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Quality Improvement for the Management of Hyponatremia in Kidney Failure: Scholarship of Integration and Application

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Hyponatremia, which is associated with increased mortality and morbidity, is the most common electrolyte disorder encountered in clinical practice. Thus, prevention, early recognition, and optimal management are crucial; however, the management of hyponatremia is complicated. The article by Neyra *et al.*[1] provides a novel therapeutic method for severe hyponatremia in patients who need renal replacement therapy; it also demonstrates a good format of the quality improvement report for the nephrology community.

For symptomatic patients, failure of prompt correction of the serum sodium concentration may lead to severe neurological damage or death due to cerebral edema and brain herniation, whereas over-rapid correction of chronic hyponatremia can result in osmotic demyelination syndrome with severe neurological sequelae. Management of hyponatremia in patients requiring renal replacement therapy is especially challenging, because conventional hemodialysis rapidly increases serum sodium concentration. Nephrologists face a therapeutic dilemma when hyponatremic patients need emergency dialysis because of life-threatening electrolyte disorders or drug intoxication. Renal replacement therapy needs to be prescribed to remove potassium or toxins in a relatively short period, which may lead to an over-rapid increase in serum sodium concentration.

Clinical practice guidelines recommend limiting the increase in serum sodium concentration to a total of 10 mEq/l during the first 24 hours, and 18 mEq/l during the first 48 hours as a safe limit. Although evidence is lacking concerning whether the same limit applies to dialysis patients, it may be prudent to avoid over-rapid correction. Continuous renal replacement therapy (CRRT) is the preferred modality, because the lowest dialysate sodium level is 130 mEq/l in most hemodialysis machines, which poses a risk for the over-rapid correction of hyponatremia. To provide effective dialysis while avoiding rapid increases in serum sodium concentration, several methods of prescribing CRRT were proposed,[1–3] such as using low-sodium replacement fluid, and using standard replacement fluid and i.v. 5% dextrose in water infusion in the post-hemofilter to facilitate dilution of the blood exiting the hemofilter to keep serum sodium concentration at the preset concentration. In their article, Neyra *et al.*[1] adopted a simple method based on single-pool urea kinetic modeling and a hybrid technique of volume exchange with the addition of sterile water for sodium dilution of the standard dialysate and replacement fluid solution. They reported 3 cases that were successfully and safely treated with this method. The nephrologist and intensivist who prescribe renal replacement therapy in hyponatremic patients can manage their patients with this novel provider-friendly method.

The authors also succeeded in applying a quality improvement strategy for the management of hyponatremia in patients requiring renal replacement therapy. Delivery of renal replacement therapy is a complex process involving a multidisciplinary team and advanced technology for patients with multiple comorbidities. When treating patients with severe hyponatremia requiring renal replacement therapy, the nephrologists must select the modality and prescription. Patient-specific, tailored dialysate prescription needs to be correctly and promptly transferred and dispensed. The nephrology nurses and dialysis technicians must

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operate the machine and monitor the patient's vital signs, neurological status, intake and output, and laboratory data. Deviance of the laboratory data must be identified, promptly communicated to the nephrologists, and any modification in the prescription must be ordered and implemented in a timely manner. Providing quality care that is safe, timely, effective, efficient, equitable, and patient-centered is our utmost goal. Providing quality and safe care demands a new field of discipline: quality improvement. Quality improvement can be defined as "the combined and unceasing efforts of everyone—healthcare professionals, patients and their families, researchers, payers, planners, and educators—to make the changes that will lead to better patient outcomes (health), better system performance (care), and better professional development (learning)."[4]

Widely used quality improvement methodologies, such as PDSA (plan, do, study, act), 6-sigma, lean thinking, and the model for improvement, all share common elements: identifying the problem, setting an aim, convening the team, analyzing the work process, planning and testing changes, and measuring and learning. The authors' quality improvement project has these elements, and emphasizes the key elements for the successful implementation of the CRRT-Hyponatremia protocol. The key elements include the following: (i) identification of the need for the protocol and assembling a multidisciplinary team to develop and implement it, (ii) collaboration between the team through effective channels of communication, (iii) development of an electronic spreadsheet-based CRRT tool to standardize the process of calculating and ordering custom-made hypotonic fluid for CRRT, (iv) focus on safety measures, (v) development of a special electronic order set, (vi) close patient and CRRT monitoring, (vii) education to all members of the patient-care team, and (viii) data capturing through electronic health records. Quality improvement activity depends on the context, and the authors' work may not be applicable to other settings; however, the key concept and elements can be applied to improve the management of hyponatremic patients requiring renal replacement therapy.

Quality improvement is a scholarly work as well as real-world practice. Ernest Boyer,[5] former President of the Carnegie Foundation for the Advancement of Teaching from 1979 to 1995, broadened the meaning of "scholarship" in his seminal report *Scholarship Reconsidered*. He concluded that there are 4 functions in

Figure 1. Relationship between Boyer's[5] four functions of scholarship and streams of health care science. Knowledge generated through basic science and clinical research is translated to clinical practice guidelines or protocols by the synthesis of a body of evidence.[5–7] A structured organizational quality improvement activity using tools such as plan, do, study, act (PDSA) will close the evidence–practice gap.

scholarly work: the scholarship of discovery, the scholarship of integration, the scholarship of application, and the scholarship of teaching.[5] Discovery of a novel drug or treatment alone will not improve the health of an individual or population, unless it is translated to real-world practice. Westfall *et al.*[6] proposed 3 types of translational research: translation from biomedical science to clinical research (type 1 translational research), translation from clinical trials to guideline development (type 2 translational research), and translation from guideline to practice (type 3 translational research). Ting *et al.*[7] described that translation from guidelines to patients requires implementation and dissemination, system redesign, communication theory, behavioral and management science, and organization development. These activities are essential elements of quality improvement, and all require knowledge integration, application, and teaching, and can be regarded as scholarly work as well as practice. Figure 1 shows the relationship of Boyer's[5] 4 functions of scholarship and stream of science of health care.

Nunes *et al.*[8] conducted a systematic review on quality improvement in nephrology, and reported the paucity of high-quality studies evaluating the use of quality improvement in nephrology or reporting best practices. Disseminating information on how to publish quality improvement activities will promote quality improvement publication in nephrology, through which health care professionals share their knowledge and experience. Article format for a quality improvement report is slightly different from that for original research. SQUIRE (Standards for QUality Improvement Reporting Excellence) guidelines are used for quality improvement studies (http://www.equator-network.org/), with SQUIRE 2.0 providing a framework for reporting quality improvement research and practice.[9] The article by Neyra *et al.*[1] adheres to SQUIRE guidelines and recommendations. Nephrologists are encouraged to incorporate quality improvement methods into their everyday work and publish their learnings. In addition to the management of end-stage kidney disease, future areas of emphasis include acute kidney injury, chronic kidney disease, electrolyte disorders, and transplantation. This can be the scholarship of application and dissemination, which will bridge the gap between ideal and actual practice.

DISCLOSURE

The author declared no competing interests.

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