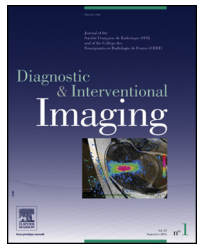
Diagnostic and Interventional Imaging (2015) **96**, 563—569



ORIGINAL ARTICLE /*Gastrointestinal imaging*

Clinical efficacy of transcatheter embolization of visceral artery pseudoaneurysms using *N*-butyl cyanoacrylate (NBCA)

Y. Won, S.L. Lee, Y. Kim, Y.M. Ku*

Department of Radiology, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea

KEYWORDS
False aneurysm;
Hemorrhage;
Therapeutic embolization;
Enbucrilate;
Interventional radiology

Abstract
Purpose: Transcatheter endovascular embolization within a reasonable time before rupture or deterioration of a patient's general condition is an important procedure for managing visceral pseudoaneurysms. *N*-butyl 2-cyanoacrylate (NBCA, enbucrilate) is an embolic material used in the blockade of visceral pseudoaneurysms. This study evaluated the clinical efficacy of transcatheter embolization of visceral artery pseudoaneurysms using NBCA.
Patients and methods: Between June 2004 and February 2014, 13 patients (9 males and 4 females; age range, 26—80 years; mean, 57.9 years) with 14 pseudoaneurysms were treated by transcatheter embolization using NBCA. NBCA was mixed with iodized oil at a 1:3 ratio to control its polymerization time and to render it radiopaque. Pseudoaneurysms were located on the gastroduodenal artery ($n = 1$), pancreaticoduodenal artery ($n = 2$), dorsal pancreatic artery ($n = 1$), proximal jejunal artery ($n = 1$), colic artery ($n = 1$), splenic artery ($n = 3$), renal artery ($n = 4$; two in one patient), and hepatic artery ($n = 1$).
Results: All patients recovered immediately following the embolization procedure, and two patients showed minor complications that required only medical observation.
Conclusions: Transcatheter embolization using NBCA for the treatment of visceral pseudoaneurysms is a safe, effective, and low-cost treatment method with a high success rate.

* Corresponding author at: Department of Radiology, College of Medicine, Uijeongbu Saint Mary's Hospital, The Catholic University of Korea, Cheonbo-ro 271, Uijeongbu-si, Gyeonggi-do 480-717, Republic of Korea. *E-mail address:* ymiku@catholic.ac.kr (Y.M. Ku).

http://dx.doi.org/10.1016/j.diii.2015.01.003
2211-5684/

Selective arterial embolization has been accepted as an appropriate therapy for the treatment of visceral pseudoaneurysms with a high success rate (> 80%) and a low complication rate [1]. Pseudoaneurysms, or false aneurysms, usually result from pancreatitis, trauma, surgery, or peptic ulcer disease. Among visceral pseudoaneurysms, frequently noted sites include the splenic artery, pancreatoduodenal artery, and, less often, the cystic artery [2]. By contrast to true aneurysms, pseudoaneurysms do not contain all three layers of the vascular wall and are thus more fragile. Pseudoaneurysms contain a single loose connective tissue layer and have a tendency to enlarge progressively and rupture, and so must be managed [3,4]. Various embolic materials have been used successfully, including *N*-butyl 2-cyanoacrylate (NBCA), microcoils, gelatin sponge particles, ethanol, polyvinyl alcohol, and thrombin [5—7].

Although various materials have been used to embolize pseudoaneurysms, coils are used most often while liquid embolic materials such as NBCA are rarely used because of handling difficulty and concerns regarding potentially fatal complications related to ischemic injury. NBCA allows rapid and permanent embolization with rapid polymerization when in contact with blood [8]. Serious complications, including bowel ischemia or innocent vessel embolization, have been reported only rarely and can be minimized by treating patients with appropriate indications and ensuring that the procedures are performed carefully by trained personnel [4,8,9].

In this report, we present our experiences regarding endovascular management using NBCA for visceral pseudoaneurysms in thirteen patients, together with a review of the literature.

