Excision of carbuncle with primary split-thickness skin grafting as a new treatment modality

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Key words
Carbuncle; Soft tissue infections

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Abstract
Carbuncles are debilitating skin infections commonly seen in diabetic patients. Excision of these infective lesions leads to large defects that require prolonged hospital stay and repeated dressings with ensuing pain and bleeding. This study is an attempt to cover the wounds resulting from excision of carbuncle with primary skin grafting so as to decrease the hospital stay and frequency of dressings.

Introduction
Skin and soft tissue infections are very common occurrences throughout life. A carbuncle is a common soft tissue infection among the elderly, especially in developing countries such as India. A large part of the population suffering from chronic debilitating disease such as diabetes adds to the issue as also the prevalence of low socioeconomic class.

Key Messages
- carbuncle is a common soft tissue infection among the elderly especially in developing countries like India
- furuncles and carbuncles are cutaneous abscesses (primary pyodermas) that begin in skin glands and hair follicles
- in our study, we propose to hasten the recovery in patients treated for carbuncles by trying a novel therapeutic approach of excision and primary split thickness skin grafting (STSG) of carbuncles
- extensive search on the Internet has not revealed any previous published study on this new treatment modality
- this open controlled study to evaluate the feasibility and compare the efficacy of excision of carbuncle primary STSG to excision of carbuncle delayed STSG, was carried out on 60 patients admitted in a tertiary care teaching hospital. The clinical diagnosis of carbuncle during the period of 36 months from June 2007 to June 2010. The study and control groups consisted of 30 patients each respectively
- the outcome of the procedure of ‘Excision of carbuncle and primary STSG’ was judged on postoperative day 7 at the time of the third check dressing of the wound
- thirty-eight of the 60 patients had Staphylococcus aureus as the aetiological agent isolated from the wound swab
- the mean duration of stay in ward in study group was 10.07 days, while in control group it was 21.08 days
- out of the 30 patients in study group, in 66.66%, i.e. 20 patients, the excision followed by primary STSG was successful
- in 10 patients, i.e. 33.33% patients it failed
- these 10 patients had to undergo a repeat STSG procedure for wound closure
- there is a learning curve involved with mastering the skill of wide local excision and primary STSG of carbuncle
- a major drawback of this study was the small sample size
- further studies need to be performed in this field to refine and standardise the technique and thus produce better and consistent results
- development of an objective way to judge the extent of excision will be helpful
- this study supports the hypothesis of excision and primary STSG of the carbuncle as a feasible treatment option
- no thought has been given to lessen the pain and suffering of the patient with carbuncle
- our study is unique in that because we tried to address this issue
Furuncles and carbuncles are cutaneous abscesses (primary pyoderma) that begin in skin glands and hair follicles. An acute deep-seated red hot nodule or abscess that evolves from a staphylococcal folliculitis is called a furuncle (boil). A carbuncle is a deeper infection composed of interconnecting abscesses usually arising in contiguous hair follicles.

The operative management of carbuncles rests on the basic surgical principle of thorough debridement of all devitalised tissues followed by cleaning and dressing of the wound for a number of days or weeks till the floor of the ulcer has healthy granulation tissue (1). At this period of time, split-thickness grafting or closure of the wound, if possible is performed (2).

In our study, we propose to hasten the recovery process in patients treated for carbuncles by trying a novel therapeutic approach of excision and primary split-thickness skin grafting (STSG) of carbuncles. Extensive search on the Internet has not revealed any previous published study on this new treatment modality.

Aims and objectives

This study was undertaken to evaluate the following

1. Feasibility of excision of carbuncle with primary STSG of the resultant soft tissue defect
2. The effects of this methodology in terms of time required for wound closure in comparison to the traditional method of excision and delayed grafting.

Materials and methods

This open controlled study to evaluate the feasibility and compare the efficacy of excision of carbuncle primary STSG with excision of carbuncle delayed STSG, was carried out on 60 patients admitted in a tertiary care teaching hospital. The clinical diagnosis of carbuncle during the period of 36 months from June 2007 to June 2010. The study and control groups consisted of 30 patients each.

All diabetic patients presenting with carbuncle were admitted and detailed history and complete physical examination were carried out. All the patients were screened. The patients who fulfilled the inclusion criteria for the study were randomly allotted to the control group and the study group.

Inclusion criteria for the study were as follows

1. All diabetic patients with carbuncle;
2. Age more than 18 years;
3. Non-pregnant non-lactating females;
4. Expected size of skin loss less than 15-cm diameter after excision.

Exclusion criteria for the study were as follows

1. Patients in diabetic ketoacidosis;
2. Patients unsuitable for general anaesthesia;
3. Expected and or actual size of skin loss more than 15-cm diameter after excision;
4. Pregnant and lactating females.

