Primary Versus Secondary Closure of Cutaneous Abscesses in the Emergency Department: A Randomized Controlled Trial

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Abstract

Objectives: Cutaneous abscesses have traditionally been treated with incision and drainage (I&D) and left to heal by secondary closure. The objective was to compare the healing rates of cutaneous abscesses following I&D after primary or secondary closure.

Methods: This was a randomized, controlled, trial, balanced by center, with blocked randomization created by a random-number generator. One urban and one suburban academic emergency department (ED) participated. Subjects were randomized to primary or secondary wound closure following I&D of the abscess. Main outcome measures were the percentage of healed wounds (wound was completely closed by visual inspection; a 40% difference in wound healing was sought) and overall failure rate (need for additional intervention including suture removal, additional drainage, antibiotics, or admission within 7 days after drainage).

Results: Fifty-six adult patients with simple localized cutaneous abscesses were included; 29 were randomized to primary closure, and 27 were randomized to secondary closure. Healing rates at 7 days were similar between the primary and secondary closure groups (69.6%, 95% confidence interval [CI] = 49.1% to 84.4% vs. 59.3%, 95% CI = 40.7% to 75.5%; difference 10.3%, 95% CI = -15.8% to 34.1%). Overall failure rates at 7 days were also similar between the primary and secondary closure groups (30.4%, 95% CI = 15.6% to 50.9% vs. 28.6%, 95% CI = 15.2% to 47.1%; difference 1.8%, 95% CI = -24.2% to 28.8%).

Conclusions: The rates of wound healing and treatment failure following I&D of simple abscesses in the ED are similar after primary or secondary closure. The authors did not detect a difference of at least 40% in healing rates between primary and secondary closure.

Cutaneous abscesses account for a large number of emergency department (ED) visits and the incidence is increasing. The time-honored conventional treatment of cutaneous abscesses is incision and drainage (I&D) followed by spontaneous healing with the incision left open, called secondary intention, also referred to as secondary closure. In fact, primary closure of infected wounds, such as abscesses, is generally considered contraindicated. This dogma was first challenged over half a century ago by Elis in 1951 who described primary closure following I&D of anorectal abscesses in 30 patients. The majority of these patients healed uneventfully within 1 to 2 weeks with very few complications. Since then multiple studies have demonstrated that primary closure is not only safe following I&D of abscesses, but also results in faster healing than secondary closure.

Prior studies have been conducted outside the ED and the United States and have included mostly abscesses of the anogenital region that were drained under general anesthesia in the operating theater. In addition, most prior studies were conducted prior to the era of methicillin-resistant Staphylococcus aureus. As a result, it is unclear whether the results of prior studies...
can be generalized to current I&D of cutaneous abscesses in the ED or casualty area.

This study was designed to determine whether primary closure after I&D of cutaneous abscesses in the ED is superior to traditional secondary closure. Specifically, we tested the hypothesis that when compared with secondary closure, primary closure of drained abscesses would result in faster healing without increasing the failure rate.

METHODS

Study Design
A prospective, randomized clinical trial design was used to compare primary and secondary closure of cutaneous abscesses presenting to the ED and to test the study hypothesis. The study was approved by the respective institutional review boards and all patients gave written informed consent. No financial incentive was given for study participation.

Study Setting and Population
The study was conducted at two academic EDs with affiliated emergency medicine residency programs. One was located in a suburban location and had an annual census of approximately 85,000 patients, mostly white. The other was urban and had an annual census of 80,000 patients, mostly African Americans.

All healthy patients with localized cutaneous abscesses that required I&D in the ED were considered eligible for enrollment. Ultrasound was used at the physician’s discretion to confirm presence of a fluid collection. Patients with systemic signs of infection (such as fever, chills, and hypotension), as well as those with significant (>5 cm) surrounding cellulitis, were excluded from the study. Patients with immunocompromising conditions (such as diabetes mellitus, HIV infection, or use of systemic steroids), known risk of endocarditis, and the absence of purulence on I&D were excluded from the study. Patients requiring I&D under procedural sedation or general anesthesia were also excluded from the study. Patients already prescribed oral antibiotics prior to enrollment were not excluded. At the suburban site the study sample was a convenience sample when one of the study investigators was present in the ED. At the urban site it represents consecutive patients.

Study Protocol
Patients were assigned to a treatment arm by center with blocked randomization using a random-number generator in a 1:1 ratio. A local system was used in which the lowest numbered treatment envelope was selected from a box of four opaque envelopes. Apart from the envelope number, the treatment envelopes were identical. Treatment allocation was determined after opening the contents of the study envelopes, which revealed study allocation. Each envelope also contained standardized instructions for abscess management. Clinicians and researchers were blinded to group allocation until after randomization. It was not possible to blind the treatment itself.

