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Surgical and procedural antibiotic prophylaxis in the surgical ICU: an American Association for the Surgery of Trauma Critical Care Committee clinical consensus document

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ABSTRACT

The use of prophylactic measures, including perioperative antibiotics, for the prevention of surgical site infections is a standard of care across surgical specialties. Unfortunately, the routine guidelines used for routine procedures do not always account for many of the factors encountered with urgent/emergent operations and critically ill or high-risk patients. This clinical consensus document created by the American Association for the Surgery of Trauma Critical Care Committee is one of a three-part series and reviews surgical and procedural antibiotic prophylaxis in the surgical intensive care unit. The purpose of this clinical consensus document is to provide practical recommendations, based on expert opinion, to assist intensive care providers with decision-making for surgical prophylaxis. We specifically evaluate the current state of periprocedural antibiotic management of external ventricular drains, orthopedic operations (closed and open fractures, silver dressings, local, antimicrobial adjuncts, spine surgery, subfascial drains), abdominal operations (bowel injury and open abdomen), and bedside procedures (thoracostomy tube, gastrostomy tube, tracheostomy).

INTRODUCTION

It is estimated that approximately half of surgical site infections (SSIs) are preventable through routine measures. Perioperative antibiotics are a major component of this routine care, but the inappropriate utilization of antibiotics can lead to harm and increase antibiotic resistance.[1] Consequently, antibiotic stewardship focused on identifying the appropriate antibiotics and duration of treatment is an essential component to critical care management. In this clinical consensus document, the American Association for the Surgery of Trauma (AAST) Critical Care Committee aims to provide practical guidance to the surgical intensivist on the best practices for surgical and procedural antibiotic prophylaxis. These recommendations are summarized in table 1.

METHODS

The AAST Critical Care Committee chose antibiotic management in the intensive care unit (ICU) as a clinically relevant topic for review. This document is one part of a three-part series on this topic: authors Appelbaum, *TSACO* (in submission) and Nohra, *TSACO* (in submission). The subtopics reviewed are not comprehensive for the topic of antibiotic management in the ICU but were specifically selected to be practical and useful for the surgical intensivist. A working group was formed from the committee at large to complete this work. The members of the working group were each assigned a subtopic to review using research to date. The members were asked to base their recommendations on research within the last 10 years. If research is unique, important, and has not been replicated, then it may be used even if it is older than 10 years. The research upon which the recommendations are based was compiled at the discretion of the working group. Iterative selection of studies was not performed as in a systematic review, and the methodology of the literature search was at the discretion of the authors. Any topic with discrepant or minimal supporting literature was reviewed by the AAST Critical Care Committee with an anonymous survey. The recommendations were then reviewed by the AAST Critical Care Committee at large. Consensus was either achieved by conference or reported as 'no consensus'.

The work therefore represents expert opinion and the recommendations of the entire committee. These recommendations are not intended to substitute for the provider's clinical experience. The responsible provider must make all treatment decisions based on their independent judgment and the patient's individual clinical presentation.

NEUROSURGICAL PROCEDURES

Question: what type and duration of antibiotics should be used for periprocedural prophylaxis in the setting of external ventricular drain placement?

Recommendation

A single dose of preprocedural antibiotic prophylaxis is suggested with cefazolin often being

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Table 1 Summary of recommendations*

Problem	Recommendation
Periprocedural antibiotics for EVD	A single preprocedural dose of antibiotics—cefazolin
EVD catheter	Antimicrobial-impregnated drains should be used for EVDs.
Appropriate duration of antibiotics for craniotomy/craniectomy	A single preprocedural dose of antibiotics—cefazolin
Appropriate type and duration of antibiotics for closed extremity fractures	A single preprocedure dose of gram-positive coverage—cefazolin
Intraoperative cultures for open fractures	Wound cultures should not be routinely obtained.
Should silver dressings be used for pin sites or other infections	Silver-coated dressings should not be routinely used.
Adjunctive local antimicrobial therapy for orthopedic surgery	Local prophylactic antimicrobials should be used in 'high-risk' wounds with potentially compromised blood supply.
Duration of antibiotics for spine surgery	A preprocedural dose of antibiotics and redosing during the procedure, regardless of patient comorbidities, instrumentation, or drain placement—cefazolin
Antibiotics for subfascial spinal drains	Antibiotics do not need to be extended for subfascial drains.
Duration of antibiotics for traumatic bowel injuries	Antibiotics should be continued no more than 24 hours after source control procedure.
Duration of antibiotics for open abdomen	Antibiotics do not need to be continued beyond standard preoperative prophylaxis.
Preprocedure for tube thoracostomy	No consensus could be achieved regarding the use of prophylactic antibiotics. The committee agreed that if antibiotics are used, they should be administered prior to incision, and they do not need to be continued after tube placement—cefazolin.
Technique and antibiotic prophylaxis for tracheostomy	Percutaneous tracheostomy is the preferred technique with cefazolin or ampicillin/sulbactam continued for less than 24 hours.
Prophylaxis for gastrostomy	Preprocedural antibiotics, regardless of technique—cefazolin