A 15-cm limit was kept because this study was a novel concept. Excision with resultant large defects with primary skin grafting in uncontrolled diabetics in an emergency setting by junior residents was considered relatively unsafe by the hospital ethics committee. A similar decision was taken by the hospital ethics committee regarding exclusion of pregnant and lactating women.

Besides surgical intervention, all other treatment protocols were common to both the study and control groups.

- A valid written informed consent was taken.
- The local area of the carbuncle and the proposed donor site for harvesting STSG were shaved and prepared.
- The surgical procedure was performed under general anaesthesia.
- Wide local excision of the carbuncle was performed in all three dimensions, ensuring excision of all infected, devitalised tissue and till normal viable looking tissue became visible.
- Meticulous haemostasis was secured using electrocautery or ligation with chromic catgut.

In the study group

- The defect was covered temporarily with a sterile, saline-soaked linen mop while STSG was harvested.
- STSG of adequate dimensions was taken using Humpby’s skin grafting handle.
- The acquired graft was placed on a small sterile wooden board, ensuring that it had spread evenly. The graft was meshed with a No. 15 surgical blade.
- Meshed graft was applied over the recipient area in a uniform manner removing any wrinkles, and was secured with skin staples.
- Compression dressing was to ensure contact between applied graft and recipient bed.
- Patients with carbuncle on the back were shifted to recovery in prone position or in lateral position and the same position was maintained till the first check dress on postoperative day 3.

In the control group

Compression dressing was given with povidone iodine solution. Subsequent changes of dressings were performed everyday till the floor of the ulcer was covered by healthy granulation tissue, which was achieved in a minimum of 7 days and a maximum of 2 weeks. Redebridement was performed if necessary. A delayed STSG was performed in the same way as described for primary grafting.

Apart from the aforesaid surgical treatment administered, the following measures were also taken for all the 60 patients—in the study group as well as in the control group:

- Control of diabetes mellitus using either insulin or oral hypoglycaemic agents as indicated.
Primary skin grafting after excision of carbuncle

Appropriate common antimicrobial agents, that is, amoxicillin and clavulanic acid were administered to both groups initially 1.2 g IV eight hourly and later on converted to oral amoxicillin with clavulanic acid 625 mg eight hourly.

Supportive therapy including improvement of general condition, good nutritional support, adequate rest, good nursing care, etc.

Check dressing of the grafted wound was performed on post-operative days three, five and seven, in both test and control groups with donor site dressing opened on day 8 (earlier if clinically indicated) (Figure 1).

Observations were recorded in specially designed case record form. The collected data was analysed by computer-based statistical software SPSS1.0. The following tests were applied to study the statistical significance ($P < 0.05$):

1. Student $t$-test.
2. Pearson’s Chi squared test.

The outcome of the procedure of ‘excision of carbuncle and primary STSG’ was judged on postoperative day 7 at the time of the third check dressing of the wound. The outcome was categorised into two groups: success and failure.

Success
In the patients in whom the procedure of excision of carbuncle and primary STSG was able to achieve wound closure without resorting to a second repeat procedure, the treatment was defined as successful and these patients were included in the success group.

Failure
In the patients in whom the procedure of Excision of carbuncle and primary STSG was not able to achieve wound closure, and in whom a second grafting procedure of STSG was required, the treatment was defined as having failed and these patients were included in the failure group.

Results

The demographic profile of the patients
Tables 1 and 2 show the demographic profiles of the patients.

1. The mean age of patients with carbuncles presenting in both the groups was 54.6 and 51.93 years.
2. The duration of symptoms was comparable and there were no major co-morbid conditions affecting wound healing apart from diabetes, which was common to all patients.

Location of the carbuncle
The location of the carbuncle, across the patient population, among the study and control groups was recorded. The most common site of carbuncle was the back (Table 3).

Size of the carbuncle
The maximum diameter of the carbuncle was measured in centimetres. All lesions were arbitrarily divided into three groups, those with maximum diameter $\leq$ 5 cm, those with maximum diameter < 5 but < 10 cm and those with maximum diameter $\geq$ 10 cm (Table 4).

<table>
<thead>
<tr>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of patients</td>
<td>No. of patients</td>
</tr>
<tr>
<td>Age $&lt;40$ years</td>
<td>4</td>
</tr>
<tr>
<td>&gt;40 years</td>
<td>26</td>
</tr>
<tr>
<td>Sex Male</td>
<td>22</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 1 Age distribution with success/failure

<table>
<thead>
<tr>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of patients</td>
<td>Failures</td>
</tr>
<tr>
<td>Age $&lt;40$ years</td>
<td>4</td>
</tr>
<tr>
<td>&gt;40 years</td>
<td>26</td>
</tr>
<tr>
<td>Range</td>
<td>35–75</td>
</tr>
</tbody>
</table>
Primary skin grafting after excision of carbuncle

Organisms isolated in the wound swab
A swab from the carbuncle was subjected to microbial culture and sensitivity testing. This was performed before excision of the lesion on the day of admission.

