

EDITORIAL

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Lessons learned for postoperative wound healing: respect the past and embrace the future

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The field of patient safety in surgery has seen dramatic improvements in the new millennium [1]. Ongoing global initiatives keep a focus on assuring timely access to appropriate care for disparities while avoiding “low value” surgical care with the goal of optimizing long-term patient outcomes [2, 3]. The widespread implementation of fast-track surgery through evidence-based “enhanced recovery after surgery” (ERAS) programs has improved key outcome metrics on a global scale, including shorter hospital length of stay, reduction of opiate use for perioperative pain control, increased patient experience scores and improved outcomes [4]. In addition, the widespread implementation of standardized sepsis intervention bundles for early recognition and treatment of patients at risk of adverse outcomes from sepsis has led to a dramatic decrease of mortality and morbidity in highly vulnerable patient populations [5]. Notwithstanding the impressive achievements by proven best practices and modern evidence-based approaches for surgical care, complications related to postoperative wound healing remain unresolved conundrum in the twenty-first century [6–10]. From a historic perspective, there have been multiple landmark achievements in the arena of aseptic surgical technique [11]. The revolutionary “germ theory”, postulated by Louis Pasteur in the 1850s, was followed by pivotal improvements in the field of antiseptic techniques, such as the use of phenol as a disinfectant spray (Lister in 1865), steam sterilization (Bergmann in 1891), rubber gloves (Halstead 1890), and surgical masks (Mickulicz-Radecki 1897) [12, 13]. The subsequent groundbreaking

discovery of penicillin by Sir Alexander Fleming in 1928 further laid the foundation for the administration of perioperative antibiotic prophylaxis and represented a foremost contribution to the development of safe surgical techniques [14]. The implementation of antiseptic surgical techniques also opened the door for the development of surgical implants, which was pioneered by grand entrepreneurs, such as Carl Hansmann (1886), Albin Lambotte (1909), Gerhard Küntscher (1940), and Robert Danis (1949) [15–17]. In 1958, the Arbeitsgemeinschaft für Osteosynthesefragen (AO) was founded and provided an umbrella for research, outcome documentation, education, development of implants and instrumentation [18]. As the learning curve has continued over the last decades, the surgical community has developed an improved understanding of appropriate soft tissue management. Thus, it has been realized that in patients with musculoskeletal injuries, successful management of the traumatized surrounding soft tissues plays a key role in achieving favorable surgical outcomes [19]. Although we have made rapid progress in improving surgical outcomes in patients with musculoskeletal injuries, we still have a long way to go. Despite the availability of appropriate antiseptic techniques, modern technology, and an improved understanding of soft tissue management, the risk of surgical site complications leaves significant room for improvement. As of today, the risk of surgical site infection in patients with high-risk lower extremity fractures, such as high-energy fractures of the tibial plateau, tibial plafond, and calcaneus, may be as high as 15% [20]. This rate may even be higher in elderly patients and patients with medical co-morbidities [6]. Surgical site infections continue to represent a significant healthcare and socio-economic problem as they frequently result in hospital re-admissions, need for secondary surgeries, need for

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long-term antibiotics, sick leave days, disability, and patient morbidity. On a daily basis, healthcare providers make a significant effort in treating patients with surgical site infections as well as researching complex surgical strategies for salvaging musculoskeletal infections [21, 22]. While the appropriate treatment of surgical site infections remains an important effort, it remains crucial to continue our focus on preventing the actual occurrence of surgical site infections, in particular in high-risk injuries and high-risk patient populations. Thus, we must continue to explore early cost-efficient interventions that carry the potential to lower the incidence of surgical site infections. Potential surgical strategies requiring further investigation include the implementation of patient safety protocols, local antibiotic delivery systems [23, 24], and incisional negative-pressure wound therapy [6, 20]. Besides improving upon operative measures, the perioperative medical management will play an increasingly important role in the prevention of surgical site infections. As we are facing an aging patient population, we will see increasing rates of medical co-morbidities associated with poor wound healing, such as diabetes mellitus, malnutrition, and obesity. Thus, further research efforts may focus on the efficacy of perioperative medical and nutritional optimization.

As of today, there remains a critical gap of knowledge in many of these areas. For instance, we must learn more about our patients' nutritional behaviors, diagnostic measures to identify specific nutritional deficits, and the efficacy of nutritional interventions. Over the last decades, the surgical community has made great strides in developing safe surgical techniques allowing for the successful treatment of many surgical conditions, which prior had to be left untreated. Looking forward, we must retain a strict focus on quality research and innovative strategies aimed at further minimizing the risk of post-operative wound complications as we are striving to improve surgical outcomes and patient safety in surgery.

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