CRITICAL CARE

LETTER

Heparin algorithm for anticoagulation during continuous renal replacement therapy

Marlies Ostermann*, Helen Dickie, Linda Tovey and David Treacher

Abstract

Premature circuit clotting is a problem during continuous renal replacement therapy. We describe an algorithm for individualised anticoagulation with unfractionated heparin based on the patient's risk of bleeding and previous circuit life. The algorithm allows effective and safe nurse-led anticoagulation during continuous renal replacement therapy.

Introduction

Continuous renal replacement therapy (CRRT) has become an established treatment for patients with acute kidney injury in the intensive care unit (ICU). Premature circuit clotting is a common problem, leading to reduced circuit life, to reduced clearance and also to increased blood loss, work load and cost of therapy [1]. There are different ways of maintaining the circuit patent [2]. An international questionnaire showed that in the UK more than 98% of ICUs surveyed used unfractionated heparin [3]. The major advantages of unfractionated heparin are the low costs, familiarity, ease of administration and reversibility with protamine. CRRT is predominantly nurse-led [4]. After a decision is made to start CRRT, nurses usually prepare and manage the technique.

Unfractionated heparin is the first-line anticoagulant in our unit. In order to enable the nursing staff to manage CRRT effectively and safely, we aimed to have clear guidelines in place, including an algorithm for the use of heparin.

Methods

We contacted seven large ICUs in the UK and three units outside the UK. None of the ICUs contacted had a guideline for the use of unfractionated heparin during CRRT. We therefore designed an algorithm based on data from the literature and our own clinical experience (Figure 1).

Results

The principles of the algorithm (Figure 1) are as follows. First, unfractionated heparin is administered via the circuit. Second, heparin is administered into the circuit priming solution before the blood is in contact with plastic surfaces (10,000 iu heparin/1,000 ml of 0.9% NaCl). Third, the dose of heparin is based on the patient's body weight. Fourth, the starting dose of heparin is individualised depending on the risk of bleeding and the previous circuit life – subsequent doses can be adjusted by the nursing staff according to the algorithm without the need for a medical review. Fifth, there is no target activated partial thromboplastin time ratio but this ratio is kept ≤2 to prevent over-anticoagulation. Sixth, regular attention is paid to nonpharmacological methods to maintain circuit patency (that is, change of vascular access, blood flow, predilution/postdilution ratio).

A recent audit covering the period May 2008 to May 2009 confirmed a mean circuit life of 19.8 hours using unfractionated heparin without any untoward incidents.

Copies of our algorithm have already been requested by several ICUs in the UK. The aim of the present paper is therefore to share our practice more widely.

Conclusion

Our heparin algorithm allows nurse-led effective and safe anticoagulation with unfractionated heparin during CRRT.

Abbreviations

CRRT, continuous renal replacement therapy; ICU, intensive care unit.

