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 injection is a safe and effective indwelling solution for maintaining catheter patency of peripheral indwelling intermittent infusion devices (PIIIDs) in adults and children age one year or older. ASHP supports the use of 0.9% sodium chloride 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 PIIIDs 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 one year or patients in the home or other outpatient settings. This document is not applicable to 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 PIIID patency in the aforementioned patient populations and settings is warranted.

Background

PIIIDs, often referred to as "saline locks" and frequently and inappropriately called "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 PIIIDs include patient mobility and comfort and reduced fluid load.[1–4] PIIIDs 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 PIIIDs 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 or 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]

However, due to the aforementioned concerns regarding heparin administration and the potential for medication dose error, many clinicians preferentially began using sodium chloride for flushes even before evidence was available that supported the use of sodium chloride instead of heparin.

Efficacy

Studies have indicated that 0.9% sodium chloride injection alone is as effective as heparin-containing solutions in maintaining PIIID patency.[7–16] In several randomized, double-blind studies in which PIIIDs 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 heparin sodium 10 or 100 units/mL.[10–12] The frequency of phlebitis associated with the use of these solutions was also similar.[7,8,17–19] The type of solution used to maintain PIIID 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.[8,19] Several studies provide a scientific basis for using heparin flush,[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 PIIIDs. However, 0.9% sodium chloride or heparin flush may not be the appropriate flush solution when flushing drugs that may not be compatible with 0.9% sodium chloride or heparin. Specific examples of such drugs include liposomal amphotericin B, doxorubicin, and i.v. immune globulin.[22] These drugs may need to be "preflushed" with another compatible solution such as 5% dextrose injection before and after administering the incompatible drug. In addition, the size of the i.v. catheter in pediatric patients appears to be a contributing factor in determining success with 0.9% sodium chloride for maintaining the patency of PIIIDs. Evidence supports the use of 0.9% sodium chloride flushes over heparin in pediatric patients,[23–27] and 0.9% sodium chloride injection is the preferred solution mentioned in the available nursing guidelines on infusion standards.[28]

One survey found that in neonates, it was common practice to flush catheter devices with heparin 1–2 units/mL,[29] and the literature supports the use of heparin 0.5 unit/mL added to continuous infusions through peripheral lines.[30] Concentrations of heparinized 0.9% sodium chloride injection 1–10 units/mL for flushing have been studied in neonatal patients, with no significant difference in catheter life or patency between 0.9% sodium chloride injection and heparinized 0.9% sodium chloride injection.[31–33] A limitation of these studies is small sample size, indicating low statistical power. Despite the lack of evidence-based literature supporting the superiority of heparin over 0.9% sodium chloride injection or vice versa for neonatal peripheral i.v. flushes, current guidelines published by the National Association of Neonatal Nurses state that heparinized 0.9% sodium chlo-

ride 0.5 unit/mL should be used to flush peripheral i.v. catheters using 0.2–0.5 mL every three to four hours.[34] If using 0.9% sodium chloride injection in pediatric patients, avoid bacteriostatic 0.9% sodium chloride, especially in neonates.

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.[36] However, the authors from both studies noted that their sample sizes were small and not powered sufficiently to detect a significant difference in patency or complications, possibly affecting the true clinical significance of their results. While published data from pregnant patients are conflicting, common practice is to use 0.9% sodium chloride flushes for peripheral i.v. catheters in this patient population.

Adverse Effects of Heparin Flush

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. Heparin is incompatible with many anthracyclines, including daunorubicin and doxorubicin, as well as benzodiazepines such as diazepam and midazolam.[22]

Cost Implications

Enhanced quality of patient care should be the primary reason for deciding to use 0.9% sodium chloride injection for flushing. Secondarily, the choice of 0.9% sodium chloride injection may avoid substantial costs associated with drugs, related supplies, and staff time.[9]

