The Effects Of Changing Surgical Blades After Skin Cutting During Cesarean Section On The Risk of Postoperative Infectious Morbidity: A Single-Blinded Randomized Trial At A Tertiary Hospital*

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ABSTRACT

Background. Various operative procedures and techniques have been made in attempts to diminish the incidence of postoperative wound infection. The use of two surgical knives was found to have no correlation to wound infection in several orthopedic-related surgeries. No studies, however, could be found on the effects of using such technique in cesarean section. The purpose of this study is to determine whether the use of different surgical blades for skin cutting and deep tissue incision decrease the incidence of post-cesarean infectious morbidity.

Methods. A total of 190 obstetric patients admitted for scheduled or nonscheduled cesarean section were randomly assigned to two groups by sealed number envelopes. The first group was composed of patients who used only one blade for skin and deep tissue incision. The second group used separate blades. Patients from both groups were assessed days 0 to 2 post-cesarean and 2-4 weeks after (on follow-up). The temperature pattern post-operative was monitored as well as presence of wound discharge, foul-smelling vaginal discharge, persistent abdominal pain, and persistent fever that may indicate surgical site infection, postpartum endometritis, and pelvic abscess. Statistical analysis was performed using the Fisher's Exact test.

Results. Nineteen (11.3%) of 168 patients had superficial surgical site infection, 11 (13.3%) from the single blade group, compared with 8 (9.4%) from the double blade group. The difference between the two groups was not statistically significant (p=0.29). None of the patients developed deep incisional or organ space surgical site infection, endometritis, or pelvic abscess post-cesarean. There was also no significant difference for the two groups in temperature pattern and presence of wound discharge or wound dehiscence.

Conclusion. The use of different surgical blades for skin cutting and deep tissue incision does not show to decrease post-cesarean infectious morbidity. It is unnecessary to use two knives for surgical incisions in cesarean section.

Keywords. Surgical blade; skin knife; deep knife; cesarean section; postoperative infection; surgical site infection

INTRODUCTION

It is tradition in surgery to discard the blade after use on the skin to use a new blade for the deep incision. This is done in an attempt to prevent bacteria which may be on the skin from being carried into the deeper layers of the wound. In cesarean section, it is common to use separate surgical knives in opening the skin and incising the uterus. This procedure seems to be based mainly on surgical myths and undocumented effects.

Numerous factors including the surgeon's knife have been implicated in bacterial contamination of a surgical wound. A meticulous surgical technique is said to be the most important factor in controlling surgical wound infection, part of which has traditionally been to discard the knife used to incise skin and to use a new blade for deeper dissection.[1] This practice grew out of studies done many years ago, which isolated microogranisms from sweat and surgically prepared skin.[1] Repeated investigations however have failed to show that normal skin harbors pathogenic organisms under normal conditions.[1,9]

The anaerobic flora of the skin far outnumbers the aerobic and is found mainly in the sebaceous glands.[1] These bacteria are not pathogenic and are not responsible for the infection of wounds incised through normal skin.[1] With an understanding of the bacteriology of normal skin, it is not surprising that studies have failed to show any benefit from the use of two knives in performing cesarean section.[1]

Several studies done many years ago on bacterial contamination of the surgical knife and subsequent development of wound infection have shown that there is no clinical or bacteriological evidence to support this

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idea.[1-4] Ritter et al[4] (1975) described the contamination of surgical blades used in orthopedic procedures. The cultures obtained from the wound edge just after incision of the skin and those obtained from the depth of the wound did not correlate with number or type of contamination of the knife blades. This led to the assumption that skin knives do not act as vehicle of contamination in the depth of the wound. The bacteriological study of the knife blades on a general surgical unit by Hill et al[1] (1985) showed that under normal conditions, pathogenic organisms do not contaminate the knife blade and are not carried into the wound by it. Several bacteriologic studies have surfaced since then. The studies of Grabe et al[2] (1985) and Ramon et al[3] (1994) reported similar results and concluded that the practice of changing from skin to deep blades to reduce contamination of a surgical wound is not supported by data.