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Competing interests

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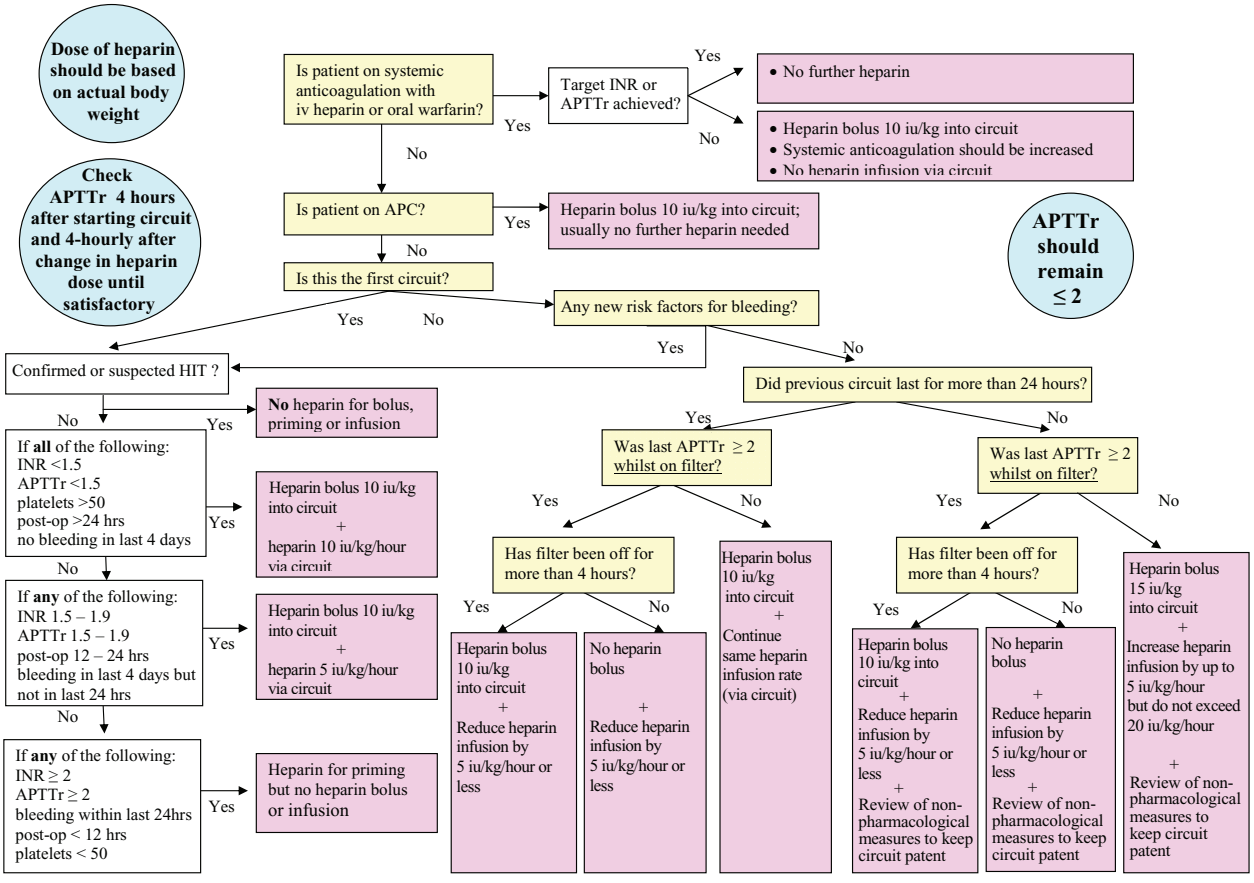

Figure 1. Algorithm for heparin anticoagulation during continuous renal replacement therapy. Algorithm is based on using 10,000 iu heparin in 40 ml of 0.9% NaCl. APC, activated protein C; APTTr, activated partial thromboplastin time ratio; CRRT, continuous renal replacement therapy; HIT, heparin-induced thrombocytopenia; INR, international normalised ratio; iv, intravenous; post-op, postoperative.

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LETTER Open Access

Revised algorithm for heparin anticoagulation during continuous renal replacement therapy

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Premature clotting of the circuit is the most common reason for unplanned interruptions in renal replacement therapy (RRT) and discrepancies between the prescribed and delivered dose of RRT [1]. The recent guideline from the Kidney Disease Improving Global Outcomes (KDIGO) working group recommended citrate as the first-line anticoagulant for continuous renal replacement therapy (CRRT) [2]. For patients with contraindications to citrate, either unfractionated or low molecular weight heparin was recommended.

Worldwide, unfractionated heparin is the most commonly used anticoagulant to maintain circuit patency [1]. The potential risks including bleeding and heparin-induced thrombocytopenia are well known. In 2010, we designed an algorithm to enable the nursing staff to manage heparin during CRRT effectively and safely [3]. In response to new knowledge and changes in clinical practice, we have revised the algorithm (Fig. 1).

The main principles of the algorithm are maintained as follows:

1. The indication for heparin should be reviewed daily. Heparin should be avoided in patients with an increased bleeding risk.
2. Unfractionated heparin is administered via the circuit unless the patient needs systemic anticoagulation for other reasons.
3. The dose of heparin is based on actual body weight.
4. Dosing of heparin is "individualised" depending on the patient's risk of bleeding and previous circuit life.
5. There is no target activated partial thromboplastin time ratio (APTTr) but APTTr ≤2 is maintained to prevent overanticoagulation.
6. Nonpharmacological methods should be considered regularly to maintain circuit patency.

