Programming Errors with Heparin Infusions

Continuous intravenous (IV) infusions of heparin administered via smart infusion pumps are subject to programming errors. Recently reported mistakes have resulted in subtherapeutic doses of IV heparin placing patients at risk for thromboembolic complications. Most continuous IV heparin infusions are weight-based, typically start with a bolus dose and then are titrated based on coagulation laboratory tests.

Some facilities have implemented interoperability between the electronic health record (EHR) and smart infusion pumps. This functionality enables the infusion orders, which have been reviewed by a pharmacist, to pre-populate the smart infusion pump screen, reducing the risk of manual programming errors. The settings must be confirmed by a nurse prior starting the infusion. The infusion is also automatically documented in the EHR. However, errors were made in patient units where interoperability was not instituted such as the emergency department (ED) and surgical/procedural areas.

The primary error has occurred when a nurse selected “non-weight based” instead of “weight based” on the initial pump screen. For example, the pump was programmed to deliver only 12 units per hour for an 80 kg patient who should have received 12 units per kg per hour, or 960 units per hour. The dose error-reduction system (DERS) was initiated and the smart pump issued a soft low-dose alert, however this was overridden by the nurse. Low-dose alerts cannot be configured as hard stops in certain smart infusion pumps. One small study identified 25 cases in three facilities in which the heparin infusion ran for at least 20 minutes as units per hour instead of units per kg per hour.

The following strategies may help reduce the risk of heparin infusion errors:

- Assess smart infusion pump data (at least quarterly) to investigate whether IV heparin errors have occurred in your facility.
- Standardize heparin infusions for weight-based dosing only; eliminate non-weight-based dosing for heparin or limit this programming choice to areas where it is absolutely needed.
- Program a hard stop for low-dose alerts with heparin if your smart infusion pump allows.
    - If your smart pumps do not have this capability, educate your nursing staff on low-dose alerts and the risks of subtherapeutic heparin doses.
    - Low-dose alerts indicate a programming error and should trigger an independent double-check.
    - All overridden smart pump alerts (high- and low-dose limits) should be reviewed.
- Implement bi-directional smart pump interoperability with the EHR including auto-programming and auto-documentation.
    - Ensure enough smart infusion pumps and channels are available in all clinical areas.
    - Drugs used during a code blue, rapid responses, trauma care, and thrombolytics for stroke patients may be excluded in the ED during management of emergencies.
    - Interoperability may be limited in surgical procedural areas due to workflow restrictions.

Reference

1. Institute for Safe Medication Practices. (2020). *Nurse Advise-ERR.* Retrieved from Institute for Safe Medication Practices: https://www.ismp.org/nursing/medication-safety-alert-october-2020

- Require an independent double check of all programming parameters and verification of the patient's name, patient's weight, drug (concentration and dose rate), line attachment, and dose-based lab values before heparin infusion is started.
    - If a second nurse is not available, have a pharmacist confirm the calculation, dosing, and rate settings.

Drug Name Stem "-calci-"

The drug name stem "calci", a prefix or infix (inserted in the middle of a drug name), is used to denote vitamin D analog drugs. Vitamin D analogs regulate bone and calcium homeostasis and treat hyperparathyroidism, vitamin D deficiency, calcium deficiency, and psoriasis. There are eight Vitamin D analogs available in the U.S. and two combination products:

- Calcifediol (Rayaldee): taken orally to prevent hyperparathyroidism associated with chronic kidney disease
- Calcipotriene (Dovonex, Sorilux): topical to treat psoriasis
- Calcitriol (systemic) (Rocaltrol): capsule, oral solution and IV solution to prevent hyperparathyroidism associated with chronic kidney disease
- Calcitriol (topical) (Vectical): ointment to treat psoriasis
- Cholecalciferol (Vitamin D3, over the counter [OTC]): taken orally to treat Vitamin D deficiency
- Doxercalciferol (Hectorol): oral and IV solution to treat Vitamin D deficiency
- Ergocalciferol (Clacidol [OTC], Calciferol [OTC], Drisdol, Ergocal): taken orally to treat Vitamin D deficiency
- Paricalcitol (Zemplar): oral and IV solution to prevent hyperparathyroidism associated with chronic kidney disease
- Cholecalciferol and alendronate (Fosamax Plus D): taken orally to treat osteoporosis in postmenopausal women and increase bone mass in men with osteoporosis
- Calcipotriene and betamethasone (Enstilar, Taclonex): topical form to treat psoriasis

Excessive amounts of drugs taken to treat vitamin D deficiency can lead to toxicity – signs include nausea, vomiting, loss of appetite, constipation, dehydration, fatigue, irritability, confusion, weakness, and weight loss. Patients using topical products should avoid sunlight, use sunscreen and wear protective clothing and eyewear. Drugs used to treat hyperparathyroidism may cause hypercalcemia, digitalis toxicity (in patients taking digoxin), and a change in bone density related to chronic kidney disease. Monitor serum calcium and phosphorus levels as well as parathyroid hormone (PTH). Drug used to treat osteoporosis may cause bone, joint, or muscle pain; osteonecrosis of the jaw; atypical femur fractures; worsening heartburn; and hypocalcemia.

Reference

1. Institute for Safe Medication Practices. (2020). *Nurse Advise-ERR.* Retrieved from Institute for Safe Medication Practices: https://www.ismp.org/nursing/medication-safety-alert-october-2020