The Institute for Safe Medication Practices Canada (ISMP Canada) is an independent national nonprofit agency established for the collection and analysis of medication error reports and the development of recommendations for the enhancement of patient safety.

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A Need to "Flush" Out High Concentration Heparin Products

ISMP Canada has received a medication error report involving heparin. The information has been shared by a hospital to provide an alert to other hospitals and healthcare providers.

A triple-lumen catheter was inserted into a patient requiring central venous access (also known as a central venous line [CVL] or central venous access device [CVAD]). After insertion, 1 mL of heparin 10,000 units/mL (instead of the intended 1,000 units/mL) was diluted with 9 mL normal saline and administered into each of the three lumens (total of 30,000 units of heparin). The next day a nurse found the central line catheter had been accidentally pulled out. Since central venous access was still required, it was decided to reinsert another CVL. Again, three 1 mL vials of concentrated heparin (10,000 units/mL) were used (each diluted with 9 mL normal saline), however the total dose of heparin administered after the second CVL insertion is unknown.

The following day, there was a decrease in the patient's blood pressure and severe bruising at the insertion site. The patient was found to have an elevated aPTT and INR, and a substantial decrease in hemoglobin. Treatment included administration of intravenous fluids, plasma volume expander Pentaspan®, fresh frozen plasma, packed red blood cells, and platelets. The patient was transferred to the Intensive Care Unit, but later developed septicemia from an infected hematoma and died of complications a few weeks later.

Because heparin has several indications, it is supplied in ampoules or vials ranging in concentration from 10 units/mL to 25,000 units/mL:[1]

Concentration/mL	Concentration/Total Volume	Unit Size
10 Units/mL	10 Units/mL	1 mL
10 Units/mL	100 Units/10 mL	10 mL
100 Units/mL	200 Units/2 mL	2 mL
100 Units/mL	1,000 Units/10 mL	10 mL
1,000 Units/mL	1,000 Units/mL	1 mL
1,000 Units/mL	10,000 Units/10 mL	10 mL
1,000 Units/mL	30,000 Units/30 mL	30 mL
10,000 Units/mL	10,000 Units/mL	1mL
10,000 Units/mL	50,000 Units/5 mL	5mL
25,000 Units/mL*	5,000 Units/0.2 mL	0.2 mL
25,000 Units/mL	50,000 Units/2 mL	2 mL

* High concentration product, however unit dose ampoule provides only 5,000 units.

Figure 1: From left to right: Heparin Lock Flush 100 units/mL (green); Hepalean-Lok® 10 units/mL (pink); Heparin injection 1,000 units/mL - 10mL and 1mL (black); and Heparin 10,000 units/mL - 5mL and 1mL (red).

Different concentrations, while packaged in vials with differently coloured caps and matching coloured labels are supplied in identically sized and shaped vials. This necessitates a very careful evaluation of both the range of heparin products required for use in hospital, and those which will be made available in patient care areas. **Patient injury as a result of a substitution error can occur in any hospital where vials of concentrated heparin, such as 10,000 units/mL, are available in patient care areas.**

Heparin is commonly used to "lock" central venous lines. Generally, protocols provide for a minimal concentration of heparin and a volume equivalent to that of the lumen. The protocol may also require the withdrawal of the heparin lock solution from the lumen prior to flushing (with normal saline) to prevent systemic heparin administration. Confusion can arise because protocols for various types of central lines sometimes combine flushing and locking in one step.

The contributing factors to the incident described above, as identified by the hospital include:

- Availability of multiple concentrations of heparin in the patient care area.
- Poor legibility of the 1 mL heparin vial label due to small size of vial, small label and small print.
- Incomplete communication between physicians and nurses at the time of gathering drugs and supplies for CVL insertion and during the procedure. It is noteworthy that the new hospital protocol for locking of central venous lines was to use a heparin concentration of 10 units/mL.

- The heparin dose administered was not documented on the patient's health record, potentially delaying and preventing recognition of the first error.

The hospital is initiating a number of actions to safeguard patients from similar events including:

- Storing heparin flush solutions separately from other heparin products in patient care areas;
- Reviewing the process for education about hospital protocols;
- Developing a pre-printed order form for central line insertion, including details on the use of heparin;
- Proposing the development of a procedure kit for central venous line insertion; and
- Providing a notice about high-alert drugs[2] and their availability in multiple concentrations.

ISMP Canada recommends that hospitals consider the following strategies for reducing the risk of a similar incident:

1) Eliminate the 10,000 units/mL formats of heparin from patient care area medication stock.
   - Use marketed, pre-mixed solutions of heparin for intravenous (IV) indications.
   - Purchase single-dose heparin such as the 5,000 units/0.2 mL ampoule (or the pre-filled heparin 5,000 unit syringe, available through special contract) for subcutaneous use.
   - Use 1,000 units/mL heparin for administration of IV bolus doses.
2) Re-evaluate the stock of heparin solutions in patient care areas since "often, more concentrations than necessary are present in both the pharmacy and patient units".[3]
3) Critically review the locking and flushing protocols for all CVADs to ensure that the lowest dose of heparin (or alternative) is used, to reduce the variety of heparin products needed in ward stock and to reduce the potential for adverse events (e.g., product mix-ups, heparin-induced thrombocytopenia [HIT]).
4) Provide readily accessible protocols that outline procedures for insertion, locking and flushing of the various CVADs. Some hospitals have developed summary charts of such protocols as a succinct reference at point of care.
5) Ensure that lock or flush protocols using an anticoagulant (e.g., heparin) require documentation in the patient's health record of the dose used.
6) Consider the use of resource nurses from specialized areas (e.g., ICU, PACU, OR), familiar with CVAD insertion and maintenance, to provide assistance to physicians when CVADs are inserted on general care units.

References:

1 Obtained from the Health Canada Drug Product Database (DPD). Available at: http://www.hc-sc.gc.ca/hpb/drugs-dpd/. Accessed November 1, 2004.
2 ISMP's list of high-alert medications, December 2003. Available at http://www.ismp.org/msaarticles/highalert.htm. Accessed June 6, 2004.
3 ISMP Medication Safety Alert! Heparin mix-ups. 2003. August 21; 8(17):1.

ISMP Canada has a national voluntary medication incident and 'near miss' reporting program founded for the purpose of sharing the learning experiences from medication errors. Implementation of preventative strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in healthcare is our collaborative goal.

To report a medication error to ISMP Canada: (i) visit our website www.ismp-canada.org, or (ii) e-mail us at info@ismp-canada.org, or (iii) phone us at 416-480-4099. ISMP Canada guarantees confidentiality and security of information received. ISMP Canada respects the wishes of the reporter as to the level of detail to be included in our publications.

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