

ASHP Therapeutic Position Statement on the Institutional Use of 0.9% Sodium Chloride Injection to Maintain Patency of Peripheral Indwelling Intermittent Infusion Devices

Statement of Position

0.9% Sodium chloride for injection is a safe and effective indwelling solution for maintaining catheter patency of peripheral indwelling intermittent infusion devices (PIIDs) in adults. ASHP supports the use of 0.9% sodium chloride for injection in preference to heparin-containing flush solutions (heparin flush) in the institutional setting, on the basis of clinical evidence indicating that 0.9% sodium chloride injection (1) is as effective as heparin flush in maintaining the patency of PIIDs when blood is not aspirated into the device, (2) is safer to use than heparin flush because of a lower potential for adverse effects, (3) avoids drug incompatibilities associated with heparin flush, and (4) is a cost-effective alternative to heparin flush. Because of limited and conflicting available scientific evidence to date, this recommendation is not applicable to children under the age of 12 years, patients who are pregnant, patients in the home or other outpatient settings, catheters used for central venous or arterial access (including peripherally inserted central catheters and midline catheters), and the maintenance of patency in indwelling venipuncture devices used to obtain blood samples. Further research on PIID patency in the aforementioned patient populations and settings is warranted.

Background

PIIDs, commonly referred to as “heparin locks,” are used to provide convenient i.v. access in patients who require intermittent i.v. administration of medications without a continuous infusion of i.v. fluids. The advantages of PIIDs include patient mobility and comfort and reduced fluid load.¹⁻⁴ PIIDs most commonly consist of an intravenously inserted catheter attached to a short external cannula with a resealable injection port that is designed to facilitate multiple needle entries; thus, these devices eliminate the unnecessary trauma of multiple venipunctures.⁴ A problem frequently encountered with a PIID is the loss of patency because of clot formation within the catheter. To prevent clot formation, catheters are commonly flushed after each administration of i.v. medication and every 8–12 hours when the device is not in use.⁵ Because of heparin’s anticoagulant effects, diluted solutions of heparin in 0.9% sodium chloride injection (e.g., 10–100 units/mL) have traditionally been used to periodically flush and fill these devices and prevent the formation of clots. Diluted heparin solutions are used to maintain patency while avoiding the systemic effects associated with therapeutic doses of heparin.⁶ The optimum concentration of heparin and whether the drug is needed at all have not been established.^{4,7-11}

Efficacy

Studies have indicated that 0.9% sodium chloride injection alone is as effective as heparin-containing solutions in maintaining PIID patency.^{5,9,10,12-19} In several randomized, double-blind studies in which PIIDs composed principally of fluoroethylene propylene (Teflon) were used, 0.9% sodium chloride injection for flushing was associated with patency rates similar to those achieved with flush solutions containing 10 or 100 units of heparin sodium per milliliter.¹³⁻¹⁵ The frequency of phlebitis associated with the use of these solutions was also similar.^{7-11,13-15} The type of solution used to maintain PIID patency may not be as important as the positive pressure maintained in the i.v. line by the capped (sealed) injection device, which appears to prevent blood reflux and clot formation in the devices.^{10,11} Several studies provide a scientific basis for using heparin,^{6,20,21} but most published research supports 0.9% sodium chloride injection as an effective alternative to heparin flush in maintaining the patency of PIIDs. Data from neonates and children four weeks to 18 years of age are conflicting, with some studies suggesting no advantage of heparin over 0.9% sodium chloride injection and other studies demonstrating that heparin flushes maintain device patency significantly longer than 0.9% sodium chloride injection. Definitive conclusions cannot be made for pediatrics based on currently available data due to differences in trial methodologies and outcome measures, as well as trial limitations, such as insufficient or unknown statistical power and protocol violations.²²⁻³⁰ One survey showed that it was common practice to flush catheter devices used in neonates with heparin 1–2 units/mL³¹; however, the majority of published trials have evaluated heparin concentrations up to 10 units/mL, and nursing guidelines state that heparin concentrations of 1–10 units/mL should be given to pediatric patients.^{23,31,32} Although the risk appears to be low, the potential for intraventricular hemorrhage and the additional volume received through heparin flushes should be considered in neonates.^{33,34}

One trial of pregnant women demonstrated significantly increased efficacy and decreased complication rates with heparin-infused catheters compared with those flushed with 0.9% sodium chloride.³⁵ A subsequent study of pregnant women found no significant differences in the number of patent catheters or in complications with catheters flushed with either heparin or 0.9% sodium chloride, but the authors noted that their small sample size provided only 11% power to detect a significant difference in patency and even less power to detect a significant difference in complications.³⁶ Data from pregnant patients are conflicting; therefore, a recommendation cannot be made until more data are available.