Standardized data collection was performed prior to I&D, including demographic and clinical characteristics as well as pain severity. Measurements of the largest diameter and width of the abscess and any surrounding cellulitis were performed and recorded by the provider prior to I&D. I&D was performed by an emergency medicine physician assistant, resident, or attending physician with local infiltrative anesthesia, stab incision, blunt dissection of all loculations, and saline irrigation (minimum of 100 mL). The incision was made parallel to the lines of minimal tension and was full thickness. Bacterial cultures from the drained pus were obtained at the discretion of the treating physician. Patients were randomized to gauze packing and secondary closure, defined as healing by secondary intention, or primary closure with 4-0 monofilament vertical mattress sutures (Figure 1) with no packing or wick placement. The minimal number of sutures required to approximate wound edges were placed. Patients assigned to secondary closure had their wounds loosely packed with a half-inch wick of gauze saturated with iodophor. Use of systemic antibiotics was left to the discretion of the attending physician.

Patients were followed up in the ED at 48 hours for wound assessment and packing removal. If at the time of follow-up there was concern that the sutured abscess had reaccumulated pus (e.g., increased swelling, pain, fluctuance, and signs of systemic illness), the sutures were removed and the abscess cavity loosely packed if a large amount of purulent material was found. Patients were then seen at 7 (±2) days for final wound follow-up and suture removal when appropriate. Assessment of wound closure was determined by research staff blinded to treatment allocation.

The primary outcome measure was the percentage of wounds that were healed at 7-day follow-up. Wounds were considered healed when the wound was completely closed and reepithelialized by visual inspection. Secondary outcomes were treatment failure rates (at 2 days, at 7 days, and overall within a 7-day period), need for hospital admission, and patient satisfaction scores. Treatment failure was defined as a worsening condition prompting additional intervention including suture removal, additional drainage, antibiotics, or admission. The overall failure rate was calculated by combining the rate of abscesses requiring additional imaging vertical mattress sutures or primary closure.
intervention at 2 and 7 days. Overall patient satisfaction was measured on a 10-cm visual analog scale from best (10) to least (0). The patients were asked to make a vertical marking along an unnumbered horizontal line measuring 10 cm marked “least” on the far left end and “most” on the far right hand. Satisfaction was measured by measuring the horizontal distance from the far left of the line to the patient marking.

Data Analysis
Continuous data were summarized as means, standard deviations (±SDs), and 95% confidence intervals (CIs) for normally distributed data or medians and interquartile ranges (IQRs) for skewed data, and compared with independent-samples t-tests and the Mann Whitney U-test as appropriate. All analyses were based on the intention-to-treat principle.

Assuming that the rate of wound healing at 7 days is around 25%, and a 40% difference in rate of wound healing would be clinically important, a trial of approximately 50 patients was planned, which would then have an 80% chance of achieving a two-sided p-value of less than 0.05. A delta of 40% was chosen based on prior studies suggesting a very large difference in healing rates between primary and secondary closure. Assuming an attrition rate of 10% we planned to enroll 55 patients.

RESULTS
During the study period, 76 potentially eligible patients meeting all inclusion criteria were approached, of whom 56 were enrolled at the suburban (40) and urban (16) centers (Figure 2). Patients at the suburban site represent a convenience sample visiting the ED while one of the investigators was present. Patients at the urban site were consecutively enrolled between November 2010 and February 2011. All patients were treated as originally allocated. Mean (±SD) patient age was 36.7 (±13.3) years, 31 (56.4%) were female, 25 (44.6%) were black or African American, 25 (44.6%) were white, and 6 (10.7%) were Hispanic. Abscess size ranged from 1 to 150 cm² with a median of 5 cm² (IQR = 4 to 10 cm²). Thirteen abscesses were located on the head and neck (23.2%), 13 were on the axilla (23.2%), 11 were on the extremities (19.6%), 10 were on the trunk (17.8%), and eight were on the buttocks (14.3%). Oral antibiotics were prescribed in 20 patients (35.7%). Treatment groups were well balanced with respect to all baseline patient characteristics (Table 1). Patient and abscess characteristics were similar between the two study sites.

