An approach to improve early detection of sternal wound infection

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Abstract

We developed a reproducible and reliable method of using a rubber stamp prospectively to document appearances of the sternal wound. 395 consecutive patients undergoing median sternotomy for cardiac procedures were studied over a period of four months. Data were collected by the Senior House Officer during the ward round for all patients at Day 3 and Day 7 post-operatively. Data were entered for 303 patients using the rubber stamp. 78 patients had no stamp entered in their case notes. 21 patients were recorded as having abnormal wounds, 11 of whom confirmed positive microbiological growth. On the other hand, 282 patients were recorded to have normal wounds, 10 of which had positive bacterial growth. Our initial results have been encouraging with almost 80% compliance and 96% specificity. A simple recording system consisting of proven signs of infection known to medical practitioners was our tool.

Introduction

Approximately 1% of patients who have median sternotomy develop a superficial wound infection, usually 7–9 days after operation[1]. Deep sternal wound infection is a potentially life-threatening complication occurring in 0.4–5 percent of all open heart operations[1-3]. It usually presents 2–4 weeks after operation, but can present months or years later[1], and it carries a mortality of ~25%[4].

Surgical site infections include superficial incisional infections, infections of the deep incision space and organ space infections[5]. Superficial wound infections are defined as those that do not penetrate the subcutaneous tissue layer. The wound may exhibit erythema and a small amount of drainage that contains bacteria. Presenting symptoms and findings include wound drainage, fever, sternal instability, excessive wound pain, leukocytosis, and dehiscence[1,6]. Earlier recognition of sternal wound complications and aggressive treatment has probably contributed to the relatively low mortality rate seen in some studies[7]. Early symptoms of wound infection after cardiac surgery are often vague[8]. In most cases traditional markers of infection such as fever, leukocytosis and C-reactive protein (CRP) have proved unreliable[9]. Early recognition of infection is of great importance for optimal treatment and management[10].

Treatment of sternal wound infection is often delayed because of difficulty in early detection. A wound healing assessment was proposed based on points given for the need for **A**dditional treatment, the presence of **S**erous discharge, **E**rythema, **P**urulent exudate, and **S**eparation of the deep tissues, the **I**solation of bacteria, and the duration of inpatient **S**tay (ASEPSIS)[11]. A sternal wound could receive a score between 0 and 24 points at each inspection. The components of ASEPSIS most significantly associated with sternal wound infection were the presence of a purulent exudate, a post-operative stay >14 days, the identification of pathogenic organisms, and the use of antibiotics[12]. This complicated scoring system has not been used widely in clinical practice. In fact, this was originally devised for research and junior doctors are often reluctant to examine the sternal wound let alone to use the score.

Although various classifications for wound scoring have been proposed, they have not gained popularity for universal use because of their complexity. In terms of diagnosis, documentation is often inadequate (as in our experience) and difficulty arises with auditing. Indications and rationale for wound swabbing and the quality of swabbing vary from unit to unit. Various risk stratifications have been investigated for wound infection and reported, but none has been followed effectively in everyday clinical setting.

In an effort to find the true incidence of sternal wound infection in a single UK center, we retrospectively collected 10 years data on wound infection. We found that our data collection was incomplete because of inadequate documentation in the medical notes. We therefore identified a need to develop a reproducible wound recording system for documentation and early detection of wound infection. We introduced a simple, reproducible and reliable method of using a rubber stamp (Figure 1) to document post-operative sternal wound appearance. We hoped to use this method as a tool to encourage medical and nursing staff to record and enter data on the sternal wound in the patients' case notes. It was our aim to improve early diagnosis of sternal wound infection and thus permit appropriate early intervention.

Materials and Methods

395 consecutive patients undergoing median sternotomy for cardiac procedures were prospectively studied over a period of four months period at St George's Hospital, London, UK. Data was collected by the Senior House Officer of the appropriate consultants' team in all patients at Day 3 and Day 7 post-operatively or at the day of hospital discharge whichever was the earlier. Two rubber stamps were provided on all cardiothoracic wards. The five surgical teams in our unit participated in the study and were instructed to enter data as part of the patients' post-operative care. Data were collected by the cardiac audit fellow from the entries into the medical notes and also by the primary investigator manually.

Data were analyzed to obtain sensitivity, specificity and positive and negative predictive values.