*All antibiotics should be based on local antibiogram and allergies.
EVD, external ventricular drain.

sufficient. Given external ventricular drain (EVD)-related infections have a wide variety of reported causative organisms, the local antibiogram should be consulted.

Discussion

EVD placement is a commonly performed neurosurgical procedure used for both monitoring and managing intracranial pressure.[1] Drain-related infections occur in approximately 10% of cases (3% to 38%), depending on local factors, antisepsis technique, antibiotic administration, and EVD catheter type.[2] The available literature on the topic is limited due to varying practice patterns and an inconsistent definition of drain-related infections.[3 4]

Most available literature on the topic focuses on the infection-related complications between those patients who receive systemic antibiotics in the periprocedural setting (period prior to EVD placement) versus duration setting (period the EVD in place). Dellit *et al* found that after an institutional protocol change to limit overall antibiotic use to periprocedural cefazolin, there was no difference in cerebral spinal fluid (CSF) infection rates between the periprocedural and duration groups. Notably, the rate of *Clostridioides difficile* infections (CDIs) decreased (5.4% vs. 2.4%) after the protocol was initiated.[5] Murphy *et al* reported similar findings after an institutional protocol change. There was no difference in the rate of ventriculitis in the periprocedural and duration groups (0.4% vs. 1.1%, p=0.22). The hospital-acquired infection rate was also higher in the duration group (0% vs. 2%, p=0.026).[6] In contrast, some meta-analyses and systematic reviews suggest that prolonged systemic antibiotic use decreases infection.[7 8] The literature is somewhat incongruent, however, as increased incidence of CDI and antimicrobial-resistant organisms is found with longer duration of antibiotic use. Therefore, a single dose of antibiotic prophylaxis is suggested preprocedure, but the significant heterogeneity of the literature precludes a strong recommendation regarding the duration of antibiotic administration. Of note, there is variability in the organisms associated with drain-related infections with both gram-negative and gram-positive organisms being reported.[9] For this reason, in 2016, the Neurocritical Care Society recommended the use of a single dose of periprocedural prophylaxis but found insufficient evidence to recommend a specific antimicrobial agent.[1] Similarly, we recognize these challenges and recommend consulting the local antibiogram and specifically considering additional risk factors, such as methicillin-resistant *Staphylococcus aureus* (MRSA) colonization but also note that cefazolin has been shown to be effective and is often sufficient for average-risk patients.[1]

Question: should antimicrobial-impregnated catheters be used for EVDs?

Recommendation

Antimicrobial-impregnated catheters should be a component of a drain-related infection prophylaxis bundle.

Discussion

Antimicrobial-impregnated catheters are a component of drain-related infection prophylaxis and have shown a reduction in infection rates.[10 11] Lajcak *et al* evaluated the rates of CSF infections in patients with impregnated and non-impregnated EVDs. Of the 529 EVDs placed in 403 patients, the rate of infections was lower in patients with antimicrobial-impregnated catheters compared with standard catheters (6.1% vs. 8.6%). Patients received a single dose of cefuroxime prior to the procedure.[11]

