Caesarean section surgical site infection surveillance

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KEYWORDS
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Summary
Surveillance of surgical site infection (SSI) is an important infection control activity. The Caesarean section procedure was selected, as part of the Scottish Surveillance of Healthcare Associated Infection Programme, to monitor and report upon the incidence of SSI. Data were collected prospectively for 715 patients undergoing a Caesarean section procedure for 35 weeks during the latter months of 2002 and the first quarter of 2003. Of these, 80 (11.2%) patients developed an SSI, 57 (71%) of which were detected by post-discharge surveillance. Risk factors associated with infection were analysed. The choice of subcuticular suture rather than staples to close the surgical site was associated with a significantly lower incidence of infection \( P = 0.021 \). Obese women experienced significantly more infections than women with a normal body mass index \( P = 0.028 \). Dissemination of the surveillance results has made clinicians aware of the influence of body mass index and choice of skin closure in relation to SSI in this patient population. Analysis of these data has led to a review of local practice. The results also indicate the importance of postdischarge surveillance if SSIs are to be detected in this patient group. Continuous data collection and timely dissemination of the results are important factors acting as the catalyst for a review of practice.

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Introduction

The significant life-changing event of motherhood places additional demands upon the reserves of all women. When coupled with recovery from major abdominal surgery and a surgical site infection (SSI), physiological and psychological well-being will inevitably be compromised.

SSI is the second most common infectious complication after urinary tract infection following Caesarean section delivery. For the majority of obstetric patients, it rarely represents a threat to life. However, there are far-reaching morbidity
and socio-economic consequences for the patient and the healthcare services, with an estimated mean additional cost during the inpatient phase of care of £280 per infection.

The risk factors for SSI in association with Caesarean section are many, including those case-mix issues present in the surgical patient population such as age, factors such as presentation to surgery (elective vs emergency), and patient care practices such as antibiotic prophylaxis. Analysis of the combined effects of the intrinsic and extrinsic risk factors predisposing patients to SSI is necessary in order to detect the common links. The intrinsic factors are patient related and the extrinsic factors are related to management and care. Although the intrinsic factors cannot be changed, the risk they present in terms of infection is identifiable and manageable.

SSI is linked to factors associated with surgery that may influence the risk of infection. The Centers for Disease Control and Prevention’s (CDC) National Nosocomial Infection Surveillance System (NNIS) risk adjustment index is an internationally recognized method of stratifying the risk of SSI according to three major factors. Firstly, the American Society of Anesthesiologists’ score reflects the patient’s state of health before surgery. Secondly, wound classification reflects the degree of contamination of the wound. Thirdly, the duration of the operation reflects the technical aspects of surgery. Infection rate increases with increasing risk index score. However, with Caesarean section, the relationship with the risk index is not established and further work is required on identification of the risk factors for SSI in this procedure category.

In a review of the literature, some Caesarean-section-specific risk factors for SSI were identified. The first of these was the presentation to theatre. There is contradictory evidence from studies regarding the association of emergency procedures with a greater incidence of infection. Another risk suggested to contribute to SSI is body mass index (BMI). A greater rate of infection associated with obese women undergoing Caesarean section surgery has been reported.

Conflicting evidence exists regarding the ideal method of skin closure following abdominal surgery. Choice of skin closure material varies between surgeons according to experience and the patient’s clinical presentation to surgery. The evidence comparing sutures with staples focuses upon speed of insertion, cost, postoperative pain and cosmetic appearance rather than infection risk.

There is also evidence to indicate that any foreign body in the surgical site may increase the probability of infection. In general, monofilament sutures appear to be associated with a decreased risk compared with other sutures. Subcuticular absorbable sutures that are buried in the wound are associated with a decreased risk of infection.

An obstetric-related risk factor of both intrinsic and extrinsic origin is the length of time that the membranes are ruptured prior to Caesarean section. Following membrane rupture, the amniotic fluid is no longer sterile and may act as a transport medium by which bacteria come into contact with the uterine and skin incisions. Research has identified an association between prolonged rupture of the membranes and an increased risk of SSI.