On the contrary, the study of Schindler et al[5] (2006) using separate skin and inside knives for elective orthopedic surgery showed that the rate of contamination of skin blades with pathogenic organisms was more than twice that of the deep blades. Organisms cultured were predominantly coagulase-negative staphylococci and proprionibacterium species. They suggested that the use of separate skin and inside knives should be maintained as good medical practice.

Hasselgren et al[6] (1984) evaluated the rate of postoperative wound infection following the use of one or two knives for incision. The infection rate with one knife was 3.6% and 5.5% with two knives. The difference was not statistically significant. The study concluded that the old surgical practice of discarding the skin knife and using a separate scalpel for the deep incision could be abandoned without increasing risk of wound infection.

Various operative procedures and techniques have been made in attempts to diminish the incidence of postoperative wound infection.[2,7] Procedures investigated include pre-operative skin disinfection, duration of operation, use of separate knives, and operating technique. In cesarean section, procedures studied include antimicrobial prophylaxis, pre-operative shaving, skin preparation, vaginal cleansing, type of skin incision (vertical vs. transverse), changing of gloves, removal of placenta, abdominal wash, and closure of subcutaneous tissue. The use of two surgical knives was found to have no correlation to wound infection in several orthopedic-related surgeries.[1-4,6,7] No studies, however, could be found on the effects of using such technique in cesarean section.

The RCOG 2004 clinical guidelines in cesarean section stated that there is no need to use separate surgical knives for opening the skin and the tissues inside, as this does not decrease the risk of wound infection.[8] Majority of the cesarean sections were performed using only one surgical knife at a tertiary government hospital in the Philippines. Though post-cesarean infectious morbidity in this institution could be attributed to certain causes, this study aims to determine whether the use of separate surgical blades for skin and uterine incision has an effect in decreasing post-cesarean infectious morbidity.

RESEARCH OBJECTIVES

The aim of the study is to determine whether the use of different surgical blades for skin cutting and deep tissue incision decrease the incidence of post-cesarean infectious morbidity and to evaluate whether it is necessary to use two knives for surgical incision.

METHODS

The study was evaluated by the Technical Review Board of the Department of Obstetrics and Gynecology and approved by the Research Ethics Board Review Panel. Informed consent was obtained. All patient information was anonymized and kept confidential.

Patients

The study was conducted at a tertiary government hospital from February to July 2013. Patients admitted at the OB admitting section and obstetric ward for scheduled or non-scheduled cesarean section, regardless of previous abdominal and uterine incision type if any, were recruited to participate in the study. Exclusion criteria include patients with intraamniotic infection (IAI); prolonged labor and/or ruptured bag of waters for more than 18 hours; presence of complicated co-morbidities such as poor glycemic control, morbid obesity, and active infection (sepsis, active tuberculosis); intra-operative morbidities (break in sterile environment, bowel injury, urinary bladder injury, cardiopulmonary arrest); cesarean sections with the following added procedures: smead jones technique, en bloc closure, other procedures that significantly deviate the standard cesarean section technique; and those who are mentally incapacitated to give consent. Sample size was computed at 190 using the R 2.15.1 software to achieve 95% power to detect a difference between the groups.

Study Design

The subjects were randomly assigned to two groups by sealed number envelopes. The first group composed of women who underwent cesarean section using only one surgical knife to incise the skin, deep tissues, and uterus. The second group used two blades, first blade for skin cutting and the second for deep tissue incision. Charts were reviewed and patient data documented which include the age, OB score, BMI, family income, co-morbidities,

Table 1. Definition of terms

Surgical blade	Blades designed for mounting in a surgical knife/scalpel handle and used to cut soft tissue. These blades consist of a flat piece of metal (stainless steel) with a sharp convex edge at the working end. When a blade is attached to a knife handle, the resulting combination is a surgical knife/scalpel	Surgical site infection	Wound infection that occurs after surgical procedure. Depending on the site and extent of infection, it is classified into three groups: superficial (skin, subcutaneous), deep incisional (fascia, muscles), and organ space SSI. Symptoms include pain or tenderness, localized swelling, purulent drainage from the incision, dehiscence, and abscess occurring within 30 days of the procedure
First blade	Used to incise the skin up to the fascia	Postpartum endometritis	Infection that involves not only the decidua but also the myometrium and parametrial tissues, which is more common in cesarean than in vaginal delivery. Symptoms include fever, commonly 38 to 39°C, abdominal pain, and foul-smelling vaginal discharge occurring in the puerperium (4-6 weeks following delivery)
Second blade	Used to incise tissues below the fascia including the uterus	Pelvic abscess	Incisional abscesses that develop following cesarean delivery. It usually causes persistent fever despite antimicrobials beginning about the fourth day post-operative
Infectious morbidity	An illness caused by infection; capable of causing an infection		