Several studies discuss implementing institutional EVD bundle management protocols that include limiting antibiotic prophylaxis and using antimicrobial-impregnated catheters.[10 12 13] Since several interventions were performed at the same time, it is difficult to discern the true effect of each component on infection rates. A single-center retrospective Australian study found no difference in infection rates after a multifaceted change in EVD placement protocol which included limiting prophylactic antibiotics to 24 hours.[12] Similarly, Harrop *et al* demonstrated that when an EVD management bundle was introduced, there was no significant difference in infection rates. However, when coupled with an antimicrobial-impregnated catheter, the

infection rates decreased from 8.2% to 1% (p=0.0005).[10] The Neurocritical Care Society recommends use of an EVD management bundle to decrease the risk of drain-related infections. Use of a sterile dressing, sterile technique, a closed system, minimal manipulation of the system, periprocedural antibiotics, and an antimicrobial-impregnated (ie, silver or antibiotic-impregnated) catheter comprised the practices within the bundle.[1]

Question: what is the appropriate selection and duration of perioperative antibiotics in the setting of craniotomy/craniectomy?

Recommendation

A single dose of preoperative antibiotic prophylaxis given within 60 minutes prior to incision is recommended for prevention of SSI and meningitis in patients who undergo cranial operative intervention. Cefazolin is usually sufficient but in patients colonized with MRSA or institutions with high rates of MRSA, vancomycin may be warranted.

Discussion

SSI and central nervous system infections after cranial surgery (craniotomy or craniectomy) are rare but can result in lasting morbidity and mortality.[14 15] Multiple randomized controlled trials from the 1980s demonstrated a significant decrease in SSI and postoperative infections for patients who received perioperative antibiotics, compared with placebo.[16–18] No recent randomized studies have been published since antibiotic prophylaxis is now considered standard of care; however, a meta-analysis found decreased odds of meningitis in patients who received antibiotic prophylaxis (1.1% vs. 2.7%) compared with patients who did not receive prophylaxis.[15]

S. aureus and coagulase-negative staphylococci are the most common causes of SSIs. MRSA and coagulase-negative staphylococci infections are less common but are increasing in prevalence. Gram-negative and polymicrobial infections are responsible for a small portion of cases. Multiple studies have shown no difference in infection rates with different antibiotic selections and most studies use a single dose of antibiotics.[14] Therefore, a single dose of cefazolin, given within 60 minutes prior to incision for all patients undergoing craniotomy or craniectomy, is generally recommended as the prophylactic antibiotic of choice.[14 19] However, there is some evidence for the dual use of cefazolin and vancomycin. Corsini Campioli *et al* performed a logistic regression to identify predictors of SSI and found dual therapy with cefazolin and vancomycin was associated with fewer SSIs. Although not supported by strong evidence, in institutions with a high prevalence of MRSA, prophylaxis with dual therapy may be considered.[19 20]

ORTHOPEDIC SURGERY

Question: for patients undergoing operative fixation of closed extremity fractures, what is the recommended type and duration of antimicrobial prophylaxis?

Recommendation

A single dose of preoperative antibiotics directed at gram-positive organisms, such as cefazolin, given within 60 minutes prior to incision, is recommended to decrease the rate of SSI.

Discussion

First-generation cephalosporins are the preferred and most studied agent for perioperative prophylaxis in closed fracture fixation, regardless of internal fixation. Later-generation cephalosporins have not been shown to be more effective but may lead to increased rates of antibiotic resistance and *C. difficile*-associated diarrhea.[14] According to the American Academy of Orthopedic Surgeons, preoperative MRSA positivity has not been shown to alter the risk of postoperative infection and consequently a first-generation cephalosporin is still the preferred agent in those patients. Vancomycin and clindamycin are appropriate alternatives for patients with β-lactam allergy, although vancomycin administration should begin early enough to be completed within 60 minutes prior to incision. Intraoperative redosing is recommended if the procedure exceeds two half-lives of the drug, or excessive blood loss (>1500 mL) is experienced.

Continued postoperative prophylaxis has not been shown to confer additional advantages compared with a single perioperative dose; therefore, perioperative antibiotics should be limited to only 24 hours after surgery.[14 21 22]

Question: should intraoperative wound cultures be used to guide antimicrobial prophylaxis for open fracture?

Recommendation

Wound cultures from the initial wound should not routinely be used to guide antimicrobial prophylaxis for open fractures.

Discussion

Initial wound cultures are of minimal utility in open fractures as they are typically polymicrobial and rarely change the antibiotic regimen. In addition, the isolated microbe(s) is often different from those seen on the initial wound culture among patients who ultimately develop infections. Wound cultures should be sent if a patient develops infection after completing the prophylactic antibiotic regimen but are of minimal utility in the initial setting.[23]

Question: should silver-coated dressings be used to decrease postoperative infection risk?