Antibiotic prophylaxis is recommended for all operations involving entry into a hollow organ. The antibiotic should be administered pre-operatively, ideally within 30 min of the induction of anaesthesia. An adequate concentration of antibiotic within the serum and tissues will reduce the risk of resident bacteria overcoming the immune system during the immediate postoperative period. However, prophylaxis will not prevent the consequences of intra-operative contamination. Single-dose antibiotic prophylaxis is recommended for Caesarean section surgery following clamping of the umbilical cord.

The identification of risk factors for SSI within the literature is further limited by the various approaches to data collection and differing data definitions for SSI. Surveillance literature supports the use of postdischarge infection surveillance to establish accurate data collection. The latest systematic review of the literature indicates that between 12% and 84% of SSIs are detected after patients are discharged from hospital. There is evidence to support the use of postdischarge infection surveillance; however, consensus on the ideal method has yet to be met. The gold standard is direct observation by a trained healthcare worker, ideally within the normal patient pathway to avoid any additional costs. This is possible in the case of Caesarean section surveillance if collaboration with community midwives is possible. In Scotland, community midwives have a statutory responsibility for patients following discharge from hospital. Patients are visited 10–14 days post operatively, and problems arising after this visit within the 30 days following surgery are also followed-up by the community midwife.

This study aimed to establish surveillance utilizing a gold standard approach to definitions and methods, and to identify specific risk factors for SSI following Caesarean section.
Methods

The study hospital is a city maternity unit with an average of 3400 births/year. Caesarean section surgery was identified from a list of adult clean surgical procedures, provided by the Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP). Data collection commenced on 30 July 2002 and continues prospectively to the present date. Analysis for this study included all patients undergoing elective or emergency Caesarean sections at the hospital site between July 2002 and March 2003.

Ethical approval was sought but the committee deemed that it was not required as no change to patient care was resulting from the surveillance, and the data were being gathered as a by-product of the normal care pathway.

The guidance provided in the SSHAIP protocol and resource pack was used as a standardized method of data collection. The definition for SSI within the SSHAIP protocol, utilized within the surveillance, is that of the CDC, and the protocol is compliant with the European data collection system, Hospital in Europe Link for Infection Control through Surveillance (HELICS).

Data collection occurred at two levels; during the inpatient stay and in the community setting for 30 days post operatively. Data collection and training, in data definitions and methods, of all staff involved in the acute and community setting were co-ordinated by the infection control surveillance nurse in the study hospital. During the inpatient stay, information from medical notes, midwifery records, clinical personnel and positive microbiology cultures were used in conjunction with clinical signs and symptoms to identify SSI.

In recognition of the importance of post-discharge surveillance identified within the literature, the study was implemented in a collaborative way with community midwives by the infection control surveillance nurse in the study hospital. As part of the normal pathway of care, patients had direct and regular observation of their Caesarean section surgical site by midwives performing routine postnatal care. Postdischarge follow-up was therefore provided by the community midwifery service. A surgical site surveillance questionnaire was incorporated into the postdischarge documentation given to the community midwife. Additional observations were made and documented by the community midwife until discharge from midwifery care.

The data collection form included the SSHAIP generic minimum dataset and additional information relating to risk factors for Caesarean section identified from the literature. Risk factors included were age, anaesthetic type, presentation to surgery, BMI, skin closure, grade of operator, duration of operation, duration of ruptured membranes, and antibiotic prophylaxis.

All data were managed centrally at the study hospital according to the Data Protection Act 1998.

Analysis

Chi-squared tests were performed to investigate the relationship between the variables of interest and the occurrence of SSI. Logistic regression analysis was performed subsequently to test the combined effects of these variables in relation to SSI. Analyses were carried out using Minitab Version 13 with a significance level of 5%.