diagnosis, type of cesarean incision, anesthesia, duration of operation, antibiotic prophylaxis, postoperative antibiotic, estimated blood loss, and significant intraoperative findings. Following surgery, temperature pattern was monitored from days 0 to 2. Surgical wound examined on day two and presence of wound discharge, wound dehiscence, foul-smelling vaginal discharge (differentiated from lochia), persistent abdominal pain, or persistent fever was inquired prior to hospital discharge to detect for surgical site infection, postpartum endometritis, and pelvic abscess. The subjects were reassessed 2-4 weeks post-operative on their out-patient follow-up or through their contact numbers for those who missed their follow-up. The presence of the same symptoms was inquired and surgical wound re-examined.

Statistical Analysis

Data collected from the subjects were recorded and analyzed using R 2.15.1 software. The Fisher's exact test was used to determine whether the use of two surgical blades decreases post-operative infectious morbidity compared to using only one surgical knife for skin and uterine incisions. T test was calculated to determine temperature pattern difference between the two groups. All tests of significance were carried out at 95% confidence interval.

RESULTS

A total of 190 obstetric patients were recruited to participate in the study. Twenty-two (12%) were dropped out, 21of which were lost to follow-up and one case with intraoperative finding of pelvic abscess. Among the 168 patients, 83 used only one blade for skin and deep tissue incision (single blade group) whereas 85 used separate blades (double blade group). Patients' characteristics between the two groups were summarized in Table 2 as mean ± standard deviation or percentage according to the variables.

Nineteen (11.3%) of 168 patients had superficial surgical site infection, 11 (13.3%) from the single blade group, compared with 8 (9.4%) from the double blade group. The difference between the two groups was not statistically significant (p=0.29). None of the patients developed deep incisional or organ space surgical site infection, endometritis, or pelvic abscess post-operatively.

The average temperature post-cesarean for the single blade group was 37.0°C, 37.4°C, 36.7°C and for the double blade group 36.9°C, 37.3°C, 36.8°C for days 0, 1, and 2, respectively. There was no significant difference for the two groups (p=0.08). No patient complained of persistent fever, wound discharge, wound dehiscence,

Table 2. Patient Characteristics

	Single blade group	Double blade group
Age (years)	28.73 ± 6.13	28.13 ± 6.18
BMI	26.57 ± 4.25	25.76 ± 5.18
Income (PhP)	9312.50 ± 5813.24	8728.05 ± 5245.93
Previous CS	40 (48.19%)	33 (38.82%)
Medical history		
Hypertension in pregnancy	18 (21.69%)	10 (8.50%)
Gestational/Overt DM	11 (13.25%)	4 (4.71%)
Gravidocardia	2 (2.41%)	2 (2.35%)
Goiter	2 (2.41%)	2 (2.35%)
Bronchial asthma	2 (2.41%)	3 (3.53%)
Others*	2 (2.41%)	4 (4.71%)
Procedure		
Primary LSCS	31 (37.35%)	43 (50.59%)
Repeat LSCS	43 (51.81%)	31 (36.36%)
Primary Classical CS	9 (10.84%)	10 (11.76%)
Repeat Classical CS	0	1 (1.18%)
Pfannensteil incision	6 (7.23%)	8 (9.41%)
Indication for CS		
Dystocia	7 (8.43%)	14 (16.47%)
Malpresentation	9 (10.84%)	9 (4.71%)
Nonreassuring fetal status	12 (14.46%)	9 (10.59%)
Placenta previa	4 (4.82%)	8 (9.41%)
Scarred	40 (48.19%)	33 (38.82%)
Twin gestation	2 (2.41%)	5 (5.88%)
Multiple congenital anomalies	3 (3.61%)	2 (2.35%)
Others**	6 (7.23%)	5 (5.88%)
Anesthesia		
SAB	72 (86.75%)	70 (82.35%)
CLEA	5 (6.02%)	10 (11.76%)
GETA	6 (7.23%)	5 (5.88%)
Duration of operation (min)	100.48 ± 28.54	92.04 ± 25.02
Estimated blood loss (mL)	607.74 ± 313.12	657.06 ± 269.50
Preoperative antibiotic		
Cefazolin	66 (79.52%)	72 (84.71%)
Cefuroxime	9 (10.84%)	8 (9.41%)
Ampicillin	4 (4.82%)	2 (2.35%)
Others	4 (4.82%)	3 (3.35%)
± Metronidazole	9 (10.84%)	4 (4.71%)
Postoperative antibiotic		
None	55 (66.27%)	55 (66.27%)
Cefuroxime	23 (27.71%)	28 (32.94%)
Others	5 (6%)	2 (2.36%)
± Metronidazole	5 (6.02%)	7 (8.24%)

