Loop Drainage of Subcutaneous Abscesses in Pediatric Patients

Kacie Hamreus

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Loop Drainage of Subcutaneous Abscesses in Pediatric Patients

Abstract

Background: Subcutaneous abscesses are increasingly common among the pediatric population in the United States. They require drainage as a means of treatment, as antibiotics alone cannot resolve the infection. The current standard of care is open incision and drainage, which often requires packing the open wound with sterile material, then removing the packing within 24-48 hours. This can be very painful, especially in pediatric populations. An alternative treatment is loop drainage, which involves making two smaller incisions and placing a drain in the wound as opposed to packing. This review compares loop drainage to open drainage in regards to cost, hospital length of stay, and rate of procedure failure.

Methods: An extensive literature search was done using MEDLINE-PubMed, CINAHL, Health & Medical Complete, and Web of Science. Keywords used included: abscess and loop drainage. All articles were assessed using GRADE criteria.

Results: A total of 143 articles were narrowed down to three primary articles that directly compared the two methods of abscess drainage. All three articles were cohort retrospective studies. The studies found that loop drainage is just as effective as open drainage, but with a decreased cost, hospital length of stay, and reduced incidence of procedure failure. Due to the nature of the three studies, they were considered to have low quality evidence and a future randomized control study needs to be done to confirm the results.

Conclusion: In pediatric patients with subcutaneous abscesses, research shows that loop drainage may be a better option when compared to open drainage results. This is a promising technique with the potential to change the standard of care for subcutaneous abscesses, especially in patient populations where medical cost is a concern.

Keywords: abscess, loop drainage, loop technique, minimally invasive drainage

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Annjanette Sommers

Keywords
Abscess, loop drainage, loop technique, minimally invasive drainage

Subject Categories
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Loop Drainage of Subcutaneous Abscesses in Pediatric Patients

Kacie Hamreus

Clinical Graduate Project Submitted to the Faculty of the
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Faculty Advisor: David Keene, PA-C
Clinical Graduate Project Coordinator: Annjanette Sommers, PA-C, MS
Biography

Kacie Hamreus was born and raised in Washington and attended Washington State University with a Bachelor of Science degree in Psychology. During her undergrad, she worked as an emergency medicine scribe at Peacehealth SW Medical Center in Vancouver, WA where she developed a love for critical care and emergency medicine.
Abstract

Background: Subcutaneous abscesses are increasingly common among the pediatric population in the United States. They require drainage as a means of treatment, as antibiotics alone cannot resolve the infection. The current standard of care is open incision and drainage, which often requires packing the open wound with sterile material, then removing the packing within 24-48 hours. This can be very painful, especially in pediatric populations. An alternative treatment is loop drainage, which involves making two smaller incisions and placing a drain in the wound as opposed to packing. This review compares loop drainage to open drainage in regards to cost, hospital length of stay, and rate of procedure failure.

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Conclusion: In pediatric patients with subcutaneous abscesses, research shows that loop drainage may be a better option when compared to open drainage results. This is a promising technique with the potential to change the standard of care for subcutaneous abscesses, especially in patient populations where medical cost is a concern.

Keywords: abscess, loop drainage, loop technique, minimally invasive drainage
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Table 1: Characteristics of Reviewed Studies
Table 2: Summary of Findings

List of Abbreviations

MRSA……………………………………………………Methicillin-Resistant Staphylococcus Aureus
GRADE………Grading of Recommendations, Assessment, Development, and Evaluation
Loop Drainage of Subcutaneous Abscesses in Pediatric Patients

BACKGROUND

The incidence of pediatric patients developing subcutaneous abscesses has been steadily increasing in recent years. It has tripled from 1995 to 2005, and in 2014 the number of pediatric subcutaneous abscesses exceeded 3.4 million cases per year. These abscesses cannot be treated successfully with oral or intravenous antibiotics alone. Instead, they require drainage, tissue debridement, and wound care with secondary intention healing in order for the infection to fully resolve. Antibiotic treatment with trimethoprim/sulfamethoxazole or clindamycin is occasionally used as a supplemental treatment depending on the patient’s presentation and the treating provider’s preference.