Results

Descriptive statistics for each of the potential risk factors are presented in Table I. Of the 715 procedures carried out during the surveillance period, all were included and 80 (11.2%) of these developed an SSI. The patient stage at the time of diagnosis of infection occurred within three categories. Fifty-seven (71%) infections were diagnosed after discharge, 22 (27%) were diagnosed in hospital and one (1%) was diagnosed on re-admission to hospital.

The majority (90%) of the SSIs identified within this study were superficial, so all SSIs were grouped for these analyses. There were no exclusions, but some patients were lost to postdischarge follow-up. A total of 532 (74%) postdischarge surveillance questionnaires were returned.

Univariate analysis indicated that type of skin closure (Chi-squared \( P = 0.041 \)) and anaesthetic type (Chi-squared \( P = 0.007 \)) were significantly associated with infections. A significantly higher proportion of patients with staples had wound infections (13% vs 8%), and a higher proportion of patients given general anaesthetic rather than regional anaesthetic had infections (22% vs 10%). The average age of those with wound infections was 31.3 [standard deviation (SD) 5.91] years, compared with 29.9 (SD 6.07) years for those without wound infections.

Skin closure, BMI, age in years, anaesthetic type, surgeon grade, antibiotic prophylaxis, and whether or not the membranes were ruptured more than 24 h prior to operation were included
in a multiple logistic regression model (Table II). The chances of developing an SSI are significantly greater when staples are used rather than subcuticular sutures to close the surgical site [odds ratio (OR) = 2.04, 95% confidence intervals (CI) 1.12–3.75]. Infection is also more likely in obese women compared with women of normal BMI (OR = 2.13, 95% CI 1.08–4.18). Risk of infection increases slightly with increasing age (P = 0.027), and there is also some evidence that underweight women have an increased risk compared with women of normal BMI (OR = 2.34, 95% CI 0.92–5.96) although

<table>
<thead>
<tr>
<th>Variable</th>
<th>Comparison</th>
<th>Coefficient</th>
<th>P value</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin closure</td>
<td>Suture vs staples</td>
<td>0.7154</td>
<td>0.021*</td>
<td>2.04</td>
<td>(1.12–3.75)</td>
</tr>
<tr>
<td>BMI group</td>
<td>Normal vs obese</td>
<td>0.7557</td>
<td>0.028*</td>
<td>2.13</td>
<td>(1.08–4.18)</td>
</tr>
<tr>
<td></td>
<td>Normal vs overweight</td>
<td>0.4899</td>
<td>0.265</td>
<td>1.63</td>
<td>(0.69–3.86)</td>
</tr>
<tr>
<td></td>
<td>Normal vs underweight</td>
<td>0.8512</td>
<td>0.074</td>
<td>2.34</td>
<td>(0.92–5.96)</td>
</tr>
<tr>
<td>Age</td>
<td>0.04859</td>
<td>0.027*</td>
<td>1.05</td>
<td>(1.01–1.10)</td>
<td></td>
</tr>
<tr>
<td>Anaesthetic</td>
<td>Local vs regional</td>
<td>-0.5100</td>
<td>0.227</td>
<td>0.60</td>
<td>(0.26–1.37)</td>
</tr>
<tr>
<td>Surgeon grade</td>
<td>Consultant vs senior house officer</td>
<td>-0.0103</td>
<td>0.980</td>
<td>0.99</td>
<td>(0.45–2.17)</td>
</tr>
<tr>
<td></td>
<td>Consultant vs registrar</td>
<td>0.0989</td>
<td>0.810</td>
<td>1.10</td>
<td>(0.49–2.47)</td>
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<tr>
<td>Membranes ruptured</td>
<td>No vs yes</td>
<td>0.5738</td>
<td>0.215</td>
<td>1.77</td>
<td>(0.72–4.39)</td>
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<tr>
<td>Antibiotics</td>
<td>No vs yes</td>
<td>0.510</td>
<td>0.654</td>
<td>1.67</td>
<td>(0.18–15.47)</td>
</tr>
</tbody>
</table>

BMI, body mass index; CI, confidence interval.