Adverse Effects of Heparin Flush Therapy

Heparin, even when used in small doses, may elicit adverse reactions in some patients. The potential for bleeding complications increases when patients receive multiple, unmonitored heparin flushes.³⁷ Repeated injections of heparin, even in small doses, can alter activated partial thromboplastin time.³⁸ Allergic reactions are an inherent risk of using heparin. Although rare, heparin-flush-associated thrombocytopenia and hemorrhage have been reported.^{37,39–41} The risks of these adverse effects may be avoided by using 0.9% sodium chloride injection instead of heparin flush.

Drug Incompatibility

Heparin has been shown to be incompatible with many commonly used i.v. drugs.⁴² If heparin flush has been used to maintain the patency of a PIIID and a drug must be administered that is incompatible with heparin, it is necessary to flush the catheter with 0.9% sodium chloride injection before and after administering the incompatible drug and then to refill the PIIID with heparin. This procedure is commonly referred to as “SASH” (sodium chloride—administration [of drug]—sodium chloride—heparin).⁴³ The use of 0.9% sodium chloride injection as a flushing agent avoids the numerous drug incompatibilities associated with heparin and obviates the need for SASH.

Cost Implications

Enhanced quality of patient care should be the primary reason for deciding to use 0.9% sodium chloride injection for flushing. Secondly, the choice of 0.9% sodium chloride injection may avoid substantial costs associated with drugs, related supplies, and staff time.¹¹

Summary

Because of current therapeutic evidence supporting the efficacy of 0.9% sodium chloride and the inherent risks associated with heparin, ASHP believes that the use of 0.9% sodium chloride injection is appropriate for maintaining the patency of PIIIDs in nonpregnant adults in institutional settings. Because of limited and conflicting available scientific evidence to date, this recommendation is not applicable to children under the age of 12 years, patients who are pregnant, patients in the home or other outpatient settings, catheters used for central venous or arterial access (including peripherally inserted central catheters and midline catheters), and the maintenance of patency in indwelling venipuncture devices used to obtain blood samples.

References

1. Millam DA. Intermittent devices. *NITA*. 1981; 4:142–5.
2. Larkin M. Heparin locks. *NITA*. 1979; 2:18–9.
3. Thomas RB, Salter FJ. Heparin locks: their advantages and disadvantages. *Hosp Formul*. 1975; 10:536–8.
4. Deeb EN, Di Mattia PE. How much heparin in the lock? *Am J IV Ther*. 1976; 3:22–6.
5. Tuten SH, Gueldner SH. Efficacy of sodium chloride versus dilute heparin for maintenance of peripheral intermittent intravenous devices. *Appl Nurs Res*. 1991; 2:63–71.
6. Hanson RL, Grant AM, Majors KR. Heparin-lock maintenance with ten units of sodium heparin in one milliliter of normal saline solution. *Surg Gynecol Obstet*. 1976; 142:373–6.
7. Garrelts JC. White clot syndrome and thrombocytopenia: reasons to abandon heparin i.v. lock flush solution. *Clin Pharm*. 1992; 11:797–9.
8. Weber DR. Is heparin really necessary in the lock and, if so, how much? *DICP*. 1991; 25:399–407.
9. Barrett PJ, Lester RL. Heparin versus saline flushing solutions in a small community hospital. *Hosp Pharm*. 1990; 25:115–8.
10. Dunn DL, Lenihan SF. The case for the saline flush. *Am J Nurs*. 1987; 87:798–9.
11. Goode CJ, Titler M, Rakel B et al. A meta-analysis of effects of heparin flush and saline flush: quality and cost implications. *Nurs Res*. 1991; 40:324–30.
12. Fry B. Intermittent heparin flushing protocols. A standardization issue. *J Intraven Nurs*. 1992; 15:160–3.
13. Epperson EL. Efficacy of 0.9% sodium chloride injection with and without heparin for maintaining indwelling intermittent injection sites. *Clin Pharm*. 1984; 3:626–9.
14. Garrelts JC, LaRocca J, Ast D et al. Comparison of heparin and 0.9% sodium chloride injection in the maintenance of indwelling intermittent i.v. devices. *Clin Pharm*. 1989; 8:34–9.
15. Hamilton RA, Plis JM, Clay C et al. Heparin sodium versus 0.9% sodium chloride injection for maintaining patency of in-dwelling intermittent infusion devices. *Clin Pharm*. 1988; 7:439–43.
16. Shearer J. Normal saline versus dilute heparin flush: a study of peripheral intermittent i.v. devices. *NITA*. 1987; 10:425–7.
17. Miracle V, Fangman B, Kayrouz P et al. Normal saline vs. heparin lock flush solution: one institution's findings. *Ky Nurse*. 1989; 37(Jul–Aug):1,6–7.
18. Ashton J, Gibson V, Summers S. Effects of heparin versus saline solution on intermittent infusion device irrigation. *Heart Lung*. 1990; 19:608–12.
19. Hook ML, Ose P. Heparin vs. normal saline. *J Intraven Nurs*. 1990; 13:150–1. Letter.
20. Cyganski JM, Donahue JM, Heaton JS. The case for the heparin flush. *Am J Nurs*. 1987; 87:796–7.
21. Holford NH, Vozeh S, Coates P et al. More on heparin lock. *N Engl J Med*. 1977; 296:1300–1. Letter.
22. Lombardi TP, Gundersen B, Zammatt LO et al. Efficacy of 0.9% sodium chloride injection with or without heparin sodium for maintaining patency of intravenous catheters in children. *Clin Pharm*. 1988; 7:832–6.
23. Shah PS, Ng E, Sinha AK. Heparin for prolonging peripheral intravenous catheter use in neonates. *Cochrane Database Syst Rev*. 2002; 4:CD002774.
24. Nelson TJ, Graves SM. 0.9% sodium chloride injection with and without heparin for maintaining peripheral indwelling intermittent-infusion devices in infants. *Am J Health-Syst Pharm*. 1998; 55:570–3.
25. Kleiber C, Hanrahan K, Fagan CL et al. Heparin vs sa-

