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Comparison of electrocautery and scalpel for blood loss and postoperative pain in Pfannenstiel incisions in recurrent cesarean sections: a randomized controlled trial

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Background: Limited data is available on the use of cold-scalpel and electrocautery blades in Cesarean delivery (CD) operations. This randomized controlled trial aimed to compare their use for subcutaneous incisions in terms of blood loss and postoperative pain in women undergoing repeat CD. *Methods*: A total of 149 women scheduled for elective CD underwent spinal anesthesia, Pfannenstiel transverse skin incision with a cold-scalpel blade, and subsequent subcutaneous incisions until the peritoneum with a cold-scalpel or electrocautery blade. Perioperative blood loss and postoperative pain were evaluated. *Results*: The groups were similar in terms of maternal age, physical characteristics, and gestational age. The electrocautery group recorded significantly less blood loss and pain at the postoperative 6th and 12th hours. No significant correlation was found between blood loss or pain and women's physical characteristics or gestational age. *Discussion*: Perioperative and postoperative pain associated with CD is one of the predominant causes of anxiety in mothers. This study demonstrated that the use of electrocautery for subcutaneous incisions was associated with lower blood loss and lower postoperative pain compared to the cold-scalpel incisions in pregnant women undergoing repeat C-sections with Pfannenstiel incision. The study supports the recently shifting trend regarding the use of electrocautery instead of the scalpel.

Keywords

Electrocautery; Cesarean section; Postoperative pain; Blood loss; Pfannenstiel incision

1. Introduction

In the last decades, increasing rates of cesarean delivery (CD) have been a common trend throughout the world [1, 2]. Currently, CD is the most common surgical procedure in the United States and Europe, with the number of CD operations exceeding one million in these regions [3, 4]. The rate of CD stands at 31.9% of deliveries in the United States (1.2 million births) and 52% in Turkey (0.7 million births) in 2018, including elective or emergency operations [5, 6]. Emergency CD operations are most commonly due to failure to progress for vaginal delivery, non-reassuring fetal heart rate tracing, and malpresentation, while the fear of labor pain is one of the most common reasons for elective CD operations [3]. Therefore, the reduction of postoperative pain and the recovery period is critical for those who prefer CD.

The CD operation usually involves a 15-cm Pfannenstiel or Joel-Cohen transverse skin incision [3, 7]. Incisions to the skin and subcutaneous tissues can be introduced using a steel scalpel or electrocautery blade. The latter has been reserved mainly for subcutaneous incisions for concerns related to wound healing and cosmetics, although that has been changing recently, with research indicating no significant difference regarding these concerns [8, 9]. The electrocautery blade has the advantage of stopping bleeding from small vessels during the incision through the ligation of vessels with electrically produced heat [10, 11]. Several studies compared the scalpel and electrocautery blade in terms of incision speed, blood loss, postoperative pain, wound healing, and complication rate in various surgical operations [9, 12–20]. However, limited data were available on the use of steel scalpel or electrocautery blade in CD operations until recent years. Earlier studies reported no significant difference between the two methods regarding blood loss or overall wound complications in women undergoing elective CD [21, 22]. However, some of the more recent randomized controlled trials indicated advantages for electrocautery incision in skin-to-peritoneum incision time, blood loss, and postoperative pain compared to the cold-scalpel incision in women undergoing CD [23–25]. Here we present our randomized controlled trial comparing the use of cold-steel scalpel or electrocautery blade for subcutaneous incisions in women undergoing repeat CD in terms of blood loss and postoperative pain.