Primary outcome data were available for 51 (91.1%) randomized patients, 23 (85.2%) allocated to primary closure, and 28 (96.5%) allocated to secondary closure. The percentage of patients whose wounds were healed at 7-day follow-up were similar between those assigned to primary (69.6%) and secondary (59.3%) closure (Table 2). At the 2-day follow-up sutures were removed by the treating physician in six (22.2%) patients assigned to primary closure. None of these patients had signs of systemic infection and none were admitted to the hospital. The difference in the percentage of abscesses requiring additional drainage either at 2 or at 7 days after I&D was not significant between the two study groups (Table 2). Of 24 patients treated with
Table 1
Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Primary Closure</th>
<th>Secondary Closure</th>
<th>Difference, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>27</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>Mean (±SD) age, years</td>
<td>33.1 (±12.6)</td>
<td>39.9 (±14.4)</td>
<td></td>
</tr>
<tr>
<td>Sex: female</td>
<td>15 (55.5)</td>
<td>16 (55.2)</td>
<td></td>
</tr>
<tr>
<td>Race or ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
<td>12 (44.4)</td>
<td>13 (44.8)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>11 (40.7)</td>
<td>14 (48.3)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>4 (14.8)</td>
<td>2 (6.9)</td>
<td></td>
</tr>
<tr>
<td>Abscess location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head/neck</td>
<td>4 (14.8)</td>
<td>9 (31.0)</td>
<td></td>
</tr>
<tr>
<td>Axilla</td>
<td>8 (29.6)</td>
<td>5 (17.2)</td>
<td></td>
</tr>
<tr>
<td>Extremity</td>
<td>5 (18.5)</td>
<td>6 (20.7)</td>
<td></td>
</tr>
<tr>
<td>Trunk</td>
<td>5 (18.5)</td>
<td>5 (17.2)</td>
<td></td>
</tr>
<tr>
<td>Buttock</td>
<td>5 (18.5)</td>
<td>3 (10.3)</td>
<td></td>
</tr>
<tr>
<td>Median (IQR) abscess size, cm²</td>
<td>6 (4–10)</td>
<td>4 (4–9)</td>
<td></td>
</tr>
<tr>
<td>Median (IQR) incision length, cm</td>
<td>1 (1–2)</td>
<td>1 (1–2)</td>
<td></td>
</tr>
<tr>
<td>Prescribed antibiotic</td>
<td>8 (30.8)</td>
<td>12 (41.4)</td>
<td></td>
</tr>
</tbody>
</table>

Values are reported as n (%) unless otherwise noted. IQR = interquartile range.

Table 2
Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Primary Closure, n (%)</th>
<th>Secondary Closure, n (%)</th>
<th>Difference, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>27</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>Sutures removed</td>
<td>6 (22.2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Additional drainage, day 2</td>
<td>6/27 (22.2)</td>
<td>28/14 (13.4)</td>
<td>8.8</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>10.6 to 40.0</td>
<td>5.7 to 31.5</td>
<td>-16.6 to 29.6</td>
</tr>
<tr>
<td>Healed, day 7</td>
<td>16/27 (69.6)</td>
<td>16/27 (59.3)</td>
<td>10.3</td>
</tr>
<tr>
<td>Reformed, day 7</td>
<td>1/23 (4.3)</td>
<td>4/28 (14.3)</td>
<td>-9.9</td>
</tr>
<tr>
<td>Admissions</td>
<td>0</td>
<td>1 (3.4)</td>
<td>-3.4</td>
</tr>
<tr>
<td>Overall failures</td>
<td>7/23 (30.4)</td>
<td>18/28 (28.6)</td>
<td>1.8</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>9 (7–10)</td>
<td>10 (8–10)</td>
<td>-</td>
</tr>
</tbody>
</table>

IQR = interquartile range.

In our study, loose packing was used in patients randomized to secondary closure. Whether all incised and drained abscesses in the ED require routine packing has recently been challenged by a study demonstrating similar healing rates and less pain when such abscesses were not packed. Less invasive methods of draining simple cutaneous abscesses in the ED have also received recent attention. In a study comparing ultrasound-guided needle aspiration and conventional I&D for skin abscesses in the ED, Gaspari et al. concluded that needle aspiration, even when guided by ultrasound, was insufficient due to low success rates. In contrast with I&D, needle aspiration does not allow breakdown of abscess loculations or irrigation, both of which were performed in our study, even though incision length was relatively short.

Our results were somewhat surprising in light of prior data and a recent systematic review. In the latter, 33 articles describing the use of primary closure after I&D of cutaneous abscesses were reviewed, of which seven were randomized clinical trials. Of 915 patients enrolled in a randomized trial, 455 were randomized to primary closure and 460 to secondary closure. All of the studies were conducted outside of the United States, and most of these abscesses were in the anogenital region and drained in the operating room, under general anesthesia, by a surgeon using longer incisions than those used in our study. The time to healing after primary closure (7.8 days, 95% CI = 7.3 to 8.3 days) was significantly shorter than after secondary closure (15.0 days, 95% CI = 14.3 to 15.7 days; absolute difference 7.3 days, 95% CI = 6.9 to 7.6 days). The rates of abscess recurrence after primary closure (7.6%, 95% CI = 4.6 to 10.6) were similar to those after secondary closure (7.5% to 14.7%; odds ratio = 0.66, 95% CI = 0.35 to 1.15).
LIMITATIONS

First, the study was conducted at a limited number of study sites. However, these represent two diverse ED settings and patient populations. Furthermore, our study is representative of patients with simple abscesses presenting to EDs during the era of methicillin-resistant S. aureus and where most abscesses are managed under local anesthesia alone.