Recommendation

Silver-coated dressings should not be used to decrease the risk of pin site or other infections.

Discussion

There are no data showing that the use of silver-coated dressings improves outcomes. One randomized controlled study of 30 patients who underwent debridement and fixation of open tibial fractures (80% Gustilo type 3) found no difference in the rate of pin site infection.[24] Larger prospective studies are needed on this topic.

Question: should adjunctive local antimicrobial therapy, including vancomycin powder, tobramycin-impregnated beads, or gentamicin-covered nails, be used to decrease infection risk?

Recommendation

Local application of prophylactic antimicrobials, including vancomycin powder, tobramycin-impregnated beads, or gentamicin-covered nails, should be considered to decrease infection risk.

Discussion

Although local antibiotics should not replace systemic antibiotics, adjunctive application of local antimicrobials should be considered as they may reduce colonization and biofilm formation.[25] Systemic antibiotics are dependent on tissues having adequate blood supply, so any injury with potentially compromised blood

supply should be considered high risk for infection. Local application concentrates the antimicrobial in the surgical field and this will not be affected by vascular compromise at the fracture site. A recent study by O'Toole *et al* found that prophylactic vancomycin powder may be useful for decreasing gram-positive infections.[26] Other studies have shown a reduction in SSIs with the use of gentamicin-coated nails in type 1 and 2 open fractures.[27 28] Additionally, although there are limited data on the systematic absorption of these agents, there appears to be little reason for concern of potential systematic nephrotoxicity.[28]

SPINE INSTRUMENTATION

Question: what type and duration of perioperative antibiotics should be used for spinal surgery?

Recommendation

Preoperative antibiotics should be administered to decrease infection rates. Antibiotics should be redosed intraoperatively if spinal implants are being used but prolonged antibiotics are not required for high-risk patients or for spinal instrumentation. Cefazolin is often sufficient but high-risk patients may benefit from gram-negative coverage and/or application of intrawound vancomycin or gentamicin sponges.

Discussion

The North American Spine Society (NASS) recommends, based on several randomized and retrospective studies, a single dose of preoperative antibiotics to decrease infection rates for patients undergoing spine surgery without implants.[29] Although several studies based largely on elective spinal surgery literature support a single dose of perioperative antibiotics, a prolonged postoperative course of antibiotics has not been shown to further decrease the rate of SSI and may even be associated with higher odds of CDI and prolonged hospital length of stay.[30 31] Intraoperative redosing of surgical antibiotic prophylaxis has also been associated with a reduction in SSI in a broad range of surgical procedures, but no studies have directly compared intraoperative dosing versus no redosing for spinal surgery.[32] The NASS, the Spine Intervention Society (SIS), and the Infectious Disease Society of America (IDSA) all recommend redosing antibiotics if the duration of the procedure exceeds two half-lives of the drug or in the setting of excessive blood loss.[14] Therefore, we recommend a preoperative dose of antibiotics with intraoperative redosing as needed for non-instrumented spine surgery.

Patients requiring instrumented fusions tend to have a higher rate of infection compared with those who do not receive spinal implants, and infection rates may be even higher in trauma patients, particularly those with spinal cord injuries.[33 34] Therefore, the use of prophylactic antibiotics in instrumented spinal surgery in patients with or without cord injury is recommended. Meta-analysis of relevant trials has not identified an improved risk of SSI with the use of extended postoperative prophylaxis compared with preoperative prophylaxis alone.[30] Therefore, a prolonged course of postoperative antibiotics does not appear to provide additional benefit over a preoperative dose (with intraoperative redosing to maintain therapeutic levels for prolonged procedures) for reducing postoperative infection rates. This holds true for high-risk patients as well. Patients with diabetes, obesity, age >60 years old, active smokers, and previous surgical infection history are at high risk of SSI, but there is no proven benefit to a prolonged course of antibiotics in this high-risk population.[29 35 36]