The swab taken from carbuncle (case 25) grew two isolates, namely, proteus and pseudomonas. The swab taken from carbuncle (case 16) provided two isolates, namely, proteus and klebsiella. In 12 cases, the swabs were reported to have mixed growth, that is a mixture of isolates including the commensals, indicating a contaminated sample.

Haemoglobin levels, blood sugar levels and albumin levels
Haemoglobin levels, blood sugar levels and albumin levels were compared across the patient population among the study and control groups (Table 6).

The test used was Student’s t-test.
As the ‘p’ value in all the three groups is not <0.05, the results are not statistically significant in all the three parameters.

Wound closure evaluation
All the wounds were assessed on postoperative day 7 at the time of the third check dressing after STSG. If it was decided that the wound would not require a second procedure and that adequate cover had been provided for the wound, then it was taken as the end point of the study and wound closure was stated to have been achieved. These patients comprised the ‘success’ group. If a second procedure was need for wound closure, the patients were categorised in the ‘failure’ group.

Thus, 20 of 30 patients, that is, 66.66% patients responded positively to this novel treatment and achieved wound closure.

Duration of stay in ward
Table 7 shows the duration of stay in the ward, the test used was Student’s t-test.
As the ‘p’ value is <0.05, the result is statistically significant.
Thus, on an average, the patients in the control group who had carbuncles excised had to wait for 21 days after excision for a definitive procedure for wound closure.

The take of graft as evaluated on the seventh day post grafting ranged from 50% to 90% in 20 patients from the study group and 26 patients from the control group. In 10 patients from the study group the take was 0–10% and all these patients required a second grafting procedure and were categorised as failures.

Discussion
The development of a carbuncle is an ominous sign as it denotes the breakdown of host defences. All the traditional modalities involve a prolonged treatment period. The resultant socioeconomic consequences are considerable. The duration of therapy as well as the time taken for wound closure and complete healing are long. The prolonged hospital stay of these patients causes considerable strain on the already overburdened health care system, rise in the cost of therapy and loss of work hours.

Considering these facts, any treatment modality that will reduce the duration of therapy would be most welcome.

A carbuncle is a localised lesion of skin and soft tissue involving multiple hair follicles. Interconnecting abscesses are present in the subcutaneous space. The tissue deeper to the carbuncle is viable and relatively healthy. If the carbuncle is excised widely, with the plane of excision being through this viable tissue, then the bed of resultant soft tissue defect should consist of healthy non-infected tissue. This raw surface should be amenable to wound closure by STSG performed at the same sitting. This thought was the basis of this study.
In our study, we proposed to excise the carbuncle widely and close the resultant soft tissue defect primarily with an STSG. If successful, wound closure could be achieved in a considerably short time compared to the traditional methods. The study aimed to assess the feasibility of this procedure and to compare its efficacy with the time-honoured method of excision and delayed skin grafting.

In this study conducted on 60 patients, wide excision and primary STSG was performed in 30 patients comprising the study group. Excision of the carbuncle followed by delayed STSG was performed in 30 patients comprising the control group.

As shown in Tables 1 and 2, 83.33% patients were older than 40 years. As age advances, the intrinsic capacity of the body for wound healing decreases. Thus, achieving wound closure becomes an even bigger challenge. As much as 63.33% patients were males, reinforcing the fact that carbuncles are more common in the male sex (1).

Diabetes mellitus is a multisystem disorder affecting mainly the microcirculation. The underlying tissue hypoxia, increased propensity to infections and decreased wound healing in diabetics compound the problem of carbuncles.

Patients included in our study had symptoms for 2–12 days before they presented to our hospital. Early detection of carbuncles may alter the outcome.

Thirty-four of 60 patients had carbuncles located on the back, the next common location being the scapula, gluteal region and the nape of the neck (Table 3).

As stated in Table 4, most of the patients had lesions <5 cm in maximum diameter (28 out 60). Only eight patients had lesions more than 10 cm in maximum diameter. The rest were intermediate.

The surrounding skin showed evidence of inflammation in majority of the patients. This observation co-relates with the behaviour of carbuncles, as carbuncles are known to be rapidly spreading lesions which infiltrate the surrounding tissue. This also underscores the need for extensive excision for eradication of infection.

Thirty-eight of the 60 patients had *Staphylococcus aureus* as the aetiologic agent isolated from the wound swab (Table 5). Gram-negative organisms were isolated in eight patients. Twelve swabs showed mixed growth, while two showed no growth.

The average values of haemoglobin, random blood sugar levels and albumin levels between the groups were similar as shown in Table 6.

