Predictive Risk Factors for Incision Management:

An Overview

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Surgical site infections (SSIs) continue to be a problem in all surgeries. It has been reported to varying degrees, in some reports as high as 36%, based upon the surgical specialty.[1–6] In an effort to improve surgical outcomes, the management of incisions with closed incision negative pressure wound therapy (ciNPWT) has recently come to light. Traditionally, dry dressings over "Vaseline type" gauze or other non-adherent dressing has been the post-operative standard of care. Negative pressure wound therapy (NPWT) has been around since the late 1990s. It revolutionized the management of open wounds that were historically treated with packing or wet to dry dressing changes. Due to its unique mechanism of action, surgeons began using it as a way to actively manage incisions that were felt to be at risk for wound dehiscence.[7] The dressings used for this purpose were slightly modified from the ones used for open wounds as the dressings were cut to match the length and width of the incision and the clear drape was placed on the adjacent skin to protect it from the dressing. As the results of such devices were reported, companies began creating negative pressure wound therapy dressings specifically for incision management. It has become clear however, that not all patients require negative pressure incision management. Most healthy patients will be able to heal their surgical incisions without issue. The difficulty arises in determining which patients will benefit from the use of ciNPWT, especially since there is an added cost to the use of such a device. However, it is important to remember that the healthcare costs associated with the post-surgical site complications can be significant.[1,6,8,9] Therefore, in high-risk patients, it would be reasonable as well as cost-effective to use whatever preventative measures are available to prevent these from occurring.[6,10] Recently, Willy et al.[11] published multidisciplinary recommendations for the use of ciNPWT.

There are certain SSI risk factors that transcend all surgical subspecialties. The most common risk factors include diabetes mellitus, obesity, tobacco use, and prolonged surgical time. Less common patient related risk factors include ASA score, advanced age, alcohol abuse, chronic renal insufficiency, chronic obstructive pulmonary disease, hypoalbuminemia, steroid usage, and the development of a hematoma/ seroma at the surgical site.

It is well-accepted that repeated incisions, traumatized soft tissue, undermining or degloving injuries, contamination at the site, emergency surgeries, and areas that are under high-tension upon closure or are mechanically unfavorable sites are at risk for wound dehiscence.

Additionally, there are certain procedures within each subspecialty that are at higher risk for wound complications than others.[11, 12] In orthopedic surgery, patients that sustain fractures of the lower extremity are at increased risk for wound complications, especially when compounded by the soft tissue trauma which results in subsequent edema/ swelling. This is further aggravated if the patient has comorbidities. Those patients undergoing below or above the knee amputations also can be at risk for wound problems and infection. Many open general surgical procedures, colorectal procedures, urologic procedures, or OB/GYN procedures were considered to be at risk as well. Many soft tissue procedures done by plastic surgeons are at risk for wound complications. These include breast reconstruction, post bariatric abdominoplasties, and procedures with big soft tissue defects. Patients with vascular disease that are undergoing either synthetic graft implantations or sternotomies for coronary artery bypass are at risk as well. It is important to evaluate the patient risk factors, the uniqueness of each procedure and the anatomical area undergoing the intervention.

Obesity has been well-established as a risk factor for SSI in addition to other complications.[11, 12, 13, 14] Waisbren et al.[13] evaluated 409 patients undergoing elective surgical procedures in seven different subspecialties at a single hospital. They divided patients by either percent body fat (%BF) or body mass index (BMI). They felt that %BF was a more sensitive and precise measurement of SSI risk then BMI. Using %BF was associated with a five-fold increased SSI risk than non-obese patients defined as >25% for men and >31% for women (odds ratio = 5.3; 95% CI, 1.2–23.1; p = 0.03). Using %BF was associated with a five-fold increased SSI risk. Patients with obesity undergoing acetabular surgery, pelvic surgery or hip surgery are at risk for developing an infection.[15, 16] Many of these patients develop either a hematoma or seroma due to the large soft tissue envelope. This can result in wound dehiscence and then subsequently a potentially a deeper infection. Other obese patients undergoing various surgical procedures have been shown to be at risk for wound complications as well.[12, 13, 17-19] Berger et al.,[17] evaluated 888 patients undergoing open ventral hernia repair and found that a BMI ≥40kg/m2 was a significant risk factor for SSI (OR 3.2). Cardiothoracic patients have also been found to have increased risk of SSI with a BMI > 30kg/m2.[18, 19]

