 mL). Embolization with NBCA was technically successful in all (100%) patients. Recurrence was seen in 3 (9.7%; 2—splenic artery; 1—left gastric artery) patients after a mean time of 16.3 days (range, 10–27 d) of initial embolization resulting in clinical success of 90.3%. All 3 patients underwent successful repeat embolization with secondary technical success rate of 100%. Minor (pain) and major (nontarget embolization in 2; microcatheter adhesion and fracture in 1) complications were seen in 3 patients each.

Conclusions: NBCA is a safe and effective embolization agent when injected with modified technique in treatment of visceral artery PSAs.

ABBREVIATIONS

DSA = digital subtraction angiography, NBCA = *N*-butyl cyanoacrylate, PSA = pseudoaneurysm

Visceral artery pseudoaneurysms (PSAs) develop from various causes and have a high risk of rupture leading to massive hemorrhage and death (1–4). Endovascular embolization of PSAs is associated with high success and lower mortality rates (5,6). Use of coils or microcoils, which are the preferred embolization agents for treatment of PSAs, may result in incomplete or ineffective embolization because of small-sized or tortuous feeding arteries (which result in proximal catheter position), collateral supply to the PSA, inadequate packing of coils, or deranged coagulation parameters (7,8).

N-butyl cyanoacrylate (NBCA), a permanent liquid embolization agent, has found an increasing role in the management of acute arterial gastrointestinal tract hemorrhage and PSAs (9–11). The benefits of NBCA include low viscosity, which allows distal embolization when catheterization is impossible because of difficult anatomy; embolization of collateral arteries; and nondependence on clotting function. Another benefit is reduced embolization procedure time compared with coil embolization (12). The main difficulty of using NBCA is

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that the operator needs proper training and considerable experience to avoid complications. Limited information is available in the published literature on the proper technique of NBCA injection and indications for NBCA embolization. The technique described in literature for the administration of NBCA is continuous injection with immediate retraction of the microcatheter when NBCA fills the PSA (11). This technique has a few problems. First, it increases the cost of the procedure because multiple microcatheters are needed in case of incomplete embolization. Second, repeat catheterization increases procedure time and radiation dose to the interventionist. Repeat catheterization may fail in cases of small tortuous arteries because of spasm or dissection. Furthermore, the immediate removal of the catheter can cause vascular damage if there is nonvisible adhesion of the catheter tip to the arterial wall (11). The modified technique of sequential injection of NBCA and flushing in multiple small aliquots described here is thought to overcome the above-mentioned limitations. Another gap in the literature concerns the detailed description of indications for the use of NBCA in visceral artery PSAs. In this article, we present a single-center experience of the use of NBCA in the treatment of visceral artery PSA in 31 patients; describe the indications; and discuss the feasibility, safety, and effectiveness of the modified technique of NBCA injection.

MATERIALS AND METHODS

This retrospective study was approved by the institutional review board, and patient informed consent was waived. The study included 31 patients (26 men; 5 women; mean age, 32.6 y; age range, 19–52 y) who underwent embolization with NBCA for acute arterial hemorrhage resulting from visceral artery PSA in a single center between January 2011 and December 2013. Patients who had PSA shown on digital subtraction angiography (DSA) and in whom NBCA was used as an embolization agent either alone or in addition to coils were included. All patients in whom DSA images, clinical data, or immediate follow-up data were unavailable were excluded. None of the patients fulfilled exclusion criteria. Pancreatitis was the most common etiology of PSA (n = 24), followed by surgical trauma (n = 6) and acute cholecystitis (n = 1).

Significant bleeding was present in 18 patients accompanied by hypotension (systolic blood pressure < 100 mm Hg; diastolic blood pressure < 60 mm Hg) and decreased hemoglobin (mean decrease, 3.4 g/dL; range, 2–4.8 g/dL). These patients were given intravenous fluids, whole blood, and inotropes to maintain hemodynamic stability. The remaining patients (n = 13) were hemodynamically stable at the time of embolization. Patients with upper gastrointestinal hemorrhage underwent upper gastrointestinal endoscopy for evaluation of the source of bleeding (n = 22). Endoscopy was not performed in the remaining patients, who had hemorrhagic fluid in the drainage catheters (n = 9). Computed tomography (CT) angiography was performed in all patients on a multislice CT scanner (SOMATOM Sensation 40-slice and Definition Flash 128-slice dual-energy; Siemens AG, Erlangen, Germany) after administration of 100–120 mL of water-soluble iodinated contrast agent. Arterial (5 s after peak aorta enhancement) and venous phases (70 s after injection) were obtained in all patients. Noncontrast CT sections were obtained when the scan was done on a 40-slice scanner. Virtual noncontrast images were generated in cases in which scans were done on a dual-energy scanner. Subsequently, patients were taken to the angiography suite for embolization.

The embolization procedures were performed by two radiologists (S.G., K.S.M) with 14 years and 9 years of experience in interventional radiology and 8 years and 4 years of experience with the use of NBCA, respectively. The target arteries identified on CT angiography all were selectively catheterized from a transfemoral approach. A 2.8-F microcatheter (Terumo Corp, Tokyo, Japan) was subsequently introduced coaxially, and its tip was positioned as close to the target site (PSA or its neck) as possible. The decision to use NBCA for embolization was made after DSA based on the need for preservation of the artery, difficulty in using coils successfully, and the inability to access the PSA. After flushing the microcatheter with 5% dextrose solution, NBCA–ethiodized oil (Lipiodol; Guerbet LLC, Villepinte, France) mixture (prepared in a 3:7 ratio, with 3 parts NBCA and 7 parts ethiodized oil) was injected slowly. No more than 0.3 mL was injected at a time because this is the volume of dead space of the microcatheter. The volume injected at a given time (range, 0.1–0.3 mL) depended on the size of the PSA, the size and flow rate of the parent artery, and the distance of the microcatheter tip from the PSA. Then 50% dextrose was used to flush the mixture slowly under fluoroscopy until it opacified the PSA. This injection-flushing sequence was repeated, when necessary, using the same microcatheter until embolization of the PSA was complete. The microcatheter was removed only at the end of the procedure.

There were 31 primary embolization procedures performed in 31 patients. The indications for use of NBCA were categorized into four groups (**Fig 1**): first, preservation of major feeding artery (hepatic, splenic) (n = 18 patients) (**Fig 2a–c**); second, inability to position the catheter tip distal to the PSA because of arterial tortuosity (n = 5 patients) (**Fig 3a–c**); third, failed previous coil embolization (n = 4 patients) (**Fig 4a–c**); and fourth, limited landing zone for coil deployment (n = 4 patients) (**Fig 5a, b**). In 25 cases, only NBCA was used, and in remaining 6 cases, NBCA was used in addition to coils. In 22 patients, follow-up ultrasound was performed (in cases in which the PSA