2. Materials and methods

This randomized, controlled prospective study included women who were in 38th or 39th weeks of gestation, had previous C-section experience only once, and were scheduled for elective CD. Patients requiring emergency C-section or those with diabetes, primiparous pregnancy, multiplets, preeclampsia, or systemic diseases were not included in the study. For the sample size, type-1 error (α) was set as

0.05, the power (1-β) as 0.8, and the effect size as 0.5 with G*Power. It was found that 64 cases were sufficient for each group. However, we included more cases so that the power of the study was 99% (1-β = 0.99) for a type-1 error of 5% (α = 0.05). Initially, 168 women were enrolled in the study and randomized. However, five patients were excluded due to unsuccessful spinal anesthesia resulting in general anesthesia, four patients were excluded due to post-spinal anesthesia headache, one patient was excluded due to postpartum venous thrombosis, five patients were excluded due to postpartum bleeding, and four patients were excluded since they opted out of the study. The final analysis included the data for 149 women (Fig. 1). For a completely randomized design (CRD) to allocate the patients in two groups, a total of 168 closed, unlabeled envelopes were prepared, with scalpel written in 84 and electrocautery written in 84, and then mixed. When the patient was taken into the operating room, an envelope was opened randomly, and the surgeon operated using the method written in the envelope.

2.1 Surgery

Surgeries were performed at Private Silivri Anadolu Hospital. All patients underwent spinal anesthesia (15 mg bupivacaine (3 mL, Marcaine®Spinal Heavy) through the L4–L5 interval for all patients). For all patients, Pfannenstiel transverse skin incision was made with a cold-scalpel blade when the sensory block level was T8. Subsequent incisions of the subcutaneous tissues until the peritoneum were performed with a cold-scalpel or electrocautery blade (Meditom DT-400P Electrosurgical Unit, Daiwha Crp., Kyunggi-Do, Korea) (Fig. 2). The decision for the incision method was made on the spot based on the directions given to the surgeon in a closed envelope at the time of incision. In scalpel incision, bleeding control was done with gauze pads or by suturing the vein if the bleeding was severe. In electrocautery incision, bleeding was stopped with cauterization, and the subcutaneous adipose tissue and fascia were incised with the coagulation mode of the electrocautery blade.

Blood loss was calculated by weighing the gauze pads used to stop bleeding during the surgery (minus the baseline weight before the surgery). Patients were given the same analgesia protocol after the surgery. Patients' pain level was evaluated with the Visual Analogue Scale (VAS) administered by nurses at postoperative 6th and 12th hours. The study protocol was executed in a double-blind manner; that is, patients were blinded, and the personnel who performed the interventions and collected the data were blinded. The same surgeon operated in all cases, and the surgeon was not involved in other parts of the study. The nurse in the operating room, who did not know about the other parts of the study or the patients' names, weighed the gauze pads used to stop bleeding and recorded the data on study form I. The nurses in the recovery room, who did not know which operation method was used for a patient, administered VAS and recorded the scores on study form II. For all patients, VAS was administered in the supine position while the patient was alone in the recovery room. The statistician who analyzed the data was not blinded.

2.2 Statistics

The data related to blood loss and pain scores were recorded and analyzed with Jamovi (Version 1.2.17, retrieved from https://www.jamovi.org) and JASP (Version 0.12.2, JASP Team, University of Amsterdam, The Netherlands, 2018. Available: https://jasp-stats.org/). Descriptive data were given as mean ± standard deviation (SD), median [interquartile range (IQR)], or frequency (percentage). The Kolmogorov-Smirnov test was used to evaluate the distribution of numerical variables. Independent Samples *t*-test or Mann-Whitney U-test was used to compare groups for numerical variables with or without normal distribution, respectively. Spearman correlation coefficient was used to investigate correlated variables. A *p*-value of <0.05 was used for the significance level. The power of the study was calculated with G*Power 3.1.9.7 program by using blood loss levels based on the data collected in this study and the sample size of 75 + 74 = 149. The power of the study was 99% for a type-1 error of 5%.