Second, the enrolled patients represent a small sample, which may have contributed to significant selection bias. For example, it is possible that patients with very “angry-looking” abscesses were intentionally excluded from the study.

Third, our study is limited to relatively small abscesses and small incisions. Prior studies have included larger abscesses and incisions. Thus, our results may have underestimated the comparative effectiveness of primary closure for large abscesses. We also excluded patients requiring procedural sedation. However, procedural sedation is rarely performed for abscess management in the two study sites. Patients requiring sedation are usually taken to the operating room. This may have introduced further selection bias. However, prior studies comparing primary and secondary closure of abscesses have generally been limited to patients undergoing I&D in the operating room.

Fourth, our study is limited to two EDs that may not be representative of other sites. However, we specifically included an inner city urban center and a relatively affluent suburban center to increase generalizability of our results. Fifth, we did not standardize the use of oral antibiotics, to better simulate actual practice in which use of antibiotics varies and is physician-dependent. However, use of antibiotics in this study was well balanced between the two study groups. Sixth, follow-up was limited to 7 days. Thus it is possible that we may have underestimated the long-term failure rate as well as the delayed healing rate. However, this underestimation would have applied equally to both study groups. Seventh, it was not possible to blind patients or practitioners from treatment allocation. While assessments of wound healing were performed by research personnel blinded to treatment assignment, it was often possible to determine treatment assignment when suture marks were present on either side of the wound.

Finally, our study was powered based on the assumption that the baseline healing rate would be only 25% and that there would be a large difference between the groups. In contrast, the healing rate was considerably higher after secondary closure. Thus our study may have been underpowered to detect any superiority of primary over secondary closure in healing rates. In addition, the CIs for the percent healed at day 7 and the percentage of overall failures were wide and included limits that many would consider clinically important.

CONCLUSIONS

Our study demonstrated that the rates of wound healing and treatment failure following incision and drainage of simple abscesses in the ED under local anesthesia are similar after primary or secondary closure. Our study did not demonstrate a 40% or greater improvement in 7-day healing rate with primary closure. Both primary and secondary closure may be considered based on patient and physician preferences. Future studies with larger sample sizes, and including larger abscesses, may better help define which closure method is superior.

References


Vol 1, No 1: Where are they now?

Editor’s note: Throughout this 20th anniversary year of Academic Emergency Medicine, this column will feature brief updates on the whereabouts of the authors of papers published in Volume 1, Number 1 – January 1994. Jonathan Singer published a “Reflections” piece in the inaugural issue, and has published 94 more over the years. -DCC

In the 1990-19999 timeframe, I was Wright State's Department of Emergency Medicine program director. I was rather unique in that I was boarded in pediatrics and pediatric emergency medicine, but not in emergency medicine. The poem in question [“Learning Ain’t Unnecessary When You’re Bent”, Acad Emerg Med 1994;1(1):60] was written when one of our overachieving residents sustained an injury, but continued to work when rest would have been in order. I was also our department's vice chair until 2007. At that point, Jim Brown and Glenn Hamilton were reversing roles, and Glenn in his last few years took the vice chair position as Jim ascended. Back in the mid 80's our department had been number nine compared to other EM departments in the country in terms of publications. We slipped by 2000, and Glenn Hamilton, noting my penchant for consistent production and elation when working with residents and fellows, made me director of scholarly activities. In that role I helped every resident achieve a submission prior to graduation.

As I functioned clinically at Dayton Children's Hospital, all my bedside insights came from the care of kids. When I retired on 6/30/2012, I had contributed 80 chapters, 80 commentaries, and 80 peer-reviewed articles to the literature. The very first was to Journal of American College of Emergency Physicians, which became Annals of Emergency Medicine. The overwhelming majority of others were published in the peds literature, largely Pediatric Emergency Care. I do believe that in my prime I exceeded the contributions of Adam Singer (no relation) to Academic Emergency Medicine. All have been “Reflections”: poems, poems with picture, or short narration. I have had 95 published in AEM, largely due to the kindness of the editorial staff and the need to fill dead space.

The days of retirement are full. I continue to mismanage patients in dreams, miss classes, fail to understand exam instructions, and awaken in a cold sweat. I continue to review for the journals (Ped Emerg Care has tapped into me 57 times since they went to the online system). I remain the editor for the PEM certifying examination for the American Board of Pediatrics. Thus, I continue to make others sweat. – Jonathan Singer, MD