- line for peripheral i.v. locks in children. *Pediatr Nurs.* 1993; 19:405–9.
26. McMullen A, Fioravanti ID, Pollack V et al. Heparinized saline or normal saline as a flush solution in intermittent intravenous lines in infants and children. *MCN Am J Matern Child Nurs.* 1993; 18:78–85.
 27. Schultz AA, Drew D, Hewitt H. Comparison of normal saline and heparinized saline for patency of IV locks in neonates. *App Nurs Res.* 2002; 15:28–34.
 28. Gyr P, Burroughs T, Smith K et al. Double blind comparison of heparin and saline flush solutions in maintenance of peripheral infusion devices. *Pediatr Nurs.* 1995; 21:383–9.
 29. Danek GD, Noris EM. Pediatric i.v. catheters: efficacy of saline flush. *Pediatr Nurs.* 1992; 18:111–3.
 30. Beecroft PC, Bossert E, Chung K et al. Intravenous lock patency in children: dilute heparin versus saline. *J Pediatr Pharm Pract.* 1997; 2:211–23.
 31. Romanowski GL, Zenk KE. Intravenous flush solutions for neonates. Paper presented at ASHP Midyear Clinical Meeting. New Orleans, LA; 1991 Dec 10.
 32. Intravenous Nurses Society. Infusion nursing standards. *J Intraven Nurs.* 2000; 23(6S):S53–4.
 33. Lesko SM, Mitchell AA, Epstein MF et al. Heparin use as a risk factor for intraventricular hemorrhage in low-birth-weight infants. *N Engl J Med.* 1986; 314:1156–60.
 34. Malloy MH, Cutter GR. The association of heparin exposure with intraventricular hemorrhage among very low birth weight infants. *J Perinatol.* 1995; 15:185–91.
 35. Meyer BA, Little CJ, Thorp JA et al. Heparin versus normal saline as a peripheral line flush in maintenance of intermittent intravenous lines in obstetric patients. *Obstet Gynecol.* 1995; 85:433–6.
 36. Niesen KM, Harris DY, Parkin LS et al. The effects of heparin versus normal saline for maintenance of peripheral intravenous locks in pregnant women. *J Obstet Gynecol Neonatal Nurs.* 2003; 32:503–8.
 37. Passannante A, Macik BG. The heparin flush syndrome: a cause of iatrogenic hemorrhage. *Am J Med Sci.* 1988; 296:71–3.
 38. Heparin sodium monograph. In: McEvoy GK, ed. AHFS drug information. Bethesda, MD: American Society of Hospital Pharmacists; 2006:2616.
 39. Heeger PS, Backstrom JT. Heparin flushes and thrombocytopenia. *Ann Intern Med.* 1986; 105:143. Letter.
 40. Doty JR, Alving BM, McDonnell DE et al. Heparin-associated thrombocytopenia in the neurosurgical patient. *Neurosurgery.* 1986; 19:69–72.
 41. Cines DB, Tomaski A, Tannenbaum S. Immune endothelial-cell injury in heparin-associated thrombocytopenia. *N Engl J Med.* 1987; 316:581–9.
 42. Trissel LA. Handbook on injectable drugs. 13th ed. Bethesda, MD: American Society of Hospital Pharmacists; 2005.
 43. Intravenous Nurses Society. Intravenous nursing. Standards of practice. *J Intraven Nurs.* 1998; 21(1 suppl):S1–91.

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