3. Results

Descriptive data for the whole study group and the cold-scalpel and electrocautery groups separately in Table 1. The cold-scalpel and electrocautery groups were similar in terms of age, physical characteristics, and pregnant women's parity and gestational age. Pregnant women operated with electrocautery recorded significantly less blood loss and VAS scores at the postoperative 6th and 12th hours than those operated with cold-scalpel ($p < 0.001$, $p = 0.001$, and $p = 0.001$, respectively). No significant correlation was found between blood loss or VAS scores of pregnant women and their physical attributes (age, BMI) or gestational age ($p > 0.05$) (Table 2). A box plot of blood loss and an error plot of VAS scores for the two groups were given in Fig. 3.

4. Discussion

Cesarean delivery is a common elective surgical procedure in many countries, most often due to expectant mothers' fears of the pain associated with natural childbirth [3, 26]. Likewise, perioperative and postoperative pain associated with CD, as well as cosmetic concerns, are the dominant causes for anxiety in mothers. As CD is more often associated with more blood loss compared to vaginal delivery, surgical methods that will reduce perioperative and postoperative pain and maintain hemostasis at the same time are optimal for the maternal outcome [27, 28]. Electrically produced heat by electrocautery blade ligates small vessels and helps stop bleeding from small vessels during the incision [10, 11].

Metanalyses of several previous studies on the use of electrocautery incision in various surgeries, including abdominal incisions, found less time to complete incision, less incision-related blood loss, and less postoperative pain with no difference in the rate of wound infections or the cosmetic aspects