The traditional method of drainage is called open drainage, and it is done with a single linear incision, curettage of loculations using a hemostat, and expression of the purulent and necrotic material within the abscess. It is then irrigated with sterile fluid, either normal saline or lidocaine, and packing is occasionally used to keep the tissue pocket open to allow for further drainage. The packing is changed after 24-48 hours. The variability in irrigation, packing, and time until packing is removed is based on individual patient basis and the provider or clinic’s preferences.

An alternative treatment to the traditional open drainage is loop drainage. This procedure involves making a small incision in the abscess, curettage of loculations using a hemostat, and irrigation of the abscess using normal saline or lidocaine. Then a second small incision is made on the opposite site of the initial incision. A drain (Vessi-loop or Penrose drain) is introduced into the abscess through one incision and pulled out of the other incision using a hemostat. The drain is loosely tied on the outer surface of the skin.
If the abscess is large or if it is an irregular shape, then multiple drains may be required. The drain is removed after 7-10 days after the initial procedure. This is a relatively new procedure that was first introduced at Orlando Medical Center for pediatric patients with subcutaneous abscesses in 2008 by researcher Dr. Ladde. Providers who attended their schooling prior to 2008 were not taught loop drainage procedure as part of their primary medical training, and it has not been a required part of continued medical education (CME) training so many providers are still unaware that it exists as an option to treat subcutaneous abscesses.

Loop drainage should be considered as an alternative to open drainage because there is notable wound care noncompliance with open drainage procedures, especially in pediatric populations. This is because the packing is occasionally pulled out or it falls out, and daily packing replacement can be painful and complicated. Often, these patients are admitted for wound care or pain control, or they require home nursing assistance to help the parents with the complicated wound care. This can be costly to the patient and the provider.

The question at hand is whether or not pediatric patients with subcutaneous abscesses have reduced cost, reduced length of hospital stay, and reduced incidence of abscess recurrence or procedure failure with loop drainage compared to open drainage.

METHODS

To find literature investigating loop drainage compared to open drainage in treating subcutaneous abscesses in pediatric populations, an extensive search was conducted using MEDLINE-PubMed, CINAHL, Health & Medical Complete, and Web of Science. The key words that were used were “abscess” and “loop drainage”. Inclusive
data was limited to pediatric patients from age 0 to 17, human subjects, and English-language articles. No exclusion data based on validity or bias of the research was used because there were only retrospective studies available so provider bias was unavoidable.

To find additional studies, the bibliographies of relevant articles were scanned and the articles were located by searching the article title in the journal databases. Articles were evaluated for quality of the evidence using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE).7

RESULTS

Within the four databases, 143 articles were scanned and reduced to five articles that focused on loop drainage as a treatment for subcutaneous abscesses in pediatric populations. The five articles were evaluated individually. The articles by Wright et al,8 McNamara et al,3 and Ladde et al5 were retrospective studies that directly compared open drainage to loop drainage, focusing on multiple outcomes including length of stay in the hospital, cost to the patient and provider, ability to be done in outpatient versus inpatient settings, need for home nursing assistance, and rate of procedure failure. These studies were further evaluated and the GRADE system was applied to determine the quality of the study. The articles by authors Ladd et al2 and Tsoraides et al4 were retrospective studies that only looked at loop drainage without a direct comparison to open drainage, so these were included for background information but not as the primary studies of interest.

The studies collectively showed that loop drainage is more effective than open drainage because there is a lower incidence of failure after the procedure. Failure was defined as requiring repeat drainage, surgical intervention, or additional antibiotic treatment.3,5 Furthermore, loop drainage had decreased cost and hospital length of stay
compared to open drainage procedures. These were the variables that were investigated as primary outcomes by the three articles. See Table 1.

**McNamara et al**

This retrospective study used hospital records of pediatric patients from The Women’s and Children’s Hospital of Buffalo from November of 2007 until July 2008. The patients either had open drainage or loop drainage of subcutaneous abscesses under conscious sedation or general anesthesia in the operating room. The subject groups were not controlled or randomized so the patient’s age, abscess location, history of prior abscess, or history of *methicillin-resistant staphylococcus aureus* (MRSA) was not a controlled variable within the study. Providers decided which patients received which type of procedure and whether conscious sedation or general anesthesia was used. Patients that received open drainage had daily wound packing changes within the hospital, and loop drainage patients had their wound site washed twice daily with soap and warm water and it was covered with a dry bandage. All patients received trimethoprim-sulfamethoxazole or clindamycin for 10-14 days.