There is no consensus on the specific antibiotic prophylaxis regimen to use for spinal surgery. A meta-analysis by Barker included three trials using both gram-positive and gram-negative coverage and three trials using gram-positive coverage alone.[37] Despite differing antibiotic regimens, there was no difference in the efficacy of differing antibiotic regimens. In most cases, cefazolin appears to be sufficient, although the addition of gram-negative coverage and/or the use of intrawound vancomycin may be appropriate in higher-risk patients. A meta-analysis by Gande *et al* evaluating the impact of vancomycin powder on SSI found a lower rate of gram-positive SSI but a significantly higher rate of gram-negative and polymicrobial SSI in the vancomycin group, cautioning against its widespread use.[38] Modest data also support the use of gentamicin-impregnated sponges and betadine irrigation for the reduction of postoperative infections.[39 40] Given these mixed data, we recommend that consideration should be given to the addition of gram-negative coverage and/or application of intrawound vancomycin or gentamicin sponges for instrumented procedures, patients with significant infection risk-related comorbidities, spinal cord injury, and cases involving the sacral spine or more than three spinal levels.[41]

Question: should the duration of perioperative antibiotics be extended and subfascial spinal drains are in place?

Recommendation:

Continued antibiotics for subfascial drains are not recommended.

Discussion

There is often concern for infection associated with closed suction subfascial drains that may be placed after posterior spinal surgery to prevent seroma or hematoma foundation. Several recent studies found that prolonged antibiotics for drain placement do not further reduce SSI compared with the standard preoperative dosing; in a recent meta-analysis, the odds of developing a deep SSI in the prolonged antibiotic group were found to be 1.10 (95% CI 0.69 to 1.74), which was not significant, and there was no difference in the rate of SSI overall. Prolonged antibiotics were associated with a trend towards increased infections with multidrug-resistant bacteria.[42] Based on these findings, continuing antibiotics until drain removal is not recommended.

TRAUMATIC BOWEL INJURY

Question: how long should antibiotics be continued in the setting of a traumatic bowel injury?

Recommendation

In patients with traumatic bowel injury, antibiotic prophylaxis covering gram-negative and anaerobic organisms should be limited to only 24 hours after source control is achieved.

Discussion

The use of antibiotics in trauma patients is commonplace but there are limited high-quality data on its use in traumatic bowel injuries. This is further complicated by the wide spectrum of injuries and patient risk factors that must be considered.

In elective gastrointestinal surgery, the American College of Surgeons and the SIS recommend the administration of prophylactic antibiotics prior to incision with antibiotic selection tailored to the specific procedure and organs involved and are intended to prevent SSI.[43] The utilization of antibiotics for traumatic bowel injuries is more complicated as it straddles the gap between prophylaxis and potential treatment. One randomized trial examined the duration of antibiotic prophylaxis in high-risk patients with penetrating abdominal trauma and found that extending prophylaxis beyond 24 hours did not decrease the incidence of intra-abdominal or extra-abdominal infections.[44]

Another retrospective comparative study examined the role of antibiotic prophylaxis according to the Surgical Care Improvement Process (SCIP) in preventing SSI in patients who underwent laparotomy for both penetrating and blunt trauma.[45] This study found that adhering to the SCIP guidelines, including redosing antibiotics in every 4 hours while in surgery or if blood loss is greater than 1500 mL, had a lower risk of SSI after controlling for confounding variables such as enteric injury. Several additional multicenter trials have shown similar results, namely that although patients suffering from bowel injury with contamination are at an increased risk of SSI, the use of extended antibiotics did not decrease the overall risk.[46–49] Based on these results, the Eastern Association for the Surgery of Trauma in 2012, SIS in 2017, and the Korean Society of Acute Care Surgery in 2019 recommended that antimicrobial therapy should be limited to no more than 24 hours in patients with traumatic bowel perforations operated on within 12 hours based on the results of several multicenter trials.[46–48 50–52] This has been further supported by a Cochrane review in 2019 which concluded there is uncertain benefit to the SSI risk for continuing antibiotics in penetrating trauma patients beyond 24 hours, compared with 24 hours or less.[53]

The selection of antibiotics should be based on the local antibiogram. The Cochrane review found uncertain benefit to any one antibiotic regimen, but multiple studies have shown a benefit to routine anaerobic coverage.[50 51 53–55] Routine anti-pseudomonal, anti-enterococcal, and anti-fungal coverage does not appear to be beneficial and is not recommended by the SIS.[50] For more details on antibiotic selection, please see the 'antibiotic prophylaxis in injury' portion of this series.