*Hepatitis B, history of GTN, history of papillary thyroid cancer

**Uncontrolled hypertension, impending eclampsia, abruption placenta, failed induction of labor, tumor previa

vaginal discharge, or persistent abdominal pain prior to hospital discharge. On follow-up (2-4 weeks post-cesarean), 25 (15%) patients had wound discharge, 13 (16%) from the single blade group and 12 (14%) from the double blade. Eight (5%) patients had wound dehiscence, six (7%) from the single blade and two (2%) from double blade group. The difference was not statistically significant for both wound discharge (p=0.47) and wound dehiscence (p=0.13). None of the patients on follow-up complained of abdominal pain or vaginal discharge.

DISCUSSION

There are numerous surgical measures used to prevent post-operative infection. Procedures investigated for cesarean section include antimicrobial prophylaxis, pre-operative skin disinfection, hand/forearm antisepsis, pre-operative shaving, type of skin incision (vertical vs. transverse), changing of gloves, abdominal wash, and closure of subcutaneous tissue. The practice of discarding the blade used to incise the skin and using a new blade for deeper incision has traditionally been thought to prevent infection. Skin knives were assumed to drag pathogenic organisms from the skin into the depths of the wound. Results of previous orthopedic and general surgery studies implied that it is an unnecessary precaution in the prevention of infection.[1-4,6,7,9] Nevertheless, changing of surgical knife is still common practice up to date. Limited data, if any, are obtained in obstetrics.

Results in this study showed that there is no statistically significant difference in post-cesarean infectious morbidity between using one blade for skin and deep tissue incision and using separate blades. There is also no significant difference between the two groups in fever pattern, wound discharge, wound dehiscence, abdominal pain, and vaginal discharge post-cesarean. These findings were similar to the study of Hasselgren et al[6] (1984) where the rate of post-operative infection following the use of one or two knives for incision was not statistically significant. The results indicate that changing of blades for skin and deep tissue incision can be abandoned without increasing the risk of post-operative infection. Other probable factors such as break in sterile technique, airborne contamination, or duration of operation should instead be taken into consideration.[2]

The bacteria of the skin fall into two groups, the transient flora and resident skin flora. The former are quite superficial and can be removed by mechanical cleansing or disinfection with antiseptics.[1,10] The latter are situated deep in hair follicles and sebaceous glands that they cannot be removed by mechanical means and anti-septics do not penetrate sufficiently to reach these organisms.[1] It is presumed that the blade used to cut the skin passes through the follicles and sebaceous glands and there is a possibility of contamination by bacteria which were not killed by pre-operative cleansing.[7] Repeated investigations however have failed to show that normal skin harbors pathogenic organisms under normal conditions probably because of the self-sterilizing properties the skin possess.[1,9] Numerous old studies isolated microorganisms from sweat, skin scrapings of unprepared skin, skin sutures, and found most of these as sterile.[9] The normal skin is self-cleansing and is only unusually colonized by pathogenic organisms.[1,9]

The source of pathogens for most surgical site infections is the endogenous flora of the skin, mucous membranes, or hollow viscera.[11] Through incision, the exposed tissues become at risk for contamination with endogenous flora commonly aerobic gram-positive cocci (e.g. staphylococci).[11] Depending where the incision was made, organisms may include fecal flora, gram-negative bacilli, or anaerobes.[11]