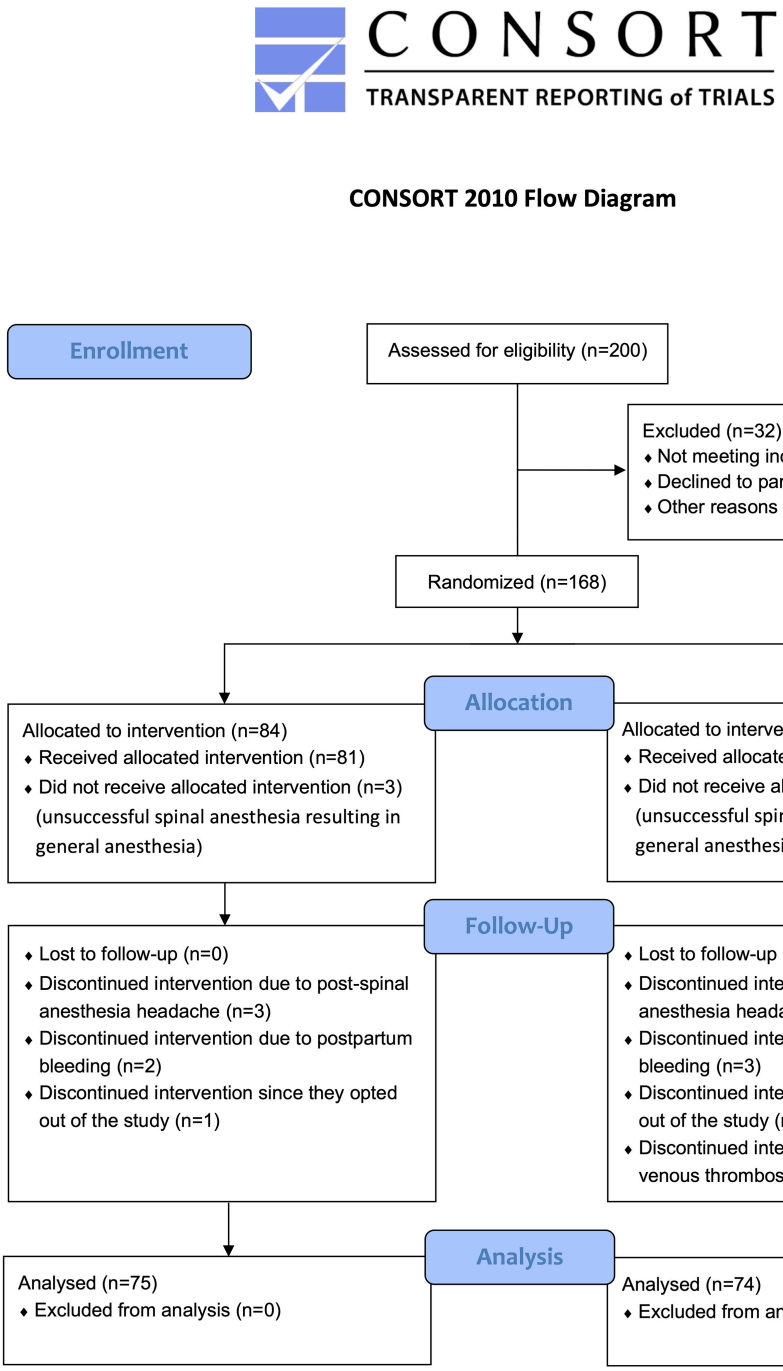

Fig. 1. CONSORT 2010 flow diagram for this study.

of the incision [14, 18–20]. In an earlier metanalysis by Ahmad and Ahmed [18], eleven clinical trials covering a total of 3122 patients and comparing electrocautery (n = 1495) and cold scalpel (n = 1627) methods for making skin incisions were analyzed. Wound infection was the most frequently addressed endpoint (ten studies), and the analysis indicated no significant difference between the infection rate in these methods. The incision time, postoperative pain, and perioperative blood loss were addressed less frequently, and these factors favored electrocautery as a better alternative for skin incisions. A metanalysis by Ly *et al.* [19] included 14 randomized controlled trials (RCTs) on skin incisions with these methods and confirmed the previous findings except for no difference between the postoperative pain at the 24th hour. More recent metanalyses included a larger number of studies: Ismail *et al.* [14] analyzed 41 studies, including 36 RCTs and four observational studies, and Charoenkwan *et al.* [29] analyzed 16 RCTs. Ismail *et al.* [14] confirmed most previous findings and suggested that electrocautery was also associated with shorter operation times and decreased overall

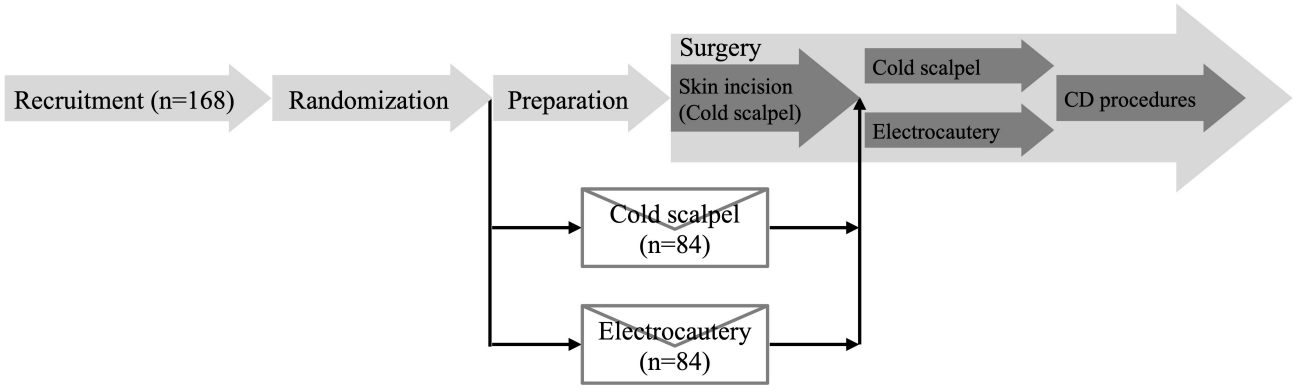

Fig. 2. Surgical operations in the study workflow.