OPEN ABDOMEN

Question: is prolonged antibiotic prophylaxis required in the setting of an open abdomen?

Recommendation

In patients who are managed with an open abdomen, no specific antimicrobial prophylaxis is required beyond that for standard laparotomy. More extensive antibiotic courses should be directed toward the underlying reason for the laparotomy and procedures performed.

Discussion

After the sentinel article ''Damage control': an approach for improved survival in exsanguinating penetrating abdominal injury', the open abdomen for trauma and emergency general surgery patients has become increasingly more common.[56 57] Limited data suggest that no additional antimicrobial coverage is required and may even be associated with worse infectious outcomes for patients with an open abdomen.[58 59] Sava *et al* recently reviewed management of the open abdomen and agreed that there is no role for routine antibiotic administration for open abdomen after trauma.[60] Therefore, the choice and duration of antibiotics should be directed at the underlying cause of the laparotomy. For example, as discussed in the Traumatic bowel injury section of this document, antibiotics for isolated bowel injury can be limited to 24 hours in most populations. If the laparotomy was performed for an intra-abdominal infection, prophylactic antibiotics are inadequate and the type and duration should be directed by the appropriate guidelines once source control has been achieved specific to the established intra-abdominal infection.[61]

TUBE THORACOSTOMY

Question: should antibiotics be administered prior to post-traumatic tube thoracostomy placement?

Recommendation

There is limited available literature on this topic with many studies being outdated or underpowered and consequently, the committee did not reach a consensus on whether prophylactic antibiotics are warranted. That said, the group did agree that if antibiotics are to be used for tube thoracostomy placement, cefazolin is often sufficient and antibiotics should be administered prior to skin incision and not continued post-tube placement.

Discussion

In the post-traumatic setting, contamination occurs prior to the intervention and administration of antibiotics in this manner is considered 'presumptive' rather than prophylactic. As a result, presumptive antibiotics have been advocated for prior to tube thoracostomy insertion to minimize the risk of empyema or pneumonia.[62]

Over the past 40 years, a number of studies have evaluated the impact of presumptive antibiotics for tube thoracostomy after injury with some indicating a benefit particularly after penetrating chest injuries.[63 64] Concerns with these studies include differing antibiotic regimens, definitions of infection (pneumonia/empyema), length of antibiotic administration, and mechanism of injury.[65] Further, many are hampered by poor patient recruitment resulting in small sample sizes with inherent concerns for type II errors. As a result of these disparate designs and low patient numbers, conclusions regarding this practice have been difficult to discern. Several meta-analyses have attempted to evaluate the use of presumptive antibiotics prior to tube thoracostomy, and some have suggested an advantage for the administration of antibiotics.[66 67] However, recent, well-designed clinical studies have failed to show an advantage to the use of presumptive antibiotics.[68–72] Furthermore, in a recent AAST prospective multicenter trial that included 1887 patients, Cook *et al* compared their findings with several different meta-analyses, and concluded that there is no evidence to advocate for the routine administration of antibiotics.

The failure of recent studies to conclusively identify a role for presumptive antibiotics may be confounded by multiple changes in practice that have evolved over the past 40 years. The greater attention to sterile technique, early surgical evacuation of retained hemothorax, smaller-sized tubes, and guidelines for early tube removal may all be contributing factors. These mixed results with relatively few large studies limit the ability to make definitive statements and consequently, the committee did not reach a consensus on whether prophylactic antibiotics should be used. The group did agree that if antibiotics are used, they should be administered prior to incision, and they do not need to be continued for any period of time after tube placement. As demonstrated by Cook *et al*, the most commonly administered antibiotic in this setting is cefazolin and the committee agreed that if antibiotics are being used, it is an appropriate selection.

TRACHEOSTOMY

Question: what surgical technique and antibiotic prophylaxis should be used to decrease SSI associated with tracheostomy placement?

Recommendation

A percutaneous dilation tracheostomy technique is the preferred approach to decrease SSI. Prophylactic antibiotics, consisting of

either cefazolin or ampicillin/sulbactam, should be administered within 60 minutes prior to incision and used for less than 24 hours.

