

Patient Safety in Burn Care

Application of Evidence-based Medicine to Improve Outcomes

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KEYWORDS

• Patient safety • Quality • Value • Adverse events • Evidence-based medicine

KEY POINTS

- Patient safety is recognized as a distinct discipline that emphasizes preventing, reducing, reporting, and analyzing medical errors.
- Evidence-based medicine has evolved to not only improve patient outcomes and increase patient safety but also promote standardization of practices, reducing variability in care.
- Areas in burn care that increasingly used evidence-based medicine include resuscitation protocols, transfusion practices, vascular access, venous thromboembolic prophylaxis, and rational use of antibiotics.

PATIENT SAFETY OVERVIEW

Hippocrates may have recognized the importance of “First, do no harm” circa 400 BC, but the modern patient safety movement began in 1999, with the landmark publication of “To Err is Human” by the Institute of Medicine. In that report, the National Academy of Sciences estimated that 44,000 to 98,000 preventable deaths were due to medical errors each year. Shortly thereafter, in response to public pressure and the clear need to decrease adverse events, the Agency for Healthcare for Research and Quality defined 6 domains of health care quality that have now become the pillars for value creation: patient safety, clinical effectiveness, patient-centered care, providing timely and accessible care, improving efficiency, and correcting disparities by making health care equitable, regardless of geographic location or socioeconomic status. Today, patient safety is recognized as a distinct discipline that emphasizes preventing, reducing, reporting, and analysis of medical errors.

As we move to a value-based health care economy, replacing fee-for-service models that reward volume, quality and cost will be the key drivers that determine the value of services provided. Evidence-based medicine has evolved to not only improve patient outcomes and increase patient safety but also promote standardization of practices to reduce variability in care. Essentially, clinical practice guidelines, or “best practices,” form the backbone of evidence-based medicine, which relies on the best available research to help inform physicians regarding the best treatment plans for patients. Furthermore, patient rights and preferences are brought into medical decision making, creating integrated yet personalized treatment pathways.

In the field of burn care, culture often trumps data, but times are changing. Through national registries, multicenter trials, use of benchmarks, and prevention of such “never events” as pressure ulcers, wrong-site surgery, and catheter-related

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infections, burn centers are now becoming leaders of the patient safety movement. Without doubt, the pre-existing interdisciplinary team structure of burn care has fostered the development of clinical pathways that provide internal consistency and help establish national standards. This article reviews 5 areas in burn care that increasingly use evidence-based medicine to optimize quality and safety: resuscitation protocols, transfusion practices, vascular access, venous thromboembolic prophylaxis, and rational use of antibiotics.

RESUSCITATION PROTOCOLS

A cornerstone aspect of large surface area burn injury is shock, characterized by both cellular edema and marked vascular permeability. Underhill¹ and Cope and Moore² provided the first clinical descriptions, with recommended therapeutic resuscitation methods. In 1968, Baxter and Shires³ described a more precise method of estimating the fluid requirement with experiments on dogs. Baxter⁴ confirmed his proposal in 1978 with a case series in human patients. As a consequence, it is now rare that patients suffer the sequelae of underresuscitation, and the concern is that overresuscitation is a more prevalent danger. Pruitt⁵ described this in 2000, warning practitioners against “fluid creep,” and Cancio and colleagues⁶ demonstrated that clinicians are much more likely to increase fluid rates for low urine output (UOP) than to decrease it for high levels.

The current emphasis is finding ways to limit resuscitation volumes, because the consequences of excessive administered volumes can be both morbid and lethal, for example, abdominal compartment syndrome, extremity compartment syndromes, and organ failure. Chung and colleagues,⁷ in a study of combat victims evacuated from the combat theater, concluded that starting with a lower calculation (2 mL/kg per% total body surface area [TBSA] vs 4 mL/kg per % TBSA) would result in lower overall volumes and may improve mortality. Their study was small and may suffer from selection bias, because only patients who survived the first days of injury and reached their center were included. Other methods to decrease resuscitation volumes are the use of colloid, and using alternative methods (than UOP) to guide resuscitation. *Cochrane Reviews* assert a 2.4 to 2.93 relative risk of death in burn patients resuscitated with colloid in addition to crystalloid.^{8,9} These results have been called into question by burn providers. A recent meta-analysis found instead that use of colloid resulted in fewer gastrointestinal and central nervous

system complications and that it may reduce compartment syndrome and mortality.¹⁰ O’Mara and colleagues¹¹ affirmed that intra-abdominal pressures were significantly lower in a colloid-resuscitated group. Most current protocols advise use of albumin after 12 to 24 hours after burn, as a method to reduce overall volume infused.

With regards to resuscitation endpoints, UOP has long been the primary clinical indicator. Recently, noninvasive cardiac indices, for example, transpulmonary thermodilution, have been suggested as a more effective method, and one that may decrease overall infusion volumes.¹² A recent systematic review of a variety of alternative methods to determine resuscitation endpoints concluded that limited evidence exists that they resulted in improved outcomes.¹³

Unfortunately, current practice is supported only by a panoply of small studies; no large-scale multicenter trial has been performed to determine optimal methods of resuscitation. The most recent consensus guidelines by the American Burn Association recommend starting resuscitation based on formulas of 2 to 4 mL/kg body weight per % TBSA during the first 24 hours, adjusting that rate based on UOP of 0.5 to 1.0 mL/kg/h in adults and 1.0 to 1.5 mL/kg/h in children, and using colloid beginning at 12 to 24 hours after injury. Hypertonic saline is considered high risk, and there is minimal risk and possible benefit to the use of ascorbic acid (high-dose vitamin C).¹⁴ Until large-scale studies improve on this knowledge, these recommendations provide the best practice for resuscitation in the thermally injured patient.

TRANSFUSION PRACTICES

Patients with large surface area burns (>20%) nearly always require blood transfusions during their hospital stay, the number of which surpass those required by patients with other conditions. Reasons for this include acute red blood cell (RBC) destruction from thermal and inflammatory insults, suppressed marrow response to erythropoietin, substantial blood loss at each excision and graft procedure, and the repetitive phlebotomy to which all critically ill patients are subjected.¹⁵ There is a relationship of anemia to tissue hypoxemia, and in the burn patient, the “lethal triad” of coagulopathy, acidosis, and hypothermia can happen repetitively throughout the hospital course. It is thought that maintaining adequate hemoglobin (Hgb) will avoid acidosis by replacing the oxygen-carrying capacity of the circulating blood volume. However, in recent decades, it has become clear that blood transfusion is not without its risks, with studies demonstrating

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