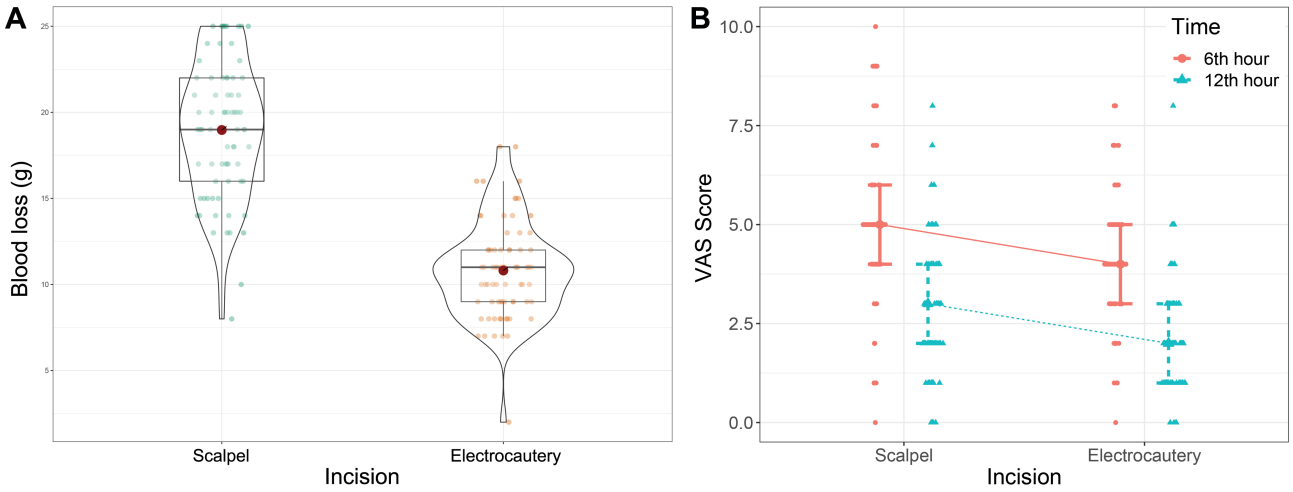

Fig. 3. Box plot of blood loss (A) and error plot of VAS scores (B) for the electrocautery and scalpel groups.

subjective wound-scar score. However, Charoenkwan *et al.* [29] indicated no clinically meaningful difference in the incision time or blood loss, no clear difference in the incision time per wound area or wound infections, and no clear evidence regarding wound dehiscence. They emphasized considerable heterogeneity among the studies and suggested that the certainty of evidence was moderate at best due to the risk of bias, heterogeneity, and imprecise results. These latest results indicate that the comparison of electrocautery and cold scalpel methods should concentrate on identical types of surgeries to obtain more homogeneity. This randomized controlled trial investigated perioperative blood loss and postoperative pain, specifically in women undergoing repeat CD, with cold-scalpel or electrocautery and found that the latter was associated with less blood loss and pain.

Concerning the CD, earlier studies by Meyer *et al.* [21] and Moreira *et al.* [22] reported no significant difference between the two methods regarding the blood loss or overall wound complications (infection, hematoma, seroma, or dehiscence) in women undergoing elective CD. However, more recent randomized controlled trials have demonstrated mixed results; some reported improved surgical outcomes with electrocautery, while others reported no difference between the two methods for some surgical parameters. A later randomized controlled trial by Elbohoty *et al.* [23] found significantly reduced skin-to-peritoneum incision time, blood loss, and postoperative pain but no significant difference in wound complications when electrocautery incision was used in repeat CD. Gupta *et al.* [24] used electrocautery for the skin incision and subcutaneous incisions and found reduced operating time with comparable wound complications in the two groups. Rodriguez and Reyes [25] limited the use of electrocautery to the skin incision followed up by standard protocols for the subsequent incisions and found no significant difference regarding wound infection postoperative pain at 24th hour or 72nd hour. AbdElaal *et al.* [30] demonstrated significantly less incision time, operative time, incisional blood loss, and postoperative pain with electrocautery but no significant difference in wound healing or complications. In another more interesting study, Kaban *et al.* [31] used electrocautery or cold scalpel for half of the skin incision on the same patient and compared the two halves in terms of wound healing and cosmetic appearance. They recorded no significant difference at postoperative 15th and 45th days between

Table 1. Descriptive data for the cold-scalpel and electrocautery groups and their comparison.