There were 134 patients who had open drainage and 85 patients who had loop drainage. Primary outcomes were length of stay, whether the procedure was done in the outpatient or inpatient, and failure rate of the procedure, defining failure as requiring a second incision and drainage. The study found that the two groups had equal lengths of stay of 0.7 days (P = 1) and the percentage of patients that had their procedure done in outpatient compared to inpatient was 66% for both treatment groups (P = 1). The study looked at failure of the procedure and found that there were four incidences within the open drainage group and zero incidences within the loop drainage group, which was a
significant clinical difference. See Table 2. This study concluded that loop drainage had lower failure rate compared to open drainage, and the study promoted it as a promising method of treating subcutaneous abscesses in the pediatric population.³

**Wright et al**

This was a retrospective study⁶ that used hospital records of pediatric patients from General Surgery at University of Kentucky College of Medicine from January 2010 until July 2011. The patients all had subcutaneous abscesses that were treated with either open or loop drainage under conscious sedation in the emergency department or in the pediatric intensive care unit (ICU). The patients were divided into Group I, II, and III, based on 6-month intervals, as the hospital was transitioning from using open drainage to loop drainage to treat subcutaneous abscesses. Group I included 110 patients that had open drainage, Group II was 127 children that included a combination of 83 open drainage and 44 loop drainage procedures, and Group III was 92 children and 90.2% of them had loop drainage. For this review, comparisons between Group I and Group III were of primary interest.⁸

The open drainage involved packing with a daily packing change that often required administration of pain medications beforehand. The loop drainage did not require pain medication and wound care involved washing the wound site with soap and water. Antibiotic use was not controlled for during the study.⁸

The results demonstrated a significant (P <0.001) decrease in length of stay for loop drainage, which was 1 day compared to 2 days for open drainage. There was also a significant decrease in direct cost for loop drainage compared to open drainage, which was $1,306 compared to $1,737 (P = < 0.001). Lastly, the percentage of patients that had
their procedure done in OP compared to IP was 9.10% for open drainage and 25% for loop drainage \((P = 0.002)\). See Table 2. Based on these results, this study by Wright et al demonstrated that the loop drainage had multiple benefits including decreased length of stay and decreased cost, thus promoting it as a enticing alternative to traditional open incision and drainage techniques.

**Ladde et al**

This was a retrospective study\(^5\) that used pediatric patients from a level I pediatric trauma and tertiary care center in Florida from January to December 2007. The patients all had a subcutaneous abscess that was drained in the emergency department and the study excluded any patients with abscesses that required surgical intervention in the operating room and any abscess on the face, scalp, hands, or feet.\(^5\)

The study had a total of 142 cases, 91 of which were open drainage and 51 were loop drainage. Whether the patient was given antibiotics was not a controlled variable, but they investigated whether the antibiotics given were significant between the two groups and found that there was no significant difference between the treatment groups \((P = 0.06)\). They also compared history of previous abscesses and found that it was not significantly different between the two groups \((P = 0.13)\). When comparing the two treatment groups and the location of the abscess, the majority of the patients who received open drainage had extremity abscesses, and the majority of the patients who received loop drainage had buttocks or groin abscesses.\(^5\)

The study investigated treatment failure as the primary outcome, which was defined as a need for re-incision, surgical intervention, or additional antibiotic use. They
found that the open drainage group was 17% and the loop drainage group was 4% (P = 0.03), indicating a significant difference between the treatment groups. See Table 2.

DISCUSSION

In pediatric patients with subcutaneous abscesses, this research shows that loop drainage compared to open drainage results in decreased cost, reduced length of hospital stay, and reduced incidence of procedure failure. Using loop drainage to treat subcutaneous abscesses is not a mainstream procedure in the medical community because it is a very new procedure that was developed in 2008 at Orlando Medical Center and it is not a required part of continued medical education. Nonetheless, the evidence to support its efficacy is promising. It is cost effective for the hospital and the patient because there is a decreased need for home wound care materials and a home nursing assistant, it can be done as an outpatient procedure, and if it is done in the hospital then length of stay was significantly shorter compared to open drainage procedures. See Table 2.

The majority of providers are formally trained on open incision and drainage, and they do not learn about loop drainage during their formal training. They have become very comfortable with this traditional method and therefore rely on this as a staple of their abscess treatment. The obstacle that providers are now facing is learning loop drainage technique and incorporating it into their practice.

