

Postoperative electrolyte management: Current practice patterns of surgeons and residents

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Background. Managing postoperative electrolyte imbalances often is driven by dogma. To identify areas of improvement, we assessed the practice pattern of postoperative electrolyte management among surgeons and residents.

Study design. An online survey was distributed among attending surgeons and surgical residents at the University of Toronto. The survey was designed according to a systematic approach for formulating self-administered questionnaires. Questions addressed workload, decision making in hypothetical clinical scenarios, and improvement strategies.

Results. Of 232 surveys distributed, 156 were completed (response rate: 67%). The majority stated that junior residents were responsible for managing electrolytes at 13 University of Toronto–affiliated hospitals. Supervision was carried out predominately by senior residents (75%). Thirteen percent reported management went unsupervised. Approximately 59% of residents were unaware how often attending surgeons assessed patients' electrolytes. Despite the majority of residents (53.7%) reporting they were never given tools or trained in electrolyte replacement, they considered themselves moderately or extremely confident. The management of hypothetical clinical scenarios differed between residents and attending surgeons. The majority (50.5%) of respondents considered that an electrolyte replacement protocol is the most appropriate improvement strategy.

Conclusion. Electrolyte replacement represents an important component of surgeons' workload. Despite reporting that formal training in electrolyte management is limited, residents consider themselves competent; however, their practice is highly variable and often differs from pharmacologic-directed recommendations. Optimizing how postoperative electrolytes are managed in surgical wards requires building a framework that improves knowledge, training, and limits unnecessary interventions. (Surgery 2015;158:289-99.)

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CORRECTION OF ELECTROLYTE ABNORMALITIES is a core principle of surgical management.^{1,2} Although patients with electrolyte imbalances may be asymptomatic, nonspecific symptoms such as headaches, lethargy, muscle weakness, intestinal dysmotility, and delirium are frequent.³ These nonspecific sequelae often go undiagnosed, thereby slowing

recovery and delaying discharge. In extreme cases imbalances can also result in life-threatening complications such as cardiac arrhythmias, respiratory depression, seizures, or coma. Enhanced recovery after surgery programs aim to attenuate variability in postoperative care and may minimize complications by promoting early resumption of diet and minimization of intravenous fluids.^{4,5} However, recommendations for management of electrolytes often are not standardized in enhanced recovery after surgery guidelines. Appropriate electrolyte replacement mitigates complications and enhances recovery, but improper dosing and blood work can be harmful.⁶

The goal of electrolyte replacement is to maintain homeostasis and optimize physiologic function.⁷ Typically, patients are monitored postoperatively

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with daily blood work, but the value of this practice has yet to be assessed, is not patient-centered, and generally is driven by dogma.⁸ Measuring electrolytes is useful when results are expected to be abnormal and can explain clinical manifestations; however, when values are normal, the standards for the frequency of monitoring are unknown. The frequency of electrolyte imbalances seen in the postoperative setting may justify frequent assessment, but surgeons should consider the subsequent increase in workload, patient discomfort, cumulative blood loss, and costs associated with phlebotomy.

Given that postoperative electrolyte imbalances lead to serious complications and that laboratory tests are potentially driven by habit, assessing the current practice of electrolyte replacement among surgeons is necessary. Such an assessment will determine the degree of clinical variability and may identify necessary improvement strategies. This study aimed to assess the current workload, practice pattern, and confidence of surgical residents and attending surgeons managing electrolytes in the postoperative period.

MATERIAL AND METHODS

Survey design. An online survey was developed via the use of a commercial, internet-based service (FluidSurveys, Ottawa, Canada). The survey was developed following recommendations to generate reliable, unbiased data from a representative sample of respondents (Fig 1).⁹ A list of topics was generated and included training and professional level, workload, clinical practice, knowledge, and improvement strategies. Questions were formulated based on the list of pertinent domains and redundant questions were eliminated. Knowledge was assessed through several clinical-based scenarios that were designed to reflect typical surgical patients whom residents at all training levels manage on the surgical ward. Clinical cases contained all the necessary information and were made as simple as possible to eliminate any confounding factors.

The survey was assessed through pretesting and clinical sensibility testing. Pretesting was carried out by 23 reviewers who were representative of the study population; this group included the three authors, ten attending surgeons, and ten residents. Reviewers were asked to assess user-friendliness, clarity, order of the questionnaire, and total time to complete the survey. Feedback was provided in a free text format. Clinical sensibility testing assessed how well the questions addressed the topic of interest. Twenty reviewers, including surgeons and residents, participated in this phase. The authors did not participate in this phase. Reviewers were

asked to assess the survey's objective and the interpretation and appropriateness of the clinical content of each question. Reviewers were also asked to determine the redundancy and clarity of the survey. A one-page assessment sheet was provided with the aforementioned items presented as questions with Likert scale-formatted answers.

Feedback from both the pretesting and clinical sensibility testing phases was reviewed and appropriate changes were made when considered reasonable by the authors. In keeping with basic principles of scientific survey studies, the final survey consisted of 25 questions (Supplementary Fig) and took an average of ten minutes to complete.¹⁰ The questions were primarily single and multiple-answer questions but also allowed participants to provide a free text answer.

Survey distribution. Personalized online invitations were e-mailed to each attending surgeon, clinical fellow, and resident affiliated with the Division of General Surgery and Division of Vascular Surgery at the University of Toronto, ON, Canada.

At the University of Toronto, both general and vascular surgery are each at least a five-year training program that meet the requirements of the Royal College of Physicians and Surgeons of Canada. Residents are eligible for both Canadian and American board certification. The program is privileged to have a large group of teaching hospitals each of which acts as a centralized referral centre for different surgical subspecialties. Residents rotate through core academic training sites, community sites, adult and pediatric level 1 trauma centers, and provincial cancer centers (Supplementary Table). Each service has several attending surgeons and one senior resident who manage a team of junior residents. Depending on the service there may be one clinical fellow. For the purpose of this survey, clinical fellows were considered attending surgeons because they completed accredited residency training programs, passed board certification examinations, have independent licenses to practice, and independently manage patients on the surgical ward. Junior residents were defined as residents in postgraduate years 1 and 2 (PGY1 and PGY2) and senior residents as those in $PGY \geq 3$. Given that Toronto only has one surgical training program, residents are exposed to a high volume of patients that encompass all surgical subspecialties and levels of complexity. Surgical teams manage pre- and postoperative patients as well as those requiring conservative management according to the subspecialty offered at each hospital (Supplementary Table).

Academic teaching is embedded in the curriculum at the University of Toronto surgery

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