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ORIGINAL ARTICLE

Continuous venovenous renal replacement therapy in critically ill patients: A work load analysis

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Continuous renal replacement therapy;
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Nursing activity;
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Regional citrate anticoagulation

Summary
Objectives: To evaluate the nursing workload related to two techniques of continuous renal replacement therapy.
Research methodology: We analysed retrospectively the nursing work load caused directly by continuous renal replacement therapy in a cohort of patients admitted consecutively over 10 months. Two types of continuous renal replacement therapy have been compared: dialysis with regional citrate anticoagulation and haemodiafiltration with systemic heparin coagulation.
Setting: Academic Hospital Intensive Care Unit.
Main outcome measures: The nursing workload was defined by the time spent in the management of continuous renal replacement therapy, including preparation of the circuit and related biological controls.
Results: 60 patients underwent a total of 202 sessions of continuous renal replacement therapy. The nursing workload as expressed as % time of nursing care was similar (12.3 [9.4–18.8] vs 13.4 [11.7–17.0] %, for haemodiafiltration and dialysis respectively, $P = 0.06$). However, the distribution of the nursing workload is different: the bigger proportion of care is circuit preparation in haemodiafiltration and biology control in dialysis.
Conclusions: Nursing time dedicated to continuous renal replacement therapy is similar whatever the renal replacement therapy technique. However, a longer duration of the filter and a better circuit predictability with dialysis and citrate anticoagulation are potential benefits for nursing workload.

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Implications for Clinical Practice

- Few studies have addressed the issue of nursing workload related to continuous venovenous replacement therapy (CRRT) in ICU.
- The study shows that CRRT requires nursing care for less than 15% of the dialysis time whatever the technique used, continuous veno-venous haemodiafiltration with systemic anticoagulation with heparin (CVVHDF) or continuous veno-venous haemodialysis with regional citrate anticoagulation (CVVHD).
- However the techniques are not equal. CVVHDF is associated with repetitive and unpredictable circuit changes, which represent a mean 90 minutes dialysis break, and disruption in the nursing plan. CVVHD requires more time dedicated to biological controls but is more predictable with less dialysis break than CVVHDF.
- Therefore, the technique chosen for CRRT has a significant impact on nursing workload.

Introduction

The load of nursing care is one of the elements that contribute to patients outcome in the Intensive care Unit (ICU) and would influence the prognosis (Kelly et al., 2014). We know that a high patient/nurse ratio impacts on safety and may even increase mortality in ICU (Penoyer, 2010), as it has been demonstrated in more routine care (Aiken et al., 2002; Needleman et al., 2002, 2011). The subject is still debated (Moreno et al., 2009), but it seems well established that a heavy nursing workload is source of complication and expense, especially after surgery (Amaravadi et al., 2000).

Little attention has been paid in the literature to the nursing workload in the management of renal replacement therapy (CRRT) in critically ill patients (Miranda et al., 2003). CRRT is frequently used in ICU, takes time to nurses and decreases nurses' availability to other treatments. A new anticoagulation technique of dialysis circuit appeared in the early 2000s that requires in regional anticoagulation with citrate (Palsson and Niles, 1999). Citrate regional anticoagulation extends the circuit lifespan and reduces costs when compared to a circuit anticoagulated with unfractionated heparin (Korkeila et al., 2000; Oudemans-van Straaten et al., 2009; Schilder et al., 2014; Zhang and Hongying, 2012). Indeed, regional citrate anticoagulation reduces the risk of bleeding, a significant advantage after cardiac surgery (Morabito et al., 2012). Consequently, it allows a simpler management by avoiding untimely dialysis breakdown. However, it interferes with calcium metabolism and alters the acid—base balance; therefore the use of citrate imposes more constraints in terms of biological monitoring (Hetzel et al., 2011).

Two years after the implementation of regional citrate anticoagulation technique in our ICU, a sufficient period to develop expertise within the team, we noticed several differences in the nursing care of the CRRT between the two anticoagulation techniques (systemic heparin and regional citrate). We have therefore designed a retrospective observational study in order to compare the nursing workload of the two techniques. We have precisely defined the nursing workload related to dialysis and have observed its distribution from a cohort of consecutive patients in a post cardiothoracic surgical ICU.

Methods

This is an observational study of all CRRT sessions performed in the cardiothoracic surgical ICU of University Hospital of Montpellier between June 2012 and February 2013.

Definitions

Definition of continuous renal replacement therapy (CRRT) session

The session was defined as any CRRT for a minimum of 24 hours and maximum 72 hours in accordance with regulatory condition use of the circuits. For each session, a CRRT file was opened as soon as the renal replacement therapy indication was decided, where all the data for the session, including all the interventions required by CRRT management, were collected. The nurse in charge of the patient completed the file. After disconnection, the nurse recorded the alarm history, the treatment time and filter duration provided by the CRRT machine.

A new file was started (even if it was the same patient) unless the session was interrupted within the first 24 hours. In this case, we considered this the same session.

Continuous renal replacement therapy techniques

The CRRT routinely used in the unit was either a continuous veno-venous haemodialysis (CVVHD), or continuous veno-venous haemofiltration (CVVHDF) with the same type of machine (Multifiltrate, Fresenius Medical Care, Bad Homburg, Germany). The design of the CRRT machine allowed use of regional anticoagulation with citrate for CVVHD, but not for CVVHDF where unfractionated heparin was used intravenously.

Anticoagulation with heparin was prescribed to ensure effective systemic anticoagulation, usually 1.5—2 times the reference (aPTT 50—60 s). Each dose change was reviewed after six hours and at least once daily. For regional citrate anticoagulation, the protocol followed was the one recommended by the circuit and solutes provider (Fresenius Medical Care). A solution of trisodium citrate 4% was administered continuously by a specific pre-dilution pump coupled to the blood flow rate to obtain a constant citrate plasma

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