

Superselective Embolization for Arterial Upper Gastrointestinal Bleeding Using *N*-Butyl Cyanoacrylate: A Single-Center Experience in 152 Patients

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ABSTRACT

Purpose: To evaluate 30-day safety and efficacy of superselective embolization for arterial upper gastrointestinal bleeding (UGIB) using *N*-butyl cyanoacrylate (NBCA).

Materials and Methods: This single-center retrospective 10-year study included 152 consecutive patients with UGIB (gastric, $n = 74$; duodenal, $n = 78$) who underwent embolization with NBCA for angiographically positive arterial bleeding. The primary endpoint was clinical success rate defined as achievement of hemostasis without rebleeding or UGIB-related mortality within 30 days after embolization. Mean systolic blood pressure and heart rate were $121.2 \text{ mm Hg} \pm 27.4$ and $97.9 \text{ beats/minute} \pm 22.5$; 31.1% of patients needed intravenous inotropes, and 36.6% had coagulopathy. The etiology of bleeding was ulcer (80.3%) or iatrogenic injury (19.7%). Statistical analysis was performed to identify predictive factors for outcomes.

Results: Technical success rate was 100%. Clinical success, 1-month mortality, and major complication rates were 70.4%, 22.4%, and 0.7%. There were significant differences in the clinical success rates between gastric and duodenal bleeding (79.4% vs 62.2%; $P = .025$). The need for intravenous inotropes at the time of embolization was a significant negative predictive factor in both gastric (odds ratio [OR] = 0.091, $P = .004$) and duodenal (OR = 0.156, $P = .002$) bleeding. The use of a microcatheter with a smaller tip (2 F) was associated with better outcomes in duodenal bleeding (OR = 7.389, $P = .005$).

Conclusions: Superselective embolization using NBCA is safe and effective for angiographically positive arterial UGIB.

ABBREVIATIONS

NBCA = *N*-butyl cyanoacrylate, OR = odds ratio, UGIB = upper gastrointestinal bleeding

Arterial upper gastrointestinal bleeding (UGIB) remains a life-threatening medical emergency despite recent advancements in endoscopic technology and improvements in drugs for gastric acid regulation (1–3). Endoscopy is the treatment of choice because the underlying disease can be diagnosed while simultaneously treating the bleeding. However, some patients cannot undergo an endoscopic

procedure, and 10%–20% of patients continue to bleed or rebleed after initial control (4,5). Transcatheter arterial embolization is accepted as an effective treatment option for UGIB in cases of endoscopic failure (6–8). However, the rich collateral arterial supply of the upper gastrointestinal tract, combined with frequent coagulopathy, contributes to rebleeding after technically successful embolization.

Theoretically, *N*-butyl cyanoacrylate (NBCA), a liquid embolic agent, has several advantages over other agents, which might improve the clinical outcomes of UGIB embolization. First, NBCA can occlude the target vessel rapidly and securely regardless of the status of the patient's coagulation system (9). Second, it can reach not only the most distal portion of the small target artery but also the communicating channels, which might be the collateral route for rebleeding (9). Thus, NBCA has been accepted as a valid option in the management of UGIB by some interventional radiologists (10–12). However, there is

