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EDITORIAL COMMENT

Technology-assisted clinical care

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This article refers to 'Controlled decongestion by Reprieve therapy in acute heart failure: results of the TARGET-1 and TARGET-2 studies', by J. Biegus *et al.*, published in this issue on pages 1079–1087.

In this issue of the Journal, there is a report of two early, simple, small non-randomised trials of a deceptively simple but innovative piece of medical equipment, Reprieve Therapy™, a device that measures urine output and administers intravenous (IV) fluid at a rate that depends on the urine output.[1] The idea is simple; the clinician wants to obtain fluid loss at a certain rate, but is uncertain how much urine flow the administered diuretics will achieve, so existing practice is to see how much is produced and then either adjust the subsequent dose or advise a change in fluid therapy to compensate for over-diuresis. The problem is that the review and decision making process, other than in an intensive care setting, may be very slow, and as a result it takes many days to achieve the required net fluid loss. Physicians are quite rightly concerned about the risk of over-diuresis affecting renal function and as a result are perhaps over-cautious with their initial and follow-up diuretic dosing. With the Reprieve Therapy™ system the clinician chooses an initial diuretic regime, sets the net fluid loss per hour to be achieved and then puts in play a system that administers sufficient IV fluid to compensate for any urine output rate that exceeds this pre-set rate. There is nothing revolutionary in the concept, for indeed the recent Heart Failure Association position statement on the use of diuretics in acute heart failure[2] advises that physicians should measure urine output regularly, and more rapidly increase the diuretic dosages to ensure an adequate output is achieved.

This system is not an implantable device, it is not a drug regime, it is what I like to call a system for 'technology-assisted clinical care' for it involves a technology to measure what is already done in practice – use a urinary catheter to collect urine and an IV cannula to deliver rehydration fluids. The novel concept is automating the measurement of one to drive the rate of administration of the other. This can do what in routine practice is too slow – adjusting the clinical orders to adapt to the clinical outcomes from the initial diuretic prescription. But the technology can do far more; it can truly accelerate diuretic dose increments, because the physician can be reassured the patient is protected from dehydration by the ongoing IV fluid replacement, that on a much faster (automatic) basis replaces fluids if too much is removed. It is easy to see why the physician may feel more comfortable increasing diuretic doses more rapidly.

The two trials presented, TARGET-1 and TARGET-2, although small (n = 10 and n = 11, respectively), prove the concept elegantly. In short, the system does 'what it says on the box'; it replaces fluid if diuretics are producing above the desired rate of fluid extraction. Of course future studies will have to be larger, be controlled and prove outcomes beyond mere fluid output. It remains to be seen whether it could facilitate earlier achievement of euvolaemia, and whether that can be done with fewer instances of worsening renal function, shorter hospital admissions, or even better short or long-term outcomes.

This report is also of value because it explores an area of unmet medical need, at least in terms of evidence-based medicine. The evidence base for our recommended treatments are well described in regular expert guidelines,[3] yet much clinical management has not been subject to randomised controlled trial evaluation, and hence is not covered by such guidelines. This is particularly so for the use of diuretics and alternative decongestive therapies.[4] Such trials are beginning to emerge.[5–8] The issue of how to manage fluid balance, diuretic doses, etc., has been reviewed in recent expert papers,[9,10] although the impact of co-morbidities is often poorly understood.[11–13] Although we can make estimates of which patient factors predict those more likely to suffer adverse effects on renal function from the use of diuretic therapy,[14] the ability to streamline and monitor the use of diuretic therapy more precisely and in a more timely manner is likely to be beneficial.

In addition, you could in future imagine systems that combine other information such as, for example, measurements of blood pressure and heart rate, congestion status, electrolyte changes,[15,16] markers of renal damage, or even direct measures of intra-renal blood flow patterns.[17] One of the most important aspects for us to remember is that diuretic dose cannot be predicted because of variability between patients and the issue of diuretic resistance,[18,19] so that any system which allows us more rapidly to select the optimum diuretic regime and achieve euvolaemia more quickly would be, I believe, of real clinical value.

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