At this point, the research comparing loop drainage to open drainage is at a very low quality. Wright et al, McNamara et al, and Ladde et al directly compared open drainage and loop drainage, but the studies were retrospective so there was no randomization or controlled variables. There was significant treatment bias within the studies because the providers decided which patients received open drainage and which
patients received loop drainage. It is not known how the providers decided which treatment to do for each group because the authors did not discuss this in their articles. This may play a role in explaining why there were greater failure rates in the open drainage group compared to the loop drainage group.

The Ladde et al study\textsuperscript{5} contained a comparison between Group I where 100% of patients received open drainage to Groups II which contained a mixture of both procedures and Group III where 90.2\% of the 92 patients received loop drainage. Moreover, age was significantly different between the two groups with average age of 6 years old for open drainage and 1.8 years old for loop drainage. Patients in the Loop group were more likely to receive sedation, 65\% compared to 35\% (P = <0.001). Furthermore, the Ladde et al study demonstrated that loop drainage was done more often on buttocks abscesses than open drainage was, 63\% compared to 28\% (P = 0.003).

In the McNamara study,\textsuperscript{3} age was also different between treatment groups with average age of the patient receiving open drainage of 7.6 years old and loop drainage was 6.1 years old. In the study, abscess location was also different, for example open drainage was done more often in head and neck and loop drainage was used more often in groin, buttocks, or perineum. This could have skewed the study results, especially in the outcome of treatment failure.\textsuperscript{3}

Despite the positive results of the multiple studies, additional research is needed comparing open drainage to loop drainage to treat subcutaneous abscesses. There are no randomized controlled trials that have been done, and this is crucial to ensuring that the results from these studies are valid. It would be important to randomize the patient’s age, location of abscess, history of prior abscess, and MRSA status. This would eliminate bias
from the provider because in the studies that were evaluated, they ultimately decided which patients would receive open drainage and which patients would receive loop drainage. Furthermore, it would be necessary to blind the researchers conducting the study to maintain as objective of results as possible.

Future research also needs to consider the outcomes of patient pain primarily with post-procedure wound care. In the Wright et al study\textsuperscript{8}, they did not assess pain as a primary outcome of the study, but they did state that patients who received open drainage often required narcotic pain medications before their wound packing was changed. The patients who received loop drainage did not require pain medication prior to their wound care, which included washing the wound site with soap and water. Another variable that should be considered in future research is long-term scar appearance. This was not investigated by any of the studies, but because loop drainage involves two small incisions versus a single large incision with open drainage, it may be a significant variable to consider. Both of these outcomes would be subjective and not easily measured, but it would be beneficial to see how open drainage compared to loop drainage differ in regards to these outcomes, since they significantly impact the patient and the patient’s family.

**CONCLUSION**

In pediatric patients with subcutaneous abscesses, research shows that loop drainage compared to open drainage results in reduced cost for the patient and hospital, reduced length of stay, and reduced incidence of procedure failure. This is going to significantly change how pediatric patients with subcutaneous abscesses are treated in inpatient and outpatient settings because there are multiple benefits to doing loop drainage and no increased cost, formal training, or risk associated with doing loop...
drainage. Within the medical community, it is recommended that providers become well-versed with loop drainage procedure and offer it to patients as an alternative to doing open drainage. This is particularly important in cases where there is increased risk of abscess recurrence or procedure failure, because loop drainage has shown decreased risk of both outcomes, and in cases where the cost of medical care is a concern. As this procedure becomes better known within the medical community, additional research should be done using randomized controlled trials to create more reliable and unbiased results and recommendations that provide better patient and hospital outcomes.
References


Table 1: Characteristics of Reviewed Studies

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of Studies</th>
<th>Study Designs</th>
<th>Downgrade Criteria</th>
<th>Upgrade Criteria</th>
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<td>Limitations</td>
<td>Indirectness</td>
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<td>Cohort - Retrospective</td>
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<tr>
<td>Failure</td>
<td>2</td>
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<td>Serious&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Serious</td>
<td>Not Serious</td>
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</table>

<sup>a</sup> Significant loss to follow-up
<sup>b</sup> Only one study investigated this outcome so there is limited data
<sup>c</sup> Low incident rate

LOS = Length of Stay
Failure = Procedure Failure
<table>
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<th>Open Drainage</th>
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LOS = Length of Stay
HNA = Home Nursing Assistance