Discussion

Tracheostomy is a common procedure performed on critically ill patients, typically for prolonged respiratory failure, but also for trauma or oncologic indications. Two main techniques have emerged, an open technique and a percutaneous technique. Both are associated with complications such as pneumothorax, hemorrhage, tracheal perforation, loss of airway, and infection.[73] SSI after tracheostomy has been reported in up to 33% in the oncology literature.[74] A Cochrane systematic review examined infectious complications of both techniques and reported a risk ratio of 0.24 (0.15, 0.37), favoring the percutaneous technique.[75]

The most common organisms responsible for SSI after tracheostomy are skin flora and oral flora. Prophylactic antibiotics are associated with reduced tracheostomy SSI rates but a variety of regimens exist, including but not limited to: cefazolin, clindamycin, ampicillin/sulbactam, and moxifloxacin.[76] Compared with the other listed regimens, clindamycin is associated with an increased rate of SSI and should not be considered as a first-line choice.[74] Additionally, there is no associated reduction in the rate of SSI for continuing with prophylactic antibiotics for more than 24 hours.[76]

GASTROSTOMY

Question: in adult patients requiring placement of an open, laparoscopic, or percutaneous gastrostomy tube, what antibiotic prophylaxis should be given?

Recommendation

Cefazolin, administered within 60 minutes prior to the surgical incision, is the preferred prophylactic agent for those receiving an open, laparoscopic, or percutaneous gastrostomy tube. Alternative antibiotic guidelines exist for those with a β-lactam allergy.

Discussion

Durable enteral access may be required by critically ill patients for feeding, medication administration, or decompression.[77] Gastrostomy tubes are commonly placed using percutaneous, endoscopic, laparoscopic, and/or open techniques. These procedures are frequently performed in a variety of settings including the operating room, procedure rooms, or at the bedside.

Gastrostomy tube placement is a clean-contaminated procedure and the standard precautions outlined in 2017 by the US Centers for Disease Control and Prevention (CDC) should be followed.[78 79] These precautions include appropriate skin preparation with soap and an antiseptic agent the night before the procedure, intraoperative skin preparation with an alcohol-based antiseptic agent, and preoperative prophylactic antibiotics. The redosing of antibiotics is not recommended if the case remains clean-contaminated. Finally, the application of antimicrobial agents (creams, ointments, powders, or solutions) to the surgical wound is also not recommended.

Specific prophylactic antibiotics, based on the type of surgical intervention, have been previously recommended within a 2013 guideline coauthored by the American Society of Health-System Pharmacists, the IDSA, the SIS, and the Society for Healthcare Epidemiology of America.[14] For gastroduodenal procedures with luminal entry, cefazolin is the recommended agent. Alternative agents recommended for those with a β-lactam allergy include clindamycin or vancomycin plus an aminoglycoside or aztreonam or fluoroquinolone. If vancomycin or fluoroquinolone is provided, administration will need to begin within 120 minutes of the surgical incision to achieve peak tissue concentrations.

Percutaneous gastrostomy (PEG) tubes have a known infection rate of 5% to 30%.[77] Interestingly, the PEG population is excluded from the 2017 CDC Surgical Site Infection guidelines, so our recommendation is based on other available literature. Specifically, a 2013 Cochrane review which included 12 randomized controlled trials investigated the benefit of prophylactic antibiotics prior to PEG placement.[80] With over 1200 pooled patients, the authors demonstrated a significant reduction in peristomal infection (OR of 0.36 (0.26, 0.5)) with the use of prophylactic antibiotics. Most of the included trials used parenteral cephalosporins. The most common organisms responsible for SSI after PEG are skin flora. Based on these data, the American Society for Gastrointestinal Endoscopy recommends cefazolin 1 g intravenously 30 minutes prior to the procedure.[81] In patients with a true β-lactam allergy who cannot tolerate cephalosporins, clindamycin is recommended.

CONCLUSION

Identifying the appropriate antibiotic prophylaxis for urgent/emergent operations and for critically ill or high-risk patients can be a complicated and nuanced decision. In most instances, the evidence suggests that prophylactic antibiotics can be limited to a single, preoperative dose. A consensus summary for the management of surgical prophylaxis for the selected surgical subgroups is provided in table 1. It is important for the surgical intensivists to be familiar with this evidence so they may advocate for the appropriate care for their patients.

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