The study of Grabe et al[2] (1985) on patients undergoing orthopedic surgery bacteriologically examined the knives used for skin and the knife used for deep incision. The predominant organism isolated were those of the normal flora of the skin. Identical bacterial strains, however, were not recovered from the skin-knife and the corresponding wound in any of the patients. It was also shown that laminar airflow significantly reduced the contamination rates of the deep knives. Based on these findings, the study seemingly point to the importance of other routes of contamination than the skin-knife such as airborne contamination and duration of operation. An old study of Ritter et al[4] (1975) showed the same findings. Knife blades were found to be contaminated less when laminar airflow was used than in conventional operating room. There was also no correlation between the cultures of the wound edges and the depth of the wound with the contaminated knife blades.

The bacteriologic study of Fairclough et al[7] (1983) showed a very low incidence of contamination of skin-knives and deep-knives. No proven relationship was demonstrated since the same organisms grew on both knives in only two cases with no clinical infection. There was only one case of wound infection, but the organism cultured from the wound was not isolated from either knife. The results indicate that the skin-knife and deep-knife are equally contaminated and knife blades are not a common vehicle for bacterial contamination of wounds. Similar results and conclusion were made in the study of Ramon et al[3] (1994) but the deep-knife became contaminated more often than the skin knife. This may be attributed to the longer exposure of the deep-knife during surgery.

The advancement in microbiological culture has increased the sensitivity in defining the presence of low

Table 3. Tally of data with computation of p value (Fisher's exact test).

Outcomes	Positive	Negative	Total	p value
Surgical site infection	19	149	168	0.29
Single blade	11	72	83	
Double blade	8	77	85	
Wound discharge	25	143	168	0.47
Single blade	13	70	83	
Double blade	12	73	85	
Wound dehiscence	8	160	168	0.13
Single blade	6	77	83	
Double blade	2	83	85	

Table 4. Temperature pattern with computation of p value (t test).

Temperature (Celsius)	Day 0	Day 1	Day 2	Mean	0.08
Single blade	37.0	37.4	36.7	37.05	
Double blade	36.9	37.3	36.8	37.00	

number of organisms with low pathogenicity.[5] A newer study by Schindler et al[5] (2006) found that the rate of contamination of skin blades with pathogenic organisms, such as coagulase-negative staphylococcus, Proprionibacterium, and Pseudomonas, was more than twice that of the deep blades. Although their study recognized that contamination of knife blades does not necessarily correlate with superficial or deep infection, they favor continuing with the practice of using two knives since the cost disadvantage of such practice is minimal in view of the significant financial implications should infections occur.

Contamination of a surgical wound may occur, but the factors which determine whether a clinical infection develops are so numerous. Exogenous sources of SSI pathogens include the surgical team, the operating room or air environment, inadequacies of antiseptic preparation of the skin, and surgical tools and instruments brought to the sterile field during an operation.[7,11] Patient characteristics associated with an increased risk of SSI include diabetes, cigarette smoking, obesity, extremes of age, poor nutritional status, systemic steroid use, and perioperative transfusion of certain blood products.[11,12] The high incidence rate of SSI in this study may probably be attributed to the exogenous sources of SSI pathogens such as mentioned above.

A meticulous surgical technique is one vital factor in preventing surgical wound infection. Surgeons should stress more importance on gentle tissue handling to minimize trauma, minimal use of cautery, careful hemostasis, using drains and suture material appropriately, eradicating dead space, adequate debridement and removal of devitalized tissue and foreign bodies.[11]

The low incidence of contamination of surgical blades and the lack of association of contamination and progression to clinical infection make the assumption of using separate blades to decrease post-operative infection very weak. Albeit conclusions were made based on orthopedic surgeries, the results of this obstetric study supports the assumption. The rate of post-cesarean wound infection was not significantly different following the use of either one or two blades.

Even if the economic impact of saving one scalpel blade at each operation is not great, some saving in money can still be made.[1] Use of two blades could be abandoned without increasing the incidence of wound infection.

CONCLUSION

The use of different surgical blades for skin cutting and deep tissue incision does not show to decrease post-cesarean infectious morbidity. Discarding a skin blade following its use on the skin is unnecessary and should not longer be mandatory practice upon surgeons.

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