The main changes to the algorithm are the following:

1. We previously suggested adding heparin to the circuit priming solution before the blood is in contact with plastic surfaces to coat the surfaces of the filter membrane and circuit tubing. It has since been brought to our attention that a randomised controlled cross-over study in 11 patients on CRRT showed no beneficial effect of heparin rinse on the thrombogenicity of the circuit, complement activation or blood leukocyte counts [4]. Therefore, instead of using 10,000 IU heparin in 1 l of 0.9 % saline to prime a circuit with total volume ~270 ml, we suggest administering a bolus of 2500 IU heparin on connection.
2. Following the withdrawal of activated protein C [5], a reference to this drug has been removed from the algorithm.

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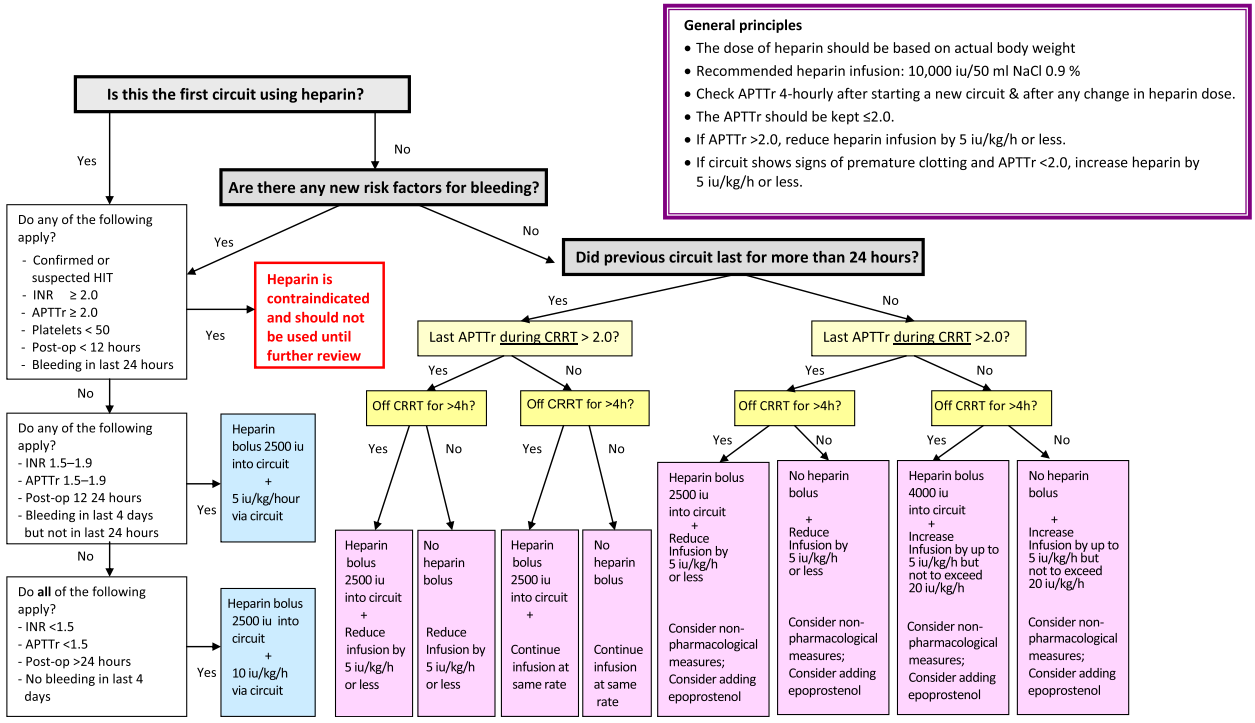

Fig. 1 Algorithm for heparin anticoagulation during CRRT. *APTTr* activated partial thromboplastin time ratio, *CRRT* continuous renal replacement therapy, *HIT* heparin-induced thrombocytopenia, *INR* international normalised ratio

The systemic effects of heparin are a potential drawback of CRRT. We hope that our proposed algorithm reduces this risk and allows effective and safe anticoagulation.

Abbreviations

APTTr: Activated partial thromboplastin time ratio; CRRT: Continuous renal replacement therapy; KDIGO: Kidney Disease Improving Global Outcomes; RRT: Renal replacement therapy.

Competing interests

The authors declare that they have no competing interests.

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