

Transhepatic Tract Embolisation After Biliary Intervention Using *n*-Butyl Cyanoacrylate and Autologous Blood: A Retrospective Analysis of 42 Patients

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Abstract

Purpose We evaluated the safety and efficacy of transhepatic tract embolisation after a biliary intervention using *n*-butyl cyanoacrylate (NBCA) and autologous blood.

Materials and Methods Between January 2017 and December 2018, 42 consecutive patients (mean age: 71 ± 15 years, 24 men) with malignant ($n = 26$) or benign ($n = 16$) biliary obstructions underwent percutaneous biliary intervention followed by tract embolisation within 2 weeks. Forty-six transhepatic tracts (4 bilateral) in 42 patients were embolised using a NBCA and lipiodol mixtures (1:1–1:2 ratios) after intraductal infusion of peripherally obtained autologous blood. The indwelling catheter diameters were 8.5–14 Fr. The median interval between percutaneous biliary drainage and tract embolisation was 10 days (range 3–14 days). Glue-cast formation via fluoroscopy and immediate complications were reviewed retrospectively in medical records. Follow-up data (median: 135, range 11–720 days) including computed tomography (CT) images ($n = 17$) were evaluated for delayed complications and glue-cast formation.

Results Successful glue-cast formations were achieved in all 46 tracts. No patients experienced haemorrhage, and only one patient had external bile leakage. Eight patients

complained of abdominal pain (numerical scale ≤ 5) immediately after embolisation, which was controlled by analgesics. Two patients had transient fever. Segmental ($n = 11$) or sub-segmental ($n = 6$) glue-cast patterns were identified along the transhepatic tract by follow-up CT. No biliary obstructions were caused by inadvertent glue spread. Fragmented glue was detected outside the stent in one patient.

Conclusion Transhepatic parenchymal tract embolisation with NBCA and autologous blood is a safe and feasible method for preventing bile leakage.

Level of Evidence Level 4, Case Series.

Keywords Transhepatic tract embolisation · Stents · *N*-butyl cyanoacrylate

Introduction

Percutaneous transhepatic biliary drainage (PTBD) catheter removal carries a risk of bile leakage or bleeding into the peritoneum unless the tract is mature, which takes at least 2 weeks [1–3]. Early catheter removal before tract maturation can cause patient discomfort, which may lead to readmission and increased hospital costs. Potential adverse events include bile peritonitis, bilomas, peritoneal bleeding, and even a biliopleural fistula when the tract involves the pleura [4]. *N*-butyl cyanoacrylate (NBCA) achieves reliable tract occlusion; however, it is difficult to generate a hard cast given the time required to polymerise in the bile. Furthermore, NBCA is difficult to control and often

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inadvertently spreads to the distal bile duct [5]. To overcome these limitations, prefilling the transhepatic tract with peripherally obtained autologous blood prior to the injection of NBCA could be more effective, as the presence of intraduct blood shortens the polymerisation time and prevents the inadvertent spread of glue into the common bile duct.

This study aims to evaluate the safety and efficacy of transhepatic tract embolisation after PTBD catheter removal using a mixture of NBCA and lipiodol after autologous blood infusion to the transhepatic tract.

Materials and Methods

Our Institutional Review Board approved this retrospective study. Between January 2017 and December 2018, a total of 42 consecutive patients (mean age: 71 years, range 14–95 years, 24 men) underwent PTBD tract embolisation. No cases were complicated by ascites. The aetiologies of the biliary obstructions were malignant tumours in 26 patients and benign causes in 16 patients. Biliary stents were placed in 22 of the 26 malignant biliary obstruction patients and 4 patients underwent surgery. Patient characteristics are presented in Table 1. Data included demographics, clinical and laboratory findings, and procedure-related complications. Laboratory and device-related data were also collected.

Table 1 Summary of patient characteristics

	Value
Age (years)	71 ± 15
Sex (M/F)	24:18
Primary disease	
Benign	16
Malignant	26
PTBD side	
Right	25
Left	13
Bilateral	4
Tract size (French)	
8.5	28
10.2	12
14.0	2
NBCA/lipiodol ratio	
1:1	18
1:1.5	15
1:2	9