*P < 0.05.
with rates between 6.3% and 10.1% quoted in other recent studies of Caesarean section SSI. However, it should be noted that comparison of rates is limited by the variety of SSI definitions and methods used in these studies. Seventy-one percent of the SSIs detected in this study were detected after discharge from hospital, which is a high proportion compared with that quoted in the literature and may, in part, be reflected in the short length of stay associated with this procedure.

SSI is linked to factors associated with surgery that may influence the risk of infection. The CDC NNIS risk adjustment index is an internationally recognized method of stratifying risk according to three major factors; however, the literature review for this study identified that the relationship with the risk index is not established for Caesarean sections and further work is required on identification of the risk factors associated with SSI.

This study identified that obesity, increasing age and method of skin closure increased the risk of SSI following Caesarean section. Other studies have suggested that obesity may increase the risk of SSI however, from the literature identified for this study, age was not identified as a risk specific to this category of surgery, although it has been for other categories of surgery.

The debate in the literature around the method of skin closure following abdominal surgery focuses on speed of insertion, cost, postoperative pain and cosmetic appearance rather than risk of SSI. Indeed, many epidemiological studies have failed to include this risk in their design. The present study identified a higher risk of SSI associated with closure using staples rather than subcuticular sutures.

The method of skin closure is a matter of personal choice, with each surgeon developing a preference for one technique over another. Surgical skill and patient-related characteristics influence the suitability and effectiveness of a skin closure material, with subsequent impact upon the risk of infection. Further work on developing the evidence base for wound closure with regard to risk of SSI is required. In the absence of a randomized control clinical trial, it is not possible to determine a causative effect; however, skin closure was independently significant irrespective of the surgeon grade. This finding led to a review of practice at the authors’ hospital and a move towards standardization of practice, which has been maintained in the longer term.

Other risk factors included in this study were limited in their value in terms of interpretation. The data capture form was not sensitive enough to record antibiotics given for reasons other than surgical site prophylaxis. Some patients were receiving antibiotics for other reasons, e.g. cardiac, prolonged rupture of the membranes, group B streptococcus, and this cover may have been considered sufficient to omit the usual single dose administered during the procedure by the anaesthetist.

Additional efforts to follow-up patients via the community midwifery service identified 57 SSIs that would not have been detected using inpatient surveillance alone. From this, it is clear that inpatient surveillance alone would only have identified 21% of SSIs, leading to an SSI rate of 3% in this patient population, when the actual rate of SSI including postdischarge surveillance was 11%. These are important data if they are to be used for feedback to improve performance. Further, the costs associated with these infections require evaluation as they are not encompassed within the £280 per case resulting from inpatient costs, and are potentially a significant burden to the patient and community healthcare setting.

The return of community midwife questionnaires is an additional piece of co-ordination in SSI surveillance. It requires co-ordination between the hospital and community, and may be seen as resource intensive as it requires activities such as reminders to staff. The postdischarge surveillance required 0.2 whole-time equivalent surveillance staff, i.e. the equivalent of one day per week to co-ordinate. The authors consider this to be worthwhile when it results in the identification of such a large proportion of postdischarge infections.

An intensive surveillance programme with engaged clinicians and infection control personnel is known to play an effective role in the reduction of healthcare-associated infections. This study has encapsulated these elements and maximized the benefits from national surveillance activity at a local level.

Postdischarge surveillance is an important element of ‘intensive’ surveillance if we are to achieve accurate infection rates. Further work is required on the cost of these infections and their burden on the primary healthcare team and the patient.

The risk factors identified within this study are important in terms of potential review of practice.
and subsequent reduction of SSI. The surveillance programme has acted as a catalyst for review of practice with regard to risk. Surveillance of Caesarean section SSI will be continuous for the foreseeable future within the SSHAIP programme, and the authors have found it to be an important and useful outcome measure locally. Quarterly analysis and feedback of the data will continue to act as a catalyst for review of practice aimed at reducing postoperative SSI rates.

Acknowledgments

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References