Summary

Because current therapeutic evidence supports the efficacy of 0.9% sodium chloride injection in maintaining PIIID patency and due to 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 adults and children age one year or older in institutional settings. Because of limited and conflicting scientific evidence available to date, this recommendation is not applicable to neonates, patients in the home or other outpatient settings, catheters used for central venous or arterial access (including peripherally inserted central catheters and midline catheters), which was beyond the scope of this therapeutic position statement, 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. Barrett PJ, Lester RL. Heparin versus saline flushing solutions in a small community hospital. *Hosp Pharm.* 1990; 25:115–8.
8. Dunn DL, Lenihan SF. The case for the saline flush. *Am J Nurs.* 1987; 87:798–9.
9. Fry B. Intermittent heparin flushing protocols. A standardization issue. *J Intraven Nurs.* 1992; 15:160–3.
10. 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.
11. 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.
12. 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.
13. Shearer J. Normal saline versus dilute heparin flush: a study of peripheral intermittent i.v. devices. *NITA.* 1987; 10:425–7.
14. 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.
15. Ashton J, Gibson V, Summers S. Effects of heparin versus saline solution on intermittent infusion device irrigation. *Heart Lung.* 1990; 19:608–12.
16. Hook ML, Ose P. Heparin vs. normal saline. *J Intraven Nurs.* 1990; 13:150–1. Letter.
17. Garrelts JC. White clot syndrome and thrombocytopenia: reasons to abandon heparin i.v. lock flush solution. *Clin Pharm.* 1992; 11:797–9.
18. Weber DR. Is heparin really necessary in the lock and, if so, how much? *DICP.* 1991; 25:399–407.
19. Goode CJ, Titler M, Rakel B, et al. A meta-analysis of effects of heparin flush and saline flush: quality and cost implications. *Nurs 2Res.* 1991; 40:324–30.
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. Trissel LA. Handbook on injectable drugs. 16th ed. Bethesda, MD: American Society of Health-System Pharmacists; 2011.

23. Mok E, Kwong TK, Chan MF. A randomized controlled trial for maintaining peripheral intravenous lock in children. *Int J Nurs Pract.* 2007; 13:33–45.
24. Hanrahan KS, Kleiber C, Fagan CL. Evaluation of saline for iv locks in children. *Pediatr Nurs.* 1994; 20:549–52.
25. Kleiber C, Hanrahan K, Fagan CL, et al. Heparin vs saline for peripheral i.v. locks in children. *Pediatr Nurs*. 1993; 19:405–9.
26. Danek G, Noris EM. Pediatric iv catheters: efficacy of saline flush. *Pediatr Nurs*. 1992; 18:111–3.
27. LeDuc K. Efficacy of normal saline solution versus heparin solution for maintaining patency of peripheral intravenous catheters in children. *J Emerg Nurs.* 1997; 23:306–9.
28. Intravenous Nurses Society. Infusion nursing standards of practice. *J Infus Nurs.* 2011; 34:37–72.
29. Romanowski GL, Zenk KE. Intravenous flush solutions for neonates. Paper presented at ASHP Midyear Clinical Meeting. New Orleans, LA; 1991 Dec 10.
30. Klenner AF, Fusch C, Rakow A, et al. Benefit and risk of heparin for maintaining peripheral venous catheters in neonates: a placebo-controlled trial. *J Pediatr.* 2003; 143:741–5.
31. Shah PS, Ng E, Sinha AK. Heparin for prolonging peripheral intravenous catheter use in neonates. *Cochrane Database Syst Rev*. 2005; 4:CD002774.
32. Goldberg M, Sankaran R, Givelichan L, et al. Maintaining patency of peripheral intermittent infusion devices with heparinized saline and saline. *Neonatal Intensive Care.* 1999; 12:18–22.
33. Heilskov J. A randomized trial of heparin and saline for maintaining intravenous locks in neonates. *J Soc Pediatr Nurs.* 1998; 3:111–6.
34. Altimier L, Brown B, Tedeschi L. NANN guidelines for neonatal nursing policies, procedures, competencies, and clinical pathways. 4th ed. Glenview, IL: National Association of Neonatal Nurses; 2006.
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 Health-System 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.

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This document supersedes the ASHP therapeutic position statement on the institutional use of 0.9% sodium chloride injection to maintain patency of peripheral indwelling intermittent infusion devices approved by the ASHP Board of Directors on January 12, 2006.

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