NBCA, *n*-butyl cyanoacrylate, PTBD percutaneous transhepatic biliary drainage

Prior to the procedure, 5–7 mL of peripheral vein blood was obtained from each patient with a heparinised syringe. Transhepatic tract embolisation was performed using an 8–14 Fr dilator. Leaving a guidewire after catheter removal, a dilator (Cook, Bloomington, IN, USA) was inserted up to the initial intrahepatic duct puncture. The dilator sizes were 1–2 Fr larger than the pre-existing biliary drainage catheter. The biliary access point was determined by comparing images from the initial PTBD and injecting contrast media. The patient's position was changed according to the dilator insertion side to prevent the NBCA/lipiodol mixture from flowing into the intrahepatic duct by gravity. After verifying dilator tip placement, blood was injected through the dilator (approximately 5–7 mL), which was then flushed with 5% dextrose water (1–2 mL). A three-way valve system was used to achieve a rapid exchange of dextrose water to NBCA. A mixture of NBCA (Histoacryl, B. Braun Surgical, Rubi, Spain) and lipiodol (Lipiodol Ultra Fluid, Guerbet, Aulnay-sous-Bois, France) was slowly injected to embolise the transhepatic tract as the dilator was pulled back on magnified view. The NBCA and lipiodol were mixed at ratios of 1:1, 1:1.5, or 1:2 depending on tract length, with a high ratio preferred for short tracts. Technical success was verified by solid glue-cast formation via fluoroscopy (Fig. 1A). Clinical success was achieved when no bile or blood oozing was observed after embolisation.

Post-procedure ultrasonography was performed to rule out bile leakage or perihepatic haematomas. Procedure-related complications were evaluated by reviewing medical records and were graded in accordance with the Cardiovascular and Interventional Radiological Society of Europe (CIRSE) classification system [6]. Follow-up computed tomography (CT) was performed in 17 patients (median interval: 58 days, range 0–343 days). CT glue-cast patterns were classified as segmental or sub-segmental [7].

Pre- and post-embolisation laboratory test results were compared with paired *t* tests using SPSS software (SPSS v17.0; SPSS Inc, Chicago, IL, USA).

Results

Successful glue-cast formations were achieved in all 46 tracts (100% technical success). We initially failed to achieve complete occlusion in one patient, but bile oozing disappeared the next day (98% clinical success). No other patients developed external bile leakage or haemorrhage. No intraperitoneal bilomas or haematomas were identified on ultrasonography. PTBD was performed on the right side in 25 patients, left side in 13 patients, and bilaterally in 4 patients. Eight patients complained of mild abdominal pain immediately after glue injection (numerical scale ≤ 5,

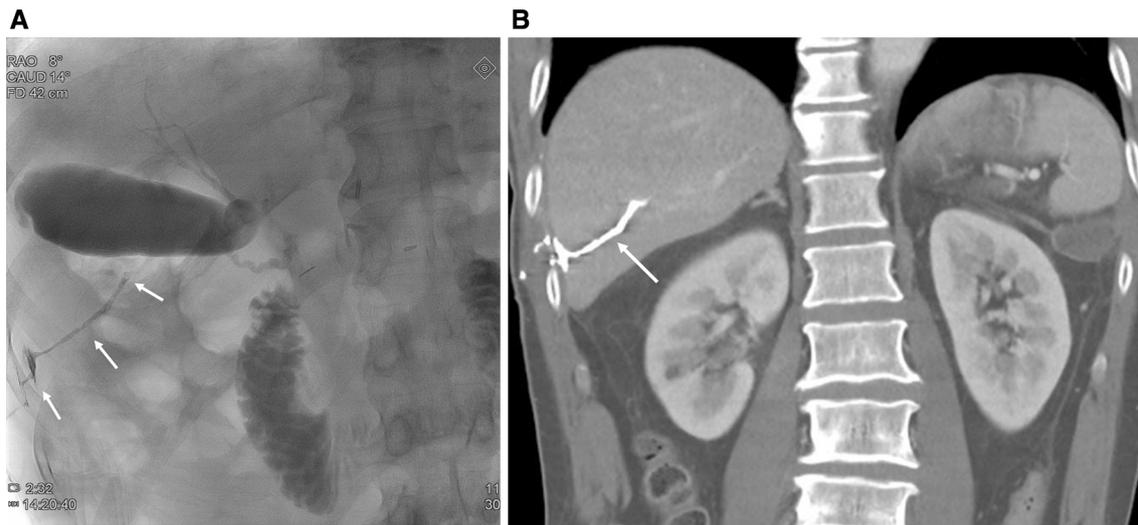


Fig. 1 **A** Fluoroscopic image of a 61-year-old man who underwent percutaneous biliary drainage due to post-operative bile leakage showing successful glue-cast formation from the intrahepatic duct to the skin after biliary tract embolisation (arrows). **B** Computed

tomography image acquired immediately after embolisation showing the formation of a segmental cast (arrow) without inadvertent glue spread (not shown)

range 0–10), which was managed by analgesics and disappeared after 1 day. Two patients had mild fevers that resolved with antipyretics (complication grade ≤ 2). The average interval between PTBD and tract embolisation was 10 days (median = 10 days, range = 3–14 days). Follow-up CT data were available for 17 patients (median = 58 days, range = 0–343 days). On CT, segmental ($n = 11$) or sub-segmental ($n = 6$) glue-cast patterns were identified along the transhepatic tract (Figs. 1B, 2A, respectively). No biliary obstructions were caused by inadvertent glue spread during follow-up (median: 135, range 11–720 days). A small amount of fragmented glue was detected outside the stent without symptoms in one patient (Fig. 2B). Haemoglobin and C-reactive protein

(CRP) levels were not significantly different before and after embolisation. Bilirubin levels decreased significantly after embolisation ($p = 0.01$, Table 2).

