

Short Communication

Vessels Remaining In the Cervical Margin Cut with A Harmonic Scalpel During Laparoscopic Hysterectomy

Ken-ichi Honda^{1*}, Yusuke Nakano², Tomoko Sumikura³, Saori Seo⁴, Yutaka Inoue¹, Sakika Yanai⁴, Makoto Murakami⁴, Naohiko Umesaki²

¹Department of Obstetrics and Gynecology, Kashiwara Municipal Hospital,

²Department of Gynecology, Izumi Municipal Hospital,

³Division of Pathology and Clinical Laboratories, National Cancer Center Hospital,

⁴Department of Obstetrics and Gynecology, Osaka City University Graduate School of Medicine.

*Corresponding author: Dr. Ken-ichi Honda, Department of Obstetrics and Gynecology, Kashiwara Municipal Hospital, 1-7-9 Houzenji, Kashiwara, Osaka, Japan 582-0005, Email: kenhonda@med.osaka-cu.ac.jp

Received: 12/22/2014

Accepted: 01/11/2015

Published: 02/24/2015

Copyright: © 2015 Honda

Abstract

The ultrasonically activated device harmonic scalpel is often used for dissection of the uterine cervix during laparoscopic surgery. To evaluate thermal damage of harmonic scalpel during laparoscopic hysterectomy, cervical margin tissues were immunohistochemically examined for CD31 antigen in the vessel structures. CD31 antigen was detected more in vessel structures in tissues dissected with the harmonic scalpel than with monopolar electrodes. We considered that harmonic scalpel is a safe surgical device with minimal thermal damage to tissues surrounding the uterine cervix at laparoscopic hysterectomy.

Keywords: CD31; Harmonic Scalpel; Monopolar Electrode; Thermal Damage; Vessel.

Introduction

The ultrasonically activated harmonic scalpel is evaluated as a safe device in laparoscopic surgery, and looks to result in rapid hemostasis and minimal thermal damage to surrounding tissues [1]. Use of monopolar electrosurgical instruments is accompanied by elevation of the surrounding tissue temperature to >200°C. With the harmonic scalpel, tissue temperature remains below 80°C for the first 8 s of tissue contact with the scalpel, although longer contact time increases tissue temperature up to 150°C [2]. High power settings make the blade

vibrate wider, and the required cutting time can be shortened, with less thermal damage. The harmonic scalpel has been used in laparoscopic hysterectomy as a cutting device between the cervix and vaginal fornix. Hemostasis at the cutting edge is required only for a short time before suturing. For wound healing, vessels remaining in the surrounding tissues play an important role in the microcirculation. We studied the histology of vessels in remaining in tissue at the cutting edge of the uterine cervix during total laparoscopic hysterectomy, to establish the minimal thermal damage to the remaining parametrial and vaginal tissues.

Methods

Immunohistochemistry: The cervical tissues dissected with the harmonic scalpel in patients who underwent laparoscopic hysterectomy and those dissected with monopolar electro-surgical electrodes in patients who underwent laparotomic hysterectomy for uterine myoma at Izumi Municipal Hospital were used. These tissues were fixed overnight in neutral buffered 3% formaldehyde, embedded in paraffin, cut into 4- μ m sections, and mounted on slides for hematoxylin and eosin staining (H&E), and for immunohistochemical study with anti-human CD31 rabbit polyclonal antibody (AnaSpec, Fremont, CA, USA). The tissue sections were autoclaved at 110°C for 10 min in 10 mM citrate buffer (pH 6.0) to expose antigens. After inactivation of endogenous peroxidase by immersing in 3% hydrogen peroxide for 10 min and washing with phosphate-buffered saline (PBS), 5% goat serum in PBS (blocking buffer) was added to the tissue sections. The tissue sections were reacted at 4°C overnight in 50-fold diluted anti-human CD31 rabbit polyclonal antibody in blocking buffer, washed with 0.1% Tween 20 in PBS, and reacted with anti-rabbit IgG antibody. Immune complexes were visualized with 3,3'-diaminobenzidine as a chromogen using an EnVision kit (Dako, Glostrup, Denmark).

Results

Tissues dissected with harmonic scalpel: In the cervical tissues dissected, the tissues in 1 mm from the cutting edge were slightly deeply eosin-stained. However, the structure of the vessels was not disrupted even at under 1 mm from the cutting edge (Fig. 1A-C) and the vessels were positive for CD31 (Fig. 1a-c), even near the cutting edge.

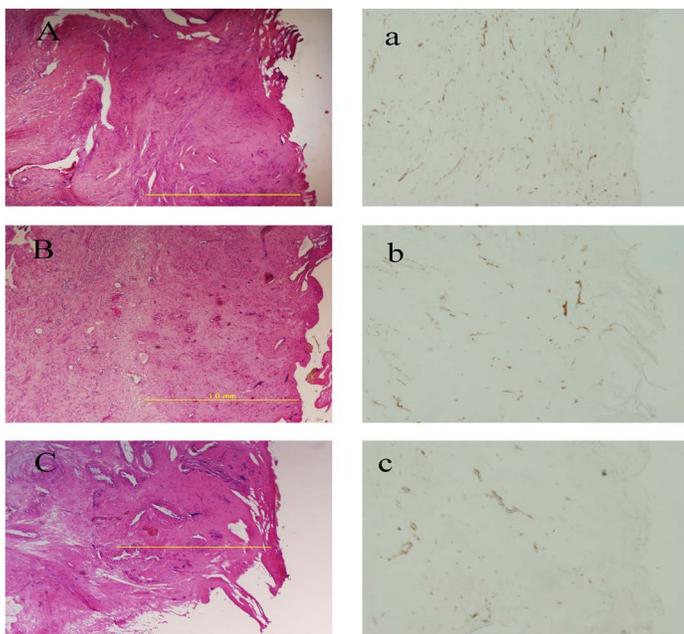


Figure 1. Photomicrographs of the cutting edge of the uterine cervix dissected with the harmonic scalpel in three patients who underwent laparoscopic hysterectomy. H&E-stained tissues at 40x magnification (A, B, C: from each patient), and tissues stained immunohistochemically with anti-CD31 rabbit polyclonal antibody (a, b, c: respectively from each patient). Yellow bars show 1 mm in length.