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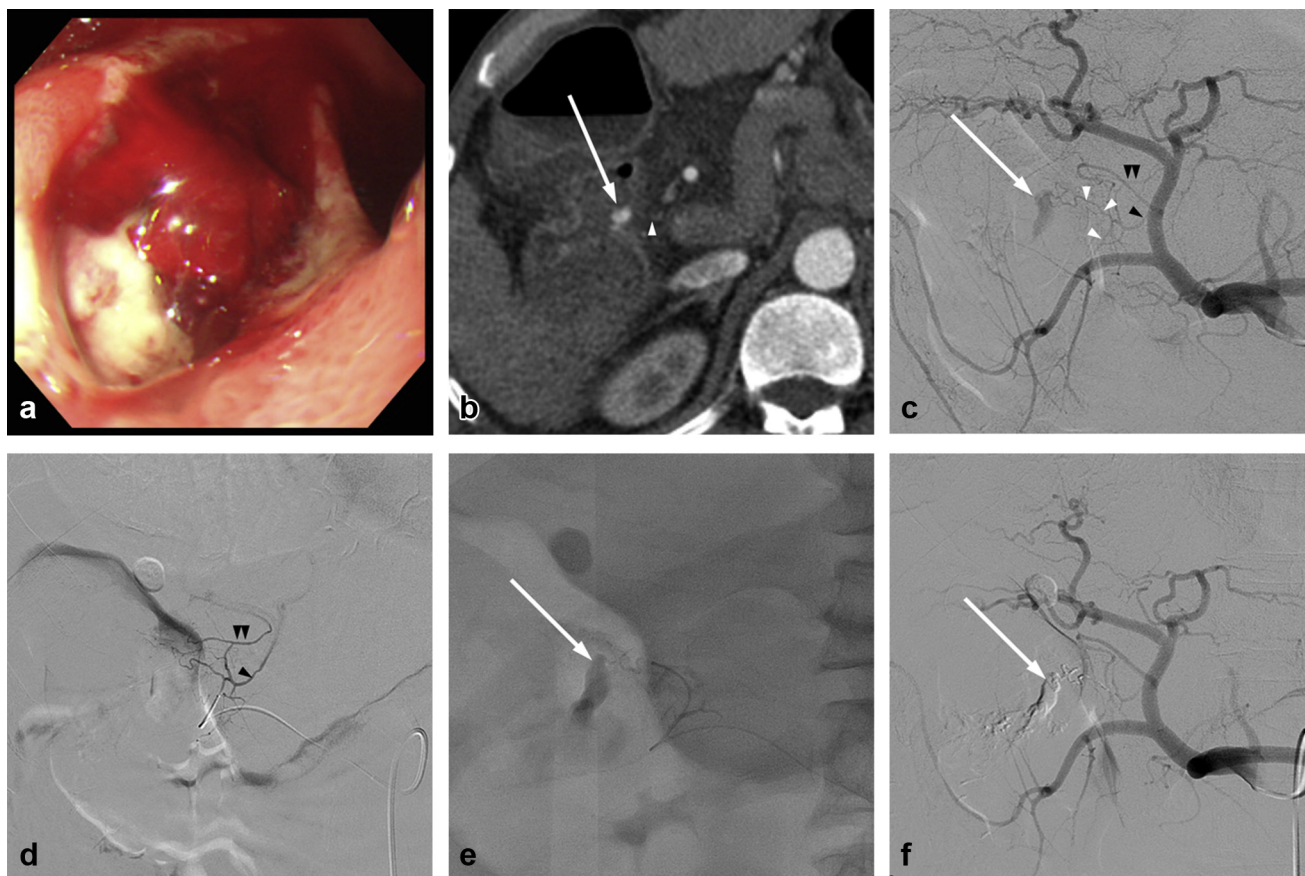


Figure 1. A 61-year-old man presented with acute hematochezia and tachycardia. **(a)** A large ulcer with active bleeding was seen at the duodenal bulb on endoscopic examination. The endoscopist recommended immediate angiography. **(b)** Contrast-enhanced CT showed a pseudoaneurysm (white arrow) at the medial wall of the duodenal bulb. A fine arterial channel (white arrowhead) was suspected to be connected to the pseudoaneurysm. **(c)** Celiac angiography revealed contrast media extravasating (white arrow) from a fine feeding artery (white arrowheads) arising from the gastroduodenal artery. This artery formed an arterial network that was connected to the common hepatic artery via 2 channels (black arrowhead, double black arrowhead). **(d)** The hemodynamic change caused by engagement of the microcatheter into the feeding branch from the gastroduodenal artery resulted in flow of the contrast media injected via the microcatheter into the common hepatic artery via the 2 channels (black arrowhead, double black arrowhead) without filling the pseudoaneurysm. **(e)** After the tip of the microcatheter was advanced closer to the bleeding point, the NBCA and ethiodized oil mixture could fill the pseudoaneurysm (white arrow) without overflowing into the common hepatic artery. **(f)** Completion angiography revealed that successful embolization of the extravasating point and the feeding artery was achieved with a glue cast (white arrow), and the common hepatic artery and gastroduodenal artery were intact.

insufficient evidence of its safety and efficacy, as the previous reports are based on relatively small numbers of patients. The aim of this study was to evaluate the safety and efficacy of selective embolization using NBCA for angiographically positive arterial UGIB in 152 consecutive patients.

MATERIALS AND METHODS

This single-center retrospective observational study was approved by the institutional review board. The requirement for informed consent was waived because of the retrospective nature of the study. Patients with UGIB who underwent embolization with NBCA (Histoacryl; B. Braun, Melsungen, Germany) for positive angiographic findings of arterial bleeding were included consecutively from 2006 to 2015, resulting in 152 patients in the study (gastric bleeding, $n = 74$; duodenal bleeding, $n = 78$).

Endoscopy and CT Examinations

Endoscopy was the primary diagnostic and therapeutic option during the study period in the institution for patients with suspected massive UGIB. Endoscopic examination results were reported according to the Forrest classification (Ia–b, acute hemorrhage; IIa–c, signs of recent hemorrhage; III, lesions without active bleeding) (13). Contrast-enhanced computed tomography (CT) was performed before angiography when endoscopy was not applicable, UGIB was still suspected despite negative endoscopic findings, or bleeding recurred after the endoscopic hemostasis.

Angiography and Embolization

Celiac and superior mesenteric arteriography was routinely performed using 5-F catheters (Rösch or Cobra; Cook, Inc, Bloomington, Indiana). If bleeding signs were not definitive, further selective angiography of the left gastric, right gastric,

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