

A Continuous Renal Replacement Therapy Protocol on the Updated Nikkiso Aquarius Platform Using Regional Citrate as First-Line Anticoagulation Significantly Improves Filter Life Span but the Position of the Vascular Access is Key

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Dear Editor,

Regional citrate anticoagulation (RCA) is the recommended standard anticoagulation for the continuous renal replacement circuit in critically ill patients with and without contraindication to heparin [1]. The Nikkiso Aquarius platform (Nikkiso Europe GmbH, Hannover, Germany) has recently been successfully modified to support RCA through a post-dilution continuous veno-venous haemofiltration (CVVH) protocol (where the replacement fluid contains calcium), and this has been reported in this journal [2]. Following appropriate training on the application of this specific RCA system, our local Aquarius-specific continuous renal replacement therapy (CRRT) protocol (A) was updated to default to RCA as the first-line therapy bar contraindications such as acute liver failure and metabolic alkalosis (pH >7.5). If RCA is contraindicated, then CVVHDF with heparin is second line and if heparin is contraindicated then CVVH with ~100% pre-dilution is third. We compared our filter life span with the historical result taken 1 year before RCA was introduced, where CVVHDF with heparin and CVVH with

pre-dilution were first- and second-line therapies, respectively (protocol B).

We also assessed the influence of vascular access tip position in the central veins as this is known to significantly influence the filter survival [3]. Our unit only uses the 13.5Fr NIKISSO flexible silicone catheter, and according to the protocol we should use 20 cm and 24 cm lines for internal jugular and femoral vein access, respectively. They have end and side ports to facilitate blood flow. There were 41 and 24 patients in each group using 141 and 63 filters, respectively. Admission reason was split between medical, surgical, and polytrauma at an approximate ratio of 75:20:5. Primary anticoagulation was 76% RCA and 24% heparin in protocol A and 42% heparin and 58% pre-dilution in protocol B. The median filter survival, censored for reasons other than clotting, was 28 vs. 18 h ($p = 0.016$) for protocol A vs. protocol B.

The secondary analysis of line tip position for all patients (141 filters) in protocol A demonstrates an overwhelming influence on filter survival secondary to clotting

(Fig. 1). A total of 96 (68%) filters used RCA, 27 (19%) heparin, and 18 (13%) used no anticoagulation (100% pre-dilution). The line tip was positioned in the right atrium or superior vena cava for 66, the brachiocephalic vein for 26 and inferior vena cava in 49 filters, respectively. Fifteen patients (46 filters) had tunneled haemodialysis lines (15 jugular and 2 femoral vein; 29 and 17 filters respectively). Although univariate analysis of factors relating to clotting depending on access does not reveal any statistically significant differences (data not shown), trends favoring RA/SVC line tip site are clear. A Cox hazard analysis for filter loss due to clotting adjusted for anticoagulation using RA/SVC as reference line tip position demonstrates a hazard ratio for clotting of 3.37 (1.82–6.26; $p < 0.0001$) for brachiocephalic and 1.99 (1.17–3.38; $p = 0.011$) for inferior vena cava tip position. No other factor, including choice

This work was performed at the Royal London Hospital in the Adult Critical Care Unit, Barts Health NHS Trust, London, UK.

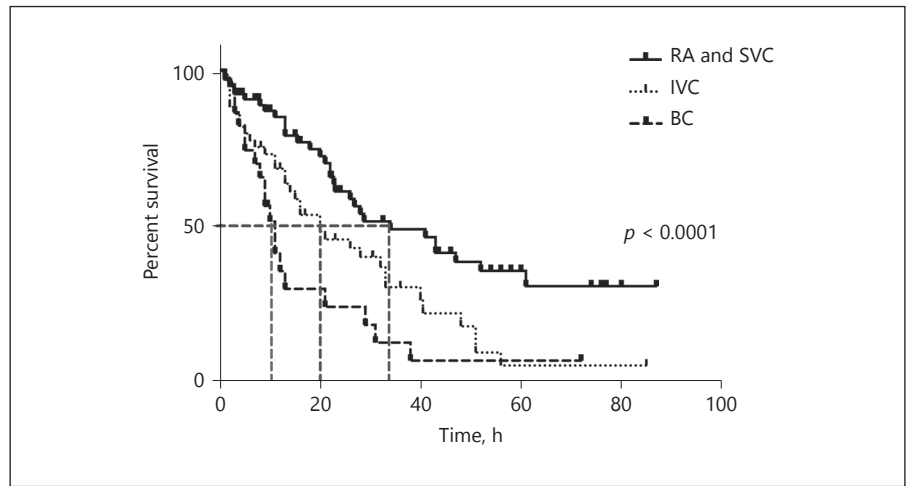


Fig. 1. Filter survival related to line tip site.

of anticoagulation influenced filter clotting.

In summary, a CRRT protocol for the updated Nikkiso Aquarius platform, where RCA can be used as first line anticoagulation significantly improves the filter life compared to one without RCA but the optimum position of the line tip at the right atrium/superior vena cava is also essential for reducing the incidence of clotting. Additional training and focus on CRRT with the nursing staff may have had an influence on improving the filter survival, but this is unlikely to be the sole

reason for the dramatic improvement seen in our data. The effects of line design on blood flow and thrombus formation are reported to have an impact on filter survival [4] and this should be considered as part of modifications to CRRT protocols.

Ethics Statement

As this was a clinical service improvement project combined with data collection and analysis as part of a prospective

audit, the Barts Health/QMUL joint research office waived the need for full Research Ethics Committee approval.

Disclosure Statement

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