Discussion

Glue-casts were successfully formed without significant complications in 46 transhepatic tracts in 42 patients using NBCA and autologous blood. Tract occlusion was achieved in 98% of cases. Follow-up studies confirmed successful glue-cast formation and the absence of associated biliary obstructions.

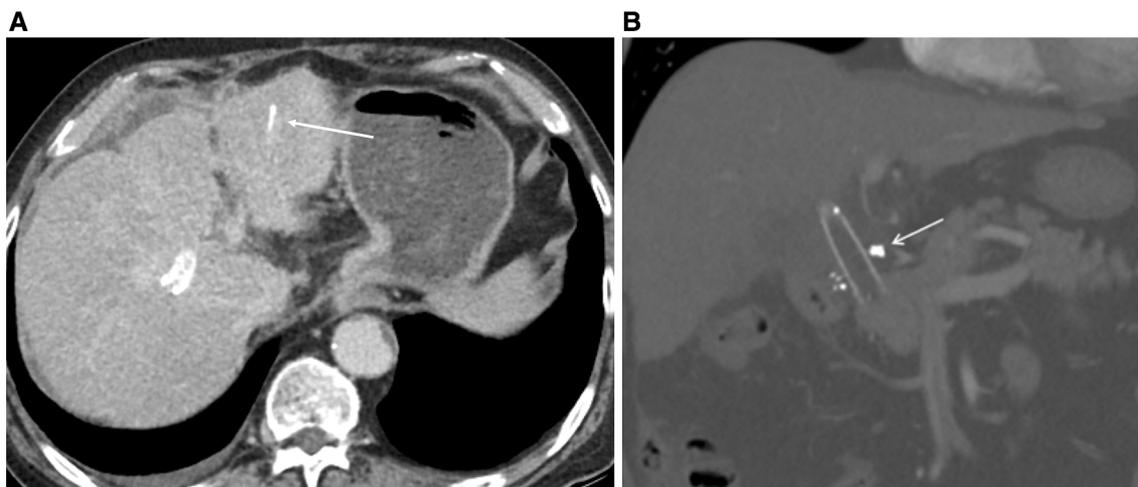


Fig. 2 **A** Computed tomography image from a 68-year-old man with gallbladder cancer showing sub-segmental glue-cast formation (arrow) after biliary tract embolisation. **B** Follow-up computed tomography image showing fragmented glue-cast migration outside the biliary stent

Table 2 Laboratory test results before and after tract embolisation

	Before embolisation	After embolisation	<i>P</i>
Haemoglobin (g/dL)	9.9 ± 1.7	12.3 ± 13.9	0.29
C-reactive protein (mg/L)	40.9 ± 37.7	36.7 ± 36.3	0.50
Total bilirubin (mg/dL)	3.3 ± 4.0	2.8 ± 3.3	0.01

Transhepatic tracts mature in 2 weeks, after which the catheter can be safely removed [1, 2]. However, the complication rate following PTBD is up to 5.6% [8]. The most common complications include bilomas and abdominal pain. On rare occasions, bile peritonitis can result in serious complications, such as shock, and can result in death if not properly managed [9, 10]. In cases complicated by ascites, bile and blood leakage can be continuous, so percutaneous bile drainage is considered a contraindication. Several investigators have used coils, vascular plugs, or a Gelfoam torpedo for embolisation procedures [5, 11–14]. However, bile does not contain blood cells or fibrin, making it difficult to achieve adequate stasis of bile when using coils or a vascular plug. Further, the use of metals causes artefacts on follow-up imaging. Since Ceike et al. [5] first reported on tract embolisation with NBCA, several investigations focused on its use. However, NBCA polymerisation is very slow in bile compared to blood, in which it polymerises within 1 s (Video 1, 2, and 3). Using a coil or plug in combination with NBCA could be a good alternative, but overall cost should be considered. A coil or plug alone cannot prevent inadvertent glue spread to the common bile duct. The use of coils after blood infusion, followed by NBCA injection can be a safer embolisation method. The use of Gelfoam is safe and effective; however, it requires a dedicated device (Hep-Plug) [5, 15].

The limitations of the study included the retrospective design and missing follow-up CT for some patients. Other shortcomings include the lack of a control group and use of different catheter sizes and NBCA/lipiodol ratios.

Conclusion

Injecting NBCA/lipiodol mixtures into the transhepatic tract after prefilling with autologous blood is a safe and effective post-intervention embolisation method.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

IRB Approval Our institutional review board approved this retrospective study (Incheon St. Mary Hospital: OC18RES10059).

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