Prevention of perioperative wound infections

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Surgical site infection (SSI) is the commonest hospital acquired infection that occurs in early postoperative period in surgical patients and accounts for 38% of infections in surgical patients and 31.1% of all infections in trauma patients. Ifs frequency increase parallels increase in number of risk factors. Prevention of peri-operative infection necessitates management directed at optimizing of patient factors like smoking, nutritional factors, immune-suppression, obesity and cardiovascular status. Use of principles like antibiotic prophylaxis, aseptic theatre conditions, respect of soft tissues during operation, local therapy and other modern patient safety practices is mandatory. Antibiotic prophylaxis should be started early pre-operatively at least 30-60 minutes before incision and antibiotic level exceeding minimal inhibitory concentration for infecting organism or before inflation of a tourniquet if applicable to closure of wound. Aiming at short preoperative stay in hospital, and pre-washing of the area concerned before cleaning with antiseptic are also imperative in reducing SSI. Preoperative skin preparation is an important element in prevention of infection, but removes only up to 80% of skin flora. Standard surgical antisepsis is an accepted method and involves scrubbing with antiseptic solutions. Chlorhexidine gluconate compared with povodine iodine showed a prolonged reduction in skin contamination and with less toxicity and skin irritation. Aqueous surgical hand scrubs are equivalent to traditional scrubs with regard to reduction of skin contamination, with higher surgeons protocol compliancy compared to traditional scrubs. The use of laminar flow and ultra-violet light in theatre is associated with decreased rates of postoperative skin infections and contamination. Respect of soft tissues during surgery through decrease in excessive use of diathermy, contusions and excessive tension is advised. Wound closure without tension and no dead space is encouraged. Issues of wound drainage have not been shown to reduce rates of infection. When used, closed suction drainage is better than open drain. SSI is a common complication and it is in the interest of the surgeon and the patient that it is prevented as it can be associated with morbidity, mortality and increased resource utilization. This article will deal with peri-operative management of the orthopaedic patient using evidence based benefits to the current practices available from recent updates, reviews and prospective randomized control trials, and some retrospective studies.

Introduction

Surgical site infections are the most common hospital acquired infection occurring in early postoperative period in surgical period in surgical patients[1]. It can be associated with morbidity, mortality and increased resource utilization. Surgical site infections account for 38% of all infections in surgical patients and 31.1% of all infections in trauma patients. Surgical site infection rates increase significantly with increase in number of risk factors[2]. The orthopaedic surgeon for optimum management of his patients should be familiar with prevention of surgical site infections, the risk factors involved and modern patient safety practices[3]. The analysis of patient factors, theatre environment and other infection control strategies will be discussed in detail with evidence based benefits.

Preoperative consideration

The patient factors which increase risk of infection include malnutrition, diabetes mellitus, chronic renal failure, immunosuppression, rheumatoid arthritis, obesity and smoking. We should also control other co-morbid factors like hypertension, cardiac disease, and asthma. It is well

known that malnutrition is associated with increased infection rates. It is estimated that malnutrition is present in 50% of patients in the surgical ward. Lack of protein leads to poor wound healing and also results in lowered cell mediated immunity[4]. Preoperative supplementation is advised to increase albumin levels before elective surgery. Clinical assessment and measurement of arthropometric indicators like arm muscle circumference and laboratory measurements like albumin level, transferrin level and total lymphocyte count are of value for optimal patient management. Adequate healing following surgery is promoted by transcuteneous oxygen tension >30mmHg, Ischaemic index (ABI>/=0.45), Albumin>3.0g/dl, total lymphocyte count of 1500/mm^3.

Diabetes Mellitus is an established risk factor for orthopaedic post operative site infection; therefore the control of sugar is an accepted principle. The median threshold for neutrophil dysfunction is estimated at 200mg/dl[5]. A diagnosis of Diabetes was associated with the greatest independent risk of surgical spinal infections after control for diabetes and other variables[6]. Other studies show increased risk of deep sternal surgical site infections following cardiac surgery that can be ameliorated in diabetes by careful perioperative monitoring and control of serum glucose levels[7,8]. An association between perioperative hypoglycemia and SSI in spinal neurosurgery was also shown[9].

Chronic renal failure is also associated with increased rate of post operative site infection especially those on dialysis. Post-renal transplant patients fare better than those on dialysis in relation to implant surgery[10]. It is recommended that they receive haemodialysis a day before elective surgery and should have a post operative ICU admission for monitoring and stabilization. Immunosuppression is associated with risk of perioperative surgical site infection. For operation on HIV seropositive patients CD4 count and albumin levels are important parameters. There is no difference in reported incidence between normal and HIV asymptomatic patients. Due to progression of the disease it is advised to remove implants after consolidation, at least after one year[11,12,13].