Patient and methods

Patients

Between June 2004 and February 2014, 13 patients (9 males and 4 females; age range, 26—80 years; mean, 57.9 years) were referred to our department for angiography. All 13 patients had previously undergone diagnostic imaging studies, and, in particular, contrast-enhanced multi-detector computed tomography (MDCT) or three-dimensional MDCT angiography.

Angiography was performed in cases of hemorrhage within 1—5 days after clinical signs, laboratory data, or relevant imaging findings, and two asymptomatic patients underwent angiography electively. This study was performed retrospectively in compliance with the requirements of our institutional review board, and informed consent for angiography and embolization was obtained from each patient or the patient's family.

Endovascular technique

After common femoral artery puncture, standard angiography was performed. A 2.4-F microcatheter was introduced coaxially into the 5-F catheter, and the tip of the microcatheter was placed as close as possible to the neck of the pseudoaneurysm. However, if the catheter tip could not be properly positioned at the pseudoaneurysm neck because of the artery's small caliber or tortuosity, it was wedged into the inlet of the arteries to be embolized so as to limit retrograde pericatheter reflux of the NBCA mixture.

Once the microcatheter was in place, a mixture of NBCA (Histoacryl Blue®; B. Braun, Melgungen, Germany) and ethiodized oil (Lipiodol Ultra-Fluide®; Guerbet, Roissy-Charles-de-Gaulle, France, Switzerland) at a ratio of 1:3 was prepared. The iodized oil provided radioopacity to the mixture and delayed the polymerization time. Angiography and embolization were performed by an interventional radiologist. Prior to injection of the NBCA mixture, the lumen of the microcatheter was flushed with 5% dextrose to prevent polymerization before reaching the arterial segments. The NBCA mixture was injected using a 1-mL syringe and under careful fluoroscopic monitoring until it filled the outflow, pseudoaneurysm neck, and parent artery inflow. Immediately after injection, the microcatheter was removed to prevent adherence of the catheter tip to the vessel wall. The inner lumen of the guiding catheter was then cleared, and post-embolic angiography was performed (Figs. 1—3).

The technical and clinical outcomes were followed in terms of the immediate control of bleeding, recurrence of bleeding, and complications. Following embolization, patients were monitored for clinical symptoms and signs of bleeding as well as hemoglobin levels, and they underwent optional imaging studies, as needed. Patients were followed up after discharge on an outpatient basis.

Results

The pseudoaneurysms were located on the gastroduodenal artery ($n = 1$), pancreaticoduodenal artery ($n = 2$), dorsal pancreatic artery ($n = 1$), proximal jejunal artery ($n = 1$), colic artery ($n = 1$), splenic artery ($n = 3$), renal artery ($n = 4$, two in one patient), and hepatic artery ($n = 1$) (Table 1). The aneurysms ranged from 4 to 25 mm in diameter, as measured from the angiograms. Active bleeding from an aneurysm presented as contrast extravasation on the angiograms.

The predisposing etiologies were as follows: splenic artery pseudoaneurysms caused by chronic pancreatitis ($n = 2$) or after total gastrectomy due to gastric cancer ($n = 1$); iatrogenic pseudoaneurysms occurring after a biopsy or laparoscopic lumpectomy of a 2.5-cm renal cell tumor; a gastroduodenal artery pseudoaneurysm after Whipple's procedure for ampulla of Vater cancer; a hepatic artery pseudoaneurysm after percutaneous transhepatic biliary drainage for biliary lithiasis; and an anterosuperior pancreatoduodenal artery pseudoaneurysm because of pancreatic cancer in a patient who had been medicated with warfarin for 40 years because of an arterial flutter.

Transcatheter embolization using the liquid agent NBCA, referred to as 'glue', was performed initially during our early clinical experience in two patients, combined with the use of a coil. NBCA embolization was successful in all of our patients, and there was complete occlusion of all pseudoaneurysms. There were only two minor complications related to the embolization procedure. One patient (patient 1) showed persistent, minor hematuria without a significant decrease in the hematocrit reading for 3 days, while