Results

Results were analyzed to determine the efficacy of this method with regard to documentation in the case notes and early diagnosis of post-operative wound infection. Data were entered in 303 patients using the rubber stamp. 78 patients had no stamp entered in their case notes. 14 patients had no notes available to verify data collection. 21 patients were recorded as having abnormal wounds, 11 of whom confirmed positive microbiological growth. 282 patients were recorded as having normal wounds, 10 of whom had positive bacterial growth. Additionally, 4 positive bacterial growths were obtained from patients who had no stamp entry and 1 for whom the case note was unavailable. Compliance with the use of the rubber stamp was

80%. The results are shown in Table I. Positive predictive value i.e. the proportion of those with positive bacterial infection identified as being abnormal using the rubber stamp was 52%. Negative predictive value i.e. the proportion of those with no bacterial growth identified as having normal wound was 96%.

Prevalence of deep sternal wound infection before this program was 2.7% on average. After introducing the surveillance program the incidence of deep sternal wound infection has reduced to 1.1% in our institution in this short period. Over the years with increasing compliance with the method we expect further reduction in the wound infection rate.
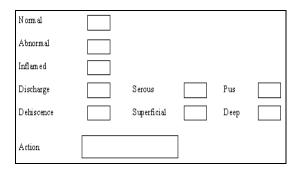

Figure 1: Rubber stamp displaying the data entered for early detection

Table I: The data emerged from the 'stamp' study

Patients underwent sternotomy	No. of patient	Comments
Total number of patients during study period	395	
Data entered in stamp	303	Compliance 80 %* (303 out of 381)
Data not entered in stamp	78	
No notes available	14	
Total no. patients recorded as 'abnormal' wound	21	
No. patients recorded as abnormal with +ve growth	11	
No. patients recorded as abnormal with no growth	10	
Total no. patients recorded as 'normal' wound	282	Late onset
No. patients recorded as normal with +ve growth	10	
No. patients recorded as normal with no growth/swab taken	271	
No. patients with 'no data entered' and +ve growth	4	
No. patients with no notes and +ve growth	1	(6.6%)
Total no. patients with +ve micro growth	26	
+Ve predictive value*	52.4	
-Ve predictive value*	96.4%	
Sensitivity*	52.4 %	
Specificity*	96.4%	

* Data excludes patients with no notes or had no data entered

Discussion

Our initial results have been encouraging with almost 80% compliance and 96% specificity. With increasing experience and awareness, we hope that the method will gain in popularity and thus lead to improve compliance.

Various wound scoring systems have been developed to aid early detection of wound infection, although very few have been devised for sternal wound infection after cardiac surgery. None of them is widely and routinely used by junior medical staff in day to day clinical practice. This is at least partially responsible for the discrepancy in reporting of the incidence of wound infection among various centers as evidenced by the wide difference in incidence in the published literature. Because of the deficiency in our center's experience in recording and documenting sternal wound infection appropriately, we felt compelled to address this locally. Therefore, we opted to increase awareness among the junior medical staff of the importance of post-operative examination of the sternal wound as a priority. We used a simple recording system consisting of proven signs of infection known to medical practitioners. It is easy to remember and to record in the case note. Indeed the stamp was carried during the ward round and entries stamped in the medical notes at the time of the ward round. Our nursing staff and surgical trainees commented on how it has helped focus attention on post-operative sternal wound healing and how it has provided a simple and reliable means of documenting this information in the patients' case notes. It has therefore been a valuable training tool and, independently our internal auditor had found that the technique was reproducible. The method was associated with a good specificity and positive predictive value.

All patients had standard pre-operative prophylactic antibiotics as per hospital protocol such as flucloxacillin 500 gm and cefuroxime 750 mg at induction and further 2 doses post-operatively. Although the early symptoms and signs of sternal wound infection are vague[8], this system has proved to be effective in detecting early infection with a specificity of 96%. We believe that the sensitivity has not accurately been reflected in 52%, as many patients with wound infection may not have positive microbiology as prophylactic peri-operative antibiotics precede wound swabbing. Furthermore, swabbing of patients with all early superficial infection may not yield bacteriological growth. Moreover, pre- and post-operative prophylactic antibiotics may contribute to the failure of the microorganism growth leading to low sensitivity in our study. Microbiological growth meant significant growth of pathological organisms such as Staphylococcus aureus, MRSA, coliforms, anerobes, β hemolytic streptococcus, and occasionally gram negative organisms in a clinically abnormal wound.

We aim to use this stamp method to help detect early signs of sternal wound complications and therefore, to promote early intervention. As such we would hope to reduce the rate of spread of infection to the deeper layers resulting in deep wound infection and systemic complications. We believe that this may help improve early detection and treatment of sternal wound infections. The stamp technique is a compliable training tool and is easy to use and encourages medical staff to regularly review sternal wounds post-operatively. It is hoped that this may contribute to reduced post-operative morbidity and hospital stay.

In conclusion, we propose the use of a simple, inexpensive, accurate method of recording the post-operative appearance of the sternal wound using a rubber stamp.

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