	All (n = 149)	Cold scalpel (n = 75)	Electrocautery (n = 74)	
Variables	Mean Median ± SD [IQR]	Mean Median ± SD [IQR]	Mean Median ± SD [IQR]	*p*
Maternal age (years)	30.9 ± 5.1	31.5 ± 4.9	30.3 ± 5.1	0.125[a]
Height (cm)	166 [162–169]	166 [162–168]	166 [162–171]	0.502[b]
Weight (kg)	75 [71–81]	74 [71–79]	77 [69–81]	0.455[b]
BMI (kg/m^2)	27.5 ± 2.7	27.5 ± 2.4	27.5 ± 2.9	0.981[a]
Gestational age (days)	269 [267–271]	270 [267–271]	269 [268–272]	0.821[b]
Blood loss (g)	14 [11–19]	19 [16–22]	11 [9–12]	<0.001[b]
VAS score (6th hour)	5 [4–5]	5 [4–6]	4 [3–5]	0.001[b]
VAS score (12th hour)	2 [1–3]	3 [2–4]	2 [1–3]	0.001[b]

[a] Independent samples *t*-test. [b] Mann-Whitney U-test.

Table 2. Correlation between maternal age, BMI, and gestational age and blood loss or pain.[a]

		Cold scalpel (n = 75)		Electrocautery (n = 74)	
Correlated variables		*r*	*p*	*r*	*p*
Maternal age (years)	Blood loss (g)	–0.041	0.727	0.014	0.905
	VAS score (6th hour)	–0.200	0.085	–0.123	0.298
	VAS score (12th hour)	–0.206	0.076	–0.093	0.429
BMI (kg/m^2)	Blood loss (g)	0.185	0.111	0.107	0.366
	VAS score (6th hour)	–0.033	0.780	–0.077	0.516
	VAS score (12th hour)	–0.046	0.694	0.030	0.801
Gestational age (days)	Blood loss (g)	–0.215	0.064	–0.166	0.158
	VAS score (6th hour)	–0.078	0.507	0.027	0.822
	VAS score (12th hour)	–0.090	0.445	0.052	0.658

[a] Spearman correlation was used.

the incisions introduced with electrocautery or cold scalpel. The use of electrocautery was also not associated with adverse neonatal Apgar scores or need for neonatal intensive care unit as well as similar operation time and postoperative wound complications [32]. These studies' results were in line with our findings related to less blood loss and postoperative pain.

That the use of electrocautery was limited to the subcutaneous incisions was a limitation of this study. The lack of data related to the other critical operational variables such as skin-to-peritoneum incision time and wound complications were other limitations.

5. Conclusions

The anticipation that extreme heat may result in higher postoperative pain, compromised wound healing, and undesirable cosmetic results have limited the use of electrocautery in Cesarean sections. Several studies have demonstrated otherwise. This study demonstrated that the use of electrocautery for subcutaneous incisions resulted in less blood loss and postoperative pain than traditional cold-scalpel incisions in pregnant women undergoing C-section with Pfannenstiel transverse skin incision. The study supports the recently-shifting trend regarding the use of electrocautery instead of a cold scalpel. However, further studies investigating longer-term outcomes are warranted.

Abbreviations

CD, Cesarean delivery; BMI, body mass index; VAS, visual analog scale; SD, standard deviation; IQR, interquartile range.

Author contributions

EA conceived, designed, performed the research and wrote the paper; GK edited the manuscript.

Ethics approval and consent to participate

The participants were informed about the procedures, and their informed consent was obtained before the procedures. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the local ethics committee at İstanbul Gelişim University (Approval number: 2020-07-06).

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Conflict of interest

The authors declare no conflict of interest.

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