Smoking has recognized deleterious effects by delaying bone union, especially in spine surgery, survival of flaps and increased risk of wound infection. This is related to the vasoconstrictive effects of nicotine. It is advised to abandon smoking before elective orthopaedic surgery for better outcome[14]. Obesity is associated with difficult exposure and closure compared to non obese patient. One of the major reasons for advocating weight loss before operation for total hip replacement was that technical aspects of the operations may be more difficult and risk of operation in theatre and post operatively was higher. Most studies do not show any significant increase in perioperative complications among obese patients except and increase in operation time by Perka et al[15,16]. Other studies have shown that with a BMI of over 30Kg/m^2 have a negative outcome and may have an increased risk of infection and of complications with the wound[17,18,19]. Rheumatoid arthritis is also associated with increased risk of surgical site infection. The effects of rheumatoid disease on pituitary adrenal axis, the medications like steroids, penicillamine, and cyclosporine need to be stopped preoperatively. Methotrexate stoppage is controversial as most studies support continual use while others advocate stoppage preoperatively[20].

Antibiotic P prophylaxis

The use of antibiotic prophylaxis has become an established standard of care in preoperative orthopeadic surgery. It a brief course of antibiotics initiated preoperatively in order to reduce the risk of postoperative wound infection. Antibiotic prophylaxis help augment other methods of asepsis. The aim is to have an antibiotic level exceeding the minimum concentration of the antibiotic for the infecting organism before application of tourniquet and incision. It should be maintained up to the end of the operation[21]. This is supported by multiple prospective double

blind studies supporting antibiotic prophylaxis in joint replacement surgery and closed fractures[22,23,24]. The use of prophylactic antibiotics in open fractures is supported by study by Patzakis and Wilkins[25] In their randomized control trial it was found that antibiotic prophylaxis was the most important factor in determining the rate of wound infection in open fractures. The antibiotic should be given as soon as is possible and then plan for the debridement. Its use is also endorsed by the Cochrane database[26]. Choice of antibiotic depends on suspected infecting organisms, the most common being staphylococcus aureus, staphylococcus epidermidis. The recommended antibiotics in Orthopaedic surgery are cefazolin or cefuroxime. Both have excellent activity against gram staphylococcus. The broad coverage of cefazolin gives it advantage over other anti-staphyloccocal penecillins and cephalosporins. Cefazolin spectrum is ideal, sufficiently broad to be effective but limited enough to avoid resistance and superinfection. It also has pharmacological advantage over other cephalospolins by having the longest half life in serum and bone[27]. The period for prophylaxis should not exceed twenty four hours. During surgery a second antibiotic should be administered if the time of operation exceeds one to two times the half life of the antibiotic or in presence of significant bleeding. Studies found no significant difference between those treated for 24h and those receiving antibiotics for seven days[3,21,28].

Preoperative Hair Removal

Removal of hair from an intended surgical site is common practice. Data supporting its use is scarce. Hair removal is done by use razors, electric clippers and depilatory creams. Shaving the night before is discouraged as it is associated with increased risk of surgical site infection. This is due to epidermal microscopic cuts which can harbor microorganisms, and aid in multiplication. Shaving with clippers has been shown to decrease risk. The use of depilatory creams was found to be more effective than shaving, however depilatory creams reported adverse effects such as skin irritation and allergies, hence clipping is preferred. No difference was shown between operations performed after shaving immediately and those without hair removal[29,30,31,32]

Antiseptic Solutions for Scrubbing

Standard surgical antisepsis is an accepted method and involves scrubbing with antiseptic solutions. Chlorhexidine gluconate, povodine iodine and alcohol based solutions are commonly used. The mechanism of action of Chlorhexidine gluconate is through disruption of bacterial cellular membranes. Compared with other antiseptic solution chlorhexidine gluconate has a long lasting activity against micro-organisms. In other studies and in a study by Kaul and Jewet[33] showed that at 6 hours after scrubbing with chlorohexidine, hands scrubbed had significantly reduced bacterial counts while those scrubbed with iodine had higher counts. Povodine iodine has shorter activity than chlorhexidine. It is inactivated by blood and serum proteins and to maximize its antibacterial action it should be allowed to dry. Alcohol solutions are effective against microbes but lack residual effects. A combination of Chlorhexidine and alcohol (1% Chlorhexidine and 61% ethylalcohol) takes advantage of both antiseptic properties.

Laminar Flow and Ultra-violet Light.

Laminar flow has been shown to reduce bacterial counts and rates of surgical site infection. In comparison to conventional air flow systems, laminar flow has been shown to be superior in decreasing rate of skin infections[34]. Ultraviolent light has been shown to decrease bacterial burden and surgical site infections and it is more efficient than laminar flow[35]. Use of both facilities is advocated.

Intra-operative Issues

Intra-operative issues which have been shown to decrease wound infections include respect for soft tissues while operating, avoiding excessive use of use of diathermy, maximizing oxygenation and avoiding hypothermia. Other issues which have been shown increased rates of skin infections are prolonged theatre time, multiple blood transfusions and increased traffic in operating theatre.

Drains

Drains are used post-operatively routinely as conduit of material from the wound, to decrease wound haematoma and decrease dead space. But current orthopaedic literature has shown no difference when drains or no drains are used. Suction drains have been shown to be better than open drains as they have decreased number of ascending bacteria.

Conclusion

Issues related to prevention of peri-operative orthopaedic surgical site infection have been discussed and recommendations from available studies have been advocated to improve the management of the patient. Optimizing of patient factors and utilizing other principles of asepsis decreases surgical site infections, and cost through decreasing resource utilization which is of interest to both patient and surgeon.

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