As stated in Table 7, the mean duration of ward stay in the study group was 10–07 days, while in the control group it was 21–08 days. The patients in control group underwent cleaning and dressing everyday with subsequent minor redebridement if necessary till the wound became ready for closure, which was judged by healthy granulation tissue. Then they were subjected to subsequent split-thickness grafting. Most of our patients are from a poor socioeconomic group and hence dressings of large wounds and glycaemic control using insulin may not be possible on an outpatient basis. Hence, it is our policy to keep these patients admitted, perform daily dressings and debridements and maintain glycaemic control.

As shown in Table 8, out of the 30 patients in the study group, in 66–66%, that is, 20 patients, the excision followed by primary STSG was successful. In 10 patients, that is, in 33.33%, it failed. These 10 patients had to undergo a repeat STSG procedure for wound closure.

This observation is worth noting. A patient being treated with conservative methods had to bear a painful wound for a long time, with resultant rise in hospital stay and expenses. The average per day hospital expense in a government-run hospital in Mumbai is approximately Rs. 3000 and hence the average savings is Rs. 30 000/ for a 10-day period.

In the study group, patients underwent a graft on the same day and had a shorter hospital stay. Procedures for delayed wound closure involves subjecting the patient to repeat anaesthesia, with the known involves risk of the anaesthetic drugs. The availability of the operation theatre and the associated support staff also becomes an issue.

The technical issues that need particularly careful attention were identified as follows:

- Optimal excision till viable tissue is seen;
- Good haemostasis;

### Table 6 Haemoglobin levels, blood sugar levels and albumin levels

<table>
<thead>
<tr>
<th>Variables</th>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td>Study group</td>
<td>30 12:52</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>30 11:61</td>
</tr>
<tr>
<td>Blood sugar</td>
<td>Study group</td>
<td>30 186:53</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>30 210:40</td>
</tr>
<tr>
<td>Albumin</td>
<td>Study group</td>
<td>30 2:93</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>30 3:06</td>
</tr>
</tbody>
</table>

### Table 7 Duration of stay in ward

<table>
<thead>
<tr>
<th>Group</th>
<th>Range</th>
<th>Mean</th>
<th>‘P’ value</th>
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<tr>
<td>Study group</td>
<td>7–15 days</td>
<td>10:07 days</td>
<td>0:0001</td>
</tr>
<tr>
<td>Control group</td>
<td>7–43 days</td>
<td>21:08 days</td>
<td></td>
</tr>
</tbody>
</table>

### Table 8 Wound closure evaluation

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Success percentage</th>
<th>Failure percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study group</td>
<td>20 66:66</td>
<td>10 33:33</td>
<td>30</td>
</tr>
<tr>
<td>Control group</td>
<td>26 100</td>
<td>0 0</td>
<td>26</td>
</tr>
</tbody>
</table>

*Four patients from the control group were lost to follow-up.*
• Secured anchoring of the graft;
• Good compression to maintain adequate contact between bed and graft;
• Ensuring immobilisation of the recipient area.

The patients enrolled at the start of the study had a comparatively poorer outcome than the ones enrolled later. With experience and with refinement of technique with each case, the outcome probably improved. Thus, there is a learning curve involved with mastering the skill of wide local excision and primary STSG of carbuncles.

A major drawback of this study was the small sample size. A multicentric trial on a larger scale may be envisaged to evaluate this treatment modality. Further studies need to be carried out in this field to refine and standardise the technique and thus produce better and consistent results. Development of an objective way to judge the extent of excision will be helpful. Innovative ways should be used to immobilise the grafted area and to give complete rest to the graft bed.

Conclusions

This study supports the hypothesis of excision and primary STSG of the carbuncle as a feasible treatment option. In our study in patients with successful outcomes, significant reduction was observed in the following:

• Time required for wound closure;
• Reduced hospital expenses;
• Morbidity.

The factors that influenced the outcome were identified to be the location of the carbuncle and immobilisation of the recipient site (both being interlinked). Experience improved the outcome as a result of better understanding of the completeness of excision and innovations in methods of immobilisation.

It can be concluded that with appropriate patient selection, complete excision of the carbuncle and good immobilisation of the recipient site, the new treatment option of excision and primary STSG of the carbuncle provides significant benefits over the conventional treatment of excision and delayed STSG.

A carbuncle is a common condition affecting the general population. Surprisingly, very few references regarding carbuncles are present in the literature. There has been no single study wherein the novel methodology of excision of the carbuncle followed by primary STSG was carried out. Traditional methods of treating this lesion are far from satisfactory. No thought has been given to lessen the pain and suffering of the patient. Our study is unique in that because we tried to address this issue.

Disclaimer

The study is not based upon communication with any society or meeting.

References