

The Use of Glue in Peripheral Applications

A technical review of NBCA.

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N-butyl cyanoacrylate (NBCA), or what is commonly referred to as *glue*, is available in the United States for treating arteriovenous malformations (AVMs) in the central nervous system. In the peripheral circulation, NBCA has been used in a wide variety of conditions (see *Applications of NBCA* sidebar). Certain properties of NBCA make it a potentially suitable agent for such applications. These properties include its high radiopacity when mixed with ethiodol (making it easy to trace fluoroscopically), quick time to embolization, low rate of same-vessel recanalization, and the ability to penetrate vascular beds in a flow-directed fashion.

Some of the advantageous properties of NBCA can also

lead to potential pitfalls. Although the list of such pitfalls and complications are long, the incidence is actually quite low in the periphery, given proper technique. In this article, the proper technique of embolization with glue is reviewed and methodologies to minimize complications are discussed. This is not meant to replace practical hands-on experience with glue. The readers must gain experience on benchtop flow models and observe more experienced operators before using glue in their patients.

TECHNIQUE OF GLUE EMBOLIZATION

The NBCA mixture is most commonly prepared by adding ethiodol in various proportions depending on the

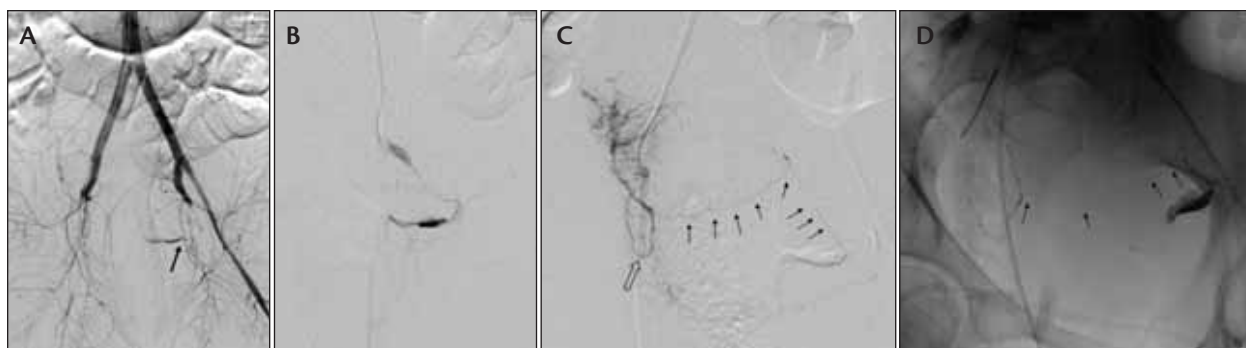


Figure 1. An arteriogram in a 32-year-old female with postpartum bleed shows an arterial bleed in the pelvis (arrow) (A). Selective left uterine arteriogram confirms the bleeding to be from this artery. Note the diffusely narrow vessels consistent with shock (B). After embolization of the left uterine artery, a right uterine arteriogram reveals a feeder to the area of injury (arrows). This artery is difficult to catheterize. Hence the uterine artery (open arrow) was injected with thin glue to penetrate the collateral flow to the bleeding area (C). Note the penetration of glue into the small feeder to the bleeding area after embolization (arrows) (D).

application. This allows for delayed polymerization of NBCA as well as better visualization. A ratio of one part ethiodol to one part NBCA (1:1) polymerizes very quickly after coming into contact with ionic solutions, while a ratio of six parts ethiodol to one part NBCA (6:1) will take longer. Therefore, the dilution ratio is determined by blood flow rate and the depth to which penetration of glue is desired. For most peripheral applications, a ratio of 4:1 or 3:1 ethiodol to glue is sufficient.

The use of a coaxial catheter system is highly recommended when injecting all liquid embolic agents, especially glue. This allows for a more secure catheter position, as well as options such as the use of the “flood technique” (discussed later). Additionally, in case of substantial reflux of glue around the microcatheter tip, maneuvers to release the retained microcatheter are easier and safer to perform.

Preparation of Mixture

In preparation of the glue mixture, optimal care must be taken to avoid contamination with ionic solutions such as blood or normal saline. This can accelerate polymerization and lead to deposition of glue in a more proximal location and/or increase the risk of catheter retention. To that end, a separate sterile table is used for all glue preparation and handling before injection. Also, gloves are changed before preparation and injection.

NBCA is provided in small, sterile, 1-mL containers. Our preferred method of preparing the ethiodol/glue mixture is to simply aspirate the glue out of its sealed container using a 1-mL syringe. The fibrin glue is subsequently injected into a desired volume of ethiodol in a 3-mL syringe, medicine cup, or shot glass. The two components are then thoroughly mixed.

