Improving the Safety of Heparin Therapy

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Improving patient safety and reducing medication errors can be a daunting prospect. One way of concentrating the efforts of a health-care organization is to concentrate first on medications that are “high-risk.”

These medications are complex to use, have a great potential for error at multiple steps and also have a great potential for patient harm from the medication. Heparin is certainly a “high-risk” medication.

My hospital belongs to a collaboration of health-care organizations in our metro area that are working together to improve patient safety. One of the first projects was to formulate recommendations to improve the safety of heparin therapy that could be used in our collaboration’s hospitals.

HEPARIN

Heparin is a complex medication and there are many potential places for error all along the system. The diagram below describes the basic medication-use system.

The following is a very abbreviated list of potential medication errors at each step:

Prescribing Errors: Abbreviating “units” by “u”, not using weight-based dosing, using the incorrect patient weight, not capping the weight for obese patients, using the wrong protocol or dosing nomogram.

Dispensing Errors: Using non-standard infusion concentrations, either not using premade bags or not having the pharmacy prepare the infusion, misreading the vial or bag label.

Administration Errors: Miscalculating the dose or infusion rate, misreading the vial or bag label, transcribing incorrectly on the medication administration record (MAR), poor documentation, misprogramming the infusion pump, not using a pump protected from free flow.

Monitoring Errors: Not getting the lab drawn at the correct time, forgetting or misreading the lab result, misinterpreting the dosing nomogram, miscalculating the new dosage or infusion rate.

MISUSE

Not only is heparin use prone to medication errors, there is a great potential for harm to the patient from its misuse. Heparin has a very narrow therapeutic range. Supratherapeutic anticoagulation levels increase the risk of bleeding complications. The bleeding risk is also increased with concomitant platelet active agents and thrombolytics as well as recent surgery, etc. On the other hand, inadequate anticoagulation in the first 24 hours of therapy has been shown to increase the risk...
of recurrent thromboembolism. The use of weight-based standardized heparin dosing nomograms increases the proportion of patients achieving the therapeutic partial thromboplastin time (PTT) range in the first 24 hours.

Recommendations to improve the safety of heparin therapy can be obtained by reviewing the literature and the recommendations from patient safety organizations. The sidebar contains a list of a few organizations, and their websites, and references. In the end, each hospital and health-care organization must examine its own heparin use process and develop its own risk reduction strategies. An experienced group of physicians, pharmacists, and nurses must work together to develop and implement strategies for improvement. The following is a list of potential strategies that could be implemented to reduce the risk of medication errors and harm from heparin.

ERROR REDUCTION

Prescribing: Develop and use weight-based heparin dosing nomograms to achieve a therapeutic range that corresponds to an anti-Xa level of 0.3-0.7 units/mL for fully therapeutic anticoagulation.

Preprinted orders should be clear, easy to read and calculate, and have clear directions for lab monitoring and dosage adjustment. Orders should have directions to discontinue any other heparin (except for line flushing) or low molecular weight heparin (LMWH) therapy. Consider using LMWHs instead of heparin (less prone to error, but higher medication costs).

Dispensing: The pharmacy should dispense all heparin infusion bags. The pharmacist should review the medication profile for allergies, therapeutic duplications, correct weight and calculations prior to administration (unless in an emergency). The pharmacy should minimize the number of different heparin concentrations and products on the formulary to only those essential ones. Only one concentration of heparin for line flushes should be available on floor-stock/override. Only one standard concentration for heparin infusions should be used. (The 100 unit/mL concentration is recommended to facilitate rate calculations.)

Administration: Develop and use consistent procedures for flushing different intravenous (IV) access lines and devices (to avoid confusion with products for therapeutic heparin administration).

Use preprinted MARs or computerized dosage references that correspond to the dosing nomogram. Use programmable “smart pumps” that have standard concentrations and usual dosage limits built in. All doses and infusion rates should be documented properly on the MAR so that anyone reviewing the MAR will know that the patient is on heparin (IV flow sheets and I/O sheets should be cross-linked to the MAR). Consider where independent double-checking of heparin administration would be likely to discover and prevent errors.

Monitoring: Preprinted order sets should have clear directions for lab testing and dosage adjustments. Automated methods for ordering and checking lab tests could be developed. At some hospitals, pharmacist-run heparin dosing services have been developed to efficiently provide monitoring and dosing adjustments 24 hours per day.

OTHER RECOMMENDATIONS

There are other possible recommendations for improving heparin safety that might be considered. Some strategies may work for some hospitals and some situations. Not everything will work for all situations.

There are different strategies for change and assessment that hospitals committed to improving the safety of heparin therapy can use. A traditional Drug Utilization Evaluation can study the care of the patients under current practices and then compare that with the care after improvements are implemented. Some major outcome measures will include (1) the percentage of patients therapeutic within the first 24h, (2) percentage of PTT values over a critical high level, (3) the percentage of patients with major and minor bleeding complications. The rapid-cycle process (PDCA – plan, do, check, act) implements and tests small improvements done sequentially in a quick cycle process. The Failure Mode and Effects Analysis looks for each step in the process where error can occur and estimates the probability of error, probability of detection, and likelihood of harm. Improvement projects should be concentrated on the steps in the process with the highest numbers. The numbers can be recalculated after change projects to track improvement over time. More information on these processes can be found in the patient safety organizations and references.

Heparin therapy is complex, error prone, and potentially harmful. By examining the system of care and applying best practices, we can improve the safety and efficacy of therapy.

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