Diabetes mellitus and the hyperglycemic state have both been correlated with increased risk for wound infections in a multitude of specialties.[14] In a review of over 7500 patients undergoing orthopedic procedures, diabetes was found to significantly increase the risk of SSIs (OR=2.2).[22] Li et al.[23] reviewed over 2,000 patients undergoing orthopedic surgeries and found an OR of 7.5 for diabetes and the development of an SSI in their cohort. Often obesity and diabetes go hand-in-hand, which can confound the literature when looking at risk factors. Certainly, however, if the patient has both, they are even more at risk for a surgical site infection. In a systematic review and meta-analysis done by Martin et al.,[24] the overall effect between diabetes and SSI was an odds ratio of 1.53. The association was significantly higher for cardiac surgery (OR=2.03). In this study, they were able to control for BMI and felt that the effect was independent of the hyperglycemic state. They hypothesized that it was due to other manifestations of diabetes such as vascular changes or white blood cell dysfunction. It was felt to be an independent risk factor for SSI. The hyperglycemic state itself can be problematic even in the absence of diabetes. Richards et al.[25] showed that in their series of 790 patients that underwent orthopaedic procedures, the hyperglycemic state was an independent risk factor for SSI in those without a history of diabetes. If their hyperglycemic index was 1.76 or greater, the odds ratio was 4.9. This decreased to an OR of 3.3 when controlling for open fractures in their series.

Smoking clearly has deleterious effects on wound healing in multiple surgical subspecialties.[26–29] Sorenson[26] performed a systematic review and meta-analysis of the literature and found an increase in complications in the smokers. There was an increase in SSI (OR=1.79), healing delay or dehiscence (OR=2.07) and wound complications (OR=2.27). They also showed, in a sub analysis, that smoking cessation intervention could reduce SSI, but not any other healing complications. In orthopaedic procedures, smoking increases the risk of SSI. [22, 23] Jain et al.[22] reviewed the records of over 7,000 patients undergoing orthopedic procedures. They found that smoking was significantly associated with SSIs (OR=6.4). Li et al.[23] showed an OR of 2.4 for smoking and the development of an SSI. In spinal procedures, Saeedinia et al.30 showed that smoking was an independent risk factor for SSI.

Models to predict SSI have been created in hopes of providing better guidelines to determine who is at risk.[31, 32] The surgical site infection risk score (SSIRS) was increased with patient factors such as smoking and increased BMI, and other comorbidities, but it also takes into consideration operative characteristics such as the length of an operation and surgical urgency.[31] This can be used for all patients but has its limitations. Although it was validated using the National Surgical Quality Improvement Program database (NSQUIP), it needs to be externally validated before widespread use. Similarly, the Risk of Infection in Orthopaedic Trauma Surgery (RIOTS) score has been described.[32] In this predictive model, fracture classification, American Society of Anesthesiologists (ASA) classification, and body mass index are utilized to predict infection. Although both these scores are somewhat limited in their use, they do underscore the fact that the overall risk for any SSI is a composite of a multitude of factors. All of these factors, including the three highlighted (obesity, smoking, and diabetes) must be taken into consideration along with other procedural (length of procedure, surgical timing, etc.) and injury factors (open fractures, soft tissues, etc.).

Once risk factors can be better identified for various surgical procedures within the subspecialties, judicious and appropriate use of ciNPWT should result in a cost-effective impact on post-surgical outcomes in the high-risk patients. A complete risk assessment will guide the surgeon and aid in determining who best will benefit, both clinically and economically, from ciNPWT.[11]

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