Before transferring the prepared glue mixture onto the field for injection into the patient, the hub of the catheter to be injected is placed on a dry, clean towel and rinsed with D5 solution. The catheter is then flushed thoroughly with D5 solution to completely clear its lumen from ionic solutions. This should be done immediately before the injection of glue.

Injection of Glue

We prefer using 3-mL syringes to inject the glue mixture. The syringe can be directly attached to the hub of the microcatheter to inject the desired volume of glue. Alternatively, a three-way stopcock can be used to allow flushing of the catheter with D5 solution between pulses of glue injection (“sandwich technique”). This reduces the risk of microcatheter retention and allows for control of the amount and depth of penetration of NBCA. To prevent reflux around the microcatheter tip, which may lead to its attachment to the vascular wall (retained catheter)

SPECTRUM OF APPLICATIONS OF NBCA IN PERIPHERAL CIRCULATION

- Acute bleeding conditions
- Upper gastrointestinal bleed
- Variceal bleed
- Hemoptysis
- Trauma
- Endoleaks (type I and II)
- Gonadal vein
- Varicocele
- Pelvic congestion
- AVMs

or withdrawal of polymerized glue during catheter pull-back, the mixture should not be injected too forcefully.

Several factors impact the depth to which glue penetration occurs; the rapidity of flow passed through the catheter tip, ratio of NBCA to ethiodol, and injection technique are the most important. In vessels with rapid blood flow, more controlled injection of the glue mixture is necessary. For this reason, a lower ratio of ethiodol to NBCA may be chosen (ethiodol to glue at a 1:1 or 1:2 ratio) to prevent penetration into the venous outflow and embolization to the pulmonary arteries. This may occur during the treatment of AVM or in conditions with arteriovenous shunting.

However, a more common technical problem arises when glue is polymerized too proximally before it has penetrated to the desired depth. A useful method to achieve more distal embolization is the application of the flood technique. In this approach, the inner diameter of the guide catheter is sufficiently larger than the outer diameter of the microcatheter to allow for a positive-pressure continuous flush with D5 around the microcatheter. This will flood the distal circulation bed with a nonionic solution, slowing the polymerization of glue and hence allowing for deeper penetration of the mixture and more distal embolization. This technique is particularly useful when embolizing a bleeding artery that is hard to reach using the current generation of microcatheters (Figure 1). Once the injection is complete, the microcatheter is aspirated and withdrawn rapidly.

POTENTIAL PITFALLS

Most of the complications related to the use of glue are avoidable by using proper technique; hence, care must be taken to prevent them. Early polymerization of glue can occur in the microcatheter leading to the occlusion of lumen and the potential loss of access. This is commonly due to contamination with ionic solutions and can be avoided by adequate flushing with D5 solution before the

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injection of glue. If this occurs, it is recommended that the microcatheter be replaced. Attempts to clear the lumen of the catheter could result in the uncontrolled expulsion of the polymerized glue into a new and critical vascular pedicle and cause either proximal occlusion or nontarget embolization.

Excessive reflux around the microcatheter tip should be avoided. Reflux of polymerized glue around the microcatheter may adhere to its tip, increasing the risk of nontarget embolization or catheter retention. If reflux is noted, the catheter tip should be pulled back sufficiently to free the tip before the glue polymerizes. Before injection, redundant loops in the microcatheter should be removed to ensure the ability for quick and controlled pullback. Occasionally, the microcatheter tip may fracture during removal attempts and is usually left in place if it is not compromising flow to critical structures.

Venous penetration by the glue mixture may lead to pulmonary embolism during embolization of AVMs. Systemic embolization is also possible in patients with right-to-left shunts such as patent foramen ovale. This can occur during embolization of AVMs and high-flow lesions. Although blockage of venous outflow by glue in the intracranial vascular malformations may increase the risk of hemorrhage, it is not usually of significant clinical concern in the periphery. A higher glue concentration ratio and injection technique can minimize this risk.

“GLUE FIRST” APPLICATIONS

Potential applications of liquid embolic agents have been listed in the Applications of NBCA sidebar. Due to the cost and potential pitfalls associated with the use of these agents, their use would be an overkill in certain conditions. Glue first applications include AVM, type II endoleaks, bleeders that are difficult to reach (Figure 1), and gonadal vein embolizations (especially in the presence of pelvic varices or multiple collaterals).

CONCLUSION

Optimal use of NBCA requires adequate practical experience with this agent. As with other liquid embolic agents, there is a steep learning curve. However, the advantages of using this class of agents in certain applications is worth the investment of time to achieve proficiency in their use. ■

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