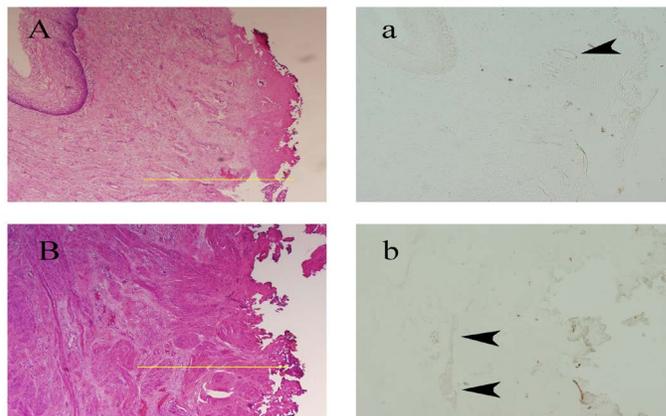


Figure 2. Photomicrographs of the cutting edge of the uterine cervix dissected with monopolar electro-surgical electrodes in two patients who underwent laparotomic hysterectomy. H&E-stained tissues at 40x magnification (A, B: from each patient), and tissues stained immunohistochemically with anti-CD31 rabbit polyclonal antibody (a, b: respectively from each patient). Yellow bars show 1 mm length, and arrowheads indicate vessels.

Tissues dissected with monopolar electrode: In the cervical tissues dissected with monopolar electro-surgical electrodes (Fig. 2A, B), the tissues at under <0.3 mm from the cutting edge were deeply eosin-stained, and vessels in the tissue at 0-2 mm from the cutting edge were negative for CD31 (Fig. 2a, b). These tissues stained with H&E showed coagulation-necrosis-like findings with distorted nuclei or anuclear masses (Fig. 2A, B). The structure of the vessel walls was destroyed or invisible and the nearest portion of the cutting edge was coagulated or likely evaporated.

Discussion

Care should be taken to avoid ureter injury when parametrial tissues and the vaginal wall are dissected from the uterine cervix with the harmonic scalpel of which lateral thermal effect is not always small as with other electro-surgical instruments [3,4]. However, the thermal effects of the harmonic scalpel are time dependent, and the temperature can remain below 80°C for parametrial and vaginal wall dissection when the power of the instrument and tissue contact time are set properly.

In the present study, CD31-positive endothelial cells remained in the cervical tissues dissected with the harmonic scalpel, but these cells seemed to be destroyed in cervical tissues dis-

sected with monopolar electrodes. The cervical tissues were heated at 110°C for 10 min for immunohistochemistry in this study, non-formalin-fixed tissues are more susceptible to thermal damage during surgery. We considered that the different effects of cutting device reflect the different thermal damage on tissues surrounding the uterine cervix. Neovascularization occurs in the remaining vessels [5]. The greater number of CD31-positive endothelial cells in vessels neighboring cutting edge of harmonic scalpel suggests more neovascularization at the wound healing site [6, 7].

Summary

In the cervical tissues dissected with the harmonic scalpel, CD31-positive endothelial cells remained in the vessels surrounding the cutting edge. The harmonic scalpel can be used as a surgical device for laparoscopic hysterectomy with minimal thermal damage.

Acknowledgments

We thank Ryosuke Kimura, Sachiko Hidaka, and Yoichi Nakamura at the Department of Clinical Pathology, Izumi Municipal Hospital for technical assistance.

References

1. Winter ML, and Mendelsohn SA. Total laparoscopic hysterectomy using the harmonic scalpel. *J Soc Laparoendosc Surg.* 1999, 3: 185-186.
2. Kinoshita T, Kanehira E, Omura K. Basic experiments to evaluate the safety of a fine-caliber ultrasonically activated device. *JSES* 1999, 4: 473-478.
3. Trivedi P, D'Costa S, Shirkande P, Wahi M, and Kumar S. Do new vessel sealing devices and Harmonic Ace increase ureteric injury in total laparoscopic hysterectomy. *J Gynecol Endosc Surg.* 2009, 1: 83-88.
4. Peker K, İnal A, Güllü H, Gül D, Şahin M et al. Comparison of vessel sealing systems with conventional. *Iranian Red Crescent Medical Journal.* 2013, 15: 488-496.
5. Erba P, Miele LF, Adini A, Ackermann M, Lamarche JM et al. A morphometrical study of mechanotransductively induced dermal neovascularization. *Plast Reconstr Surg.* 2011, 128: 288e-299e.
6. Supp DM, Wilson-Landy K, Boyce ST. Human dermal microvascular endothelial cells form vascular analogs in cultured skin substitutes after grafting to athymic mice. *FASEB J.* 2002, 16:797-804.
7. Mildner M, Hacker S, Haider T, Gschwandtner M, Werba G et al. Secretome of peripheral blood mononuclear cells enhances wound healing. *PlosOne.* 2013, 8(3): 1-8.