

Lin's Self-Retaining Abdominal Ultrasound Probe Method for Hands-Free Ultrasound-Guided Hysteroscopic Procedures: A Single-Operator Study

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Abstract

Objectives: Conventionally, an assistant would be required to hold the ultrasound probe during therapeutic hysteroscopy. To manage without a skilled assistant, Lin developed a self-retaining hands-free probe method that can be used to hold an abdominal ultrasound probe. One can now perform ultrasound-guided hysteroscopic procedures single-handedly. The purpose of this study is to report the successful development of a method to keep an abdominal ultrasound probe self-retained without an assistant's help.

Materials and Methods: A technique derived from improvisation with available equipment.

Results: The hands-free ultrasound probe was used successfully in 2680 cases needing therapeutic hysteroscopy management for various endometrial pathologies. We only encountered one case of latex allergy, which serves as a reminder to ask about latex allergy before the procedure. Upon notification, the handle can be improvised to a latex-free solution. Compression indentation marks were of negligible concern as they resolved spontaneously within 1–2 h postsurgery. We have used this method successfully and to good effect, particularly in guiding us to avoid uterine perforations during dilation of the cervix as well as during the therapeutic hysteroscopy surgery itself. This device facilitates efficient and safe therapeutic hysteroscopic surgeries. In addition, this method encourages the reuse and recycling of plastic water bottles.

Conclusion: The usage of Lin's self-retaining ultrasound probe method is practical, cheap, and not dependent on an assistant's participation during procedures.

Keywords: Operative hysteroscopy, myoma resection, ultrasound, self-retaining

INTRODUCTION

Submucosal myoma, regardless of its size, frequently causes menorrhagia and metrorrhagia and sometimes results in infertility. To date, hysteroscopic myomectomy has been regarded as the standard procedure to treat these myomas.^[1-4] While many use a resectoscope to shave the myoma from its most protruded area in the uterine cavity, the feasibility of this procedure depends on the degree of its uterine protrusion as well as the broadness of the myoma stalk.^[5,6] Often, two or more steps are required for total removal. In 2000, we published our

technique of a one-step hysteroscopic myomectomy^[7] similar to that performed in an abdominal or laparoscopic myomectomy.^[8]

Several Lin instruments were designed to facilitate the complete removal of a submucosal myoma in a single surgery.^[9] To ensure the safety of the operation, concomitant ultrasonography was used to monitor the entire procedure.^[10] Conventionally, an assistant would be required to hold the ultrasound probe in an accurate manner.

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To overcome being dependent on a skilled assistant [Figure 1], Lin developed a self-retaining hands-free probe method that can be used to hold an abdominal ultrasound probe. To the best of our knowledge, this is the most simple and cost-effective method available.

MATERIALS AND METHODS

All procedures were performed in the operating theater of Kawasaki Municipal Hospital, Kawasaki, Japan (approval number: 2018-4). Informed and written consent were obtained from the patient for their respective indication for the procedure. All patients underwent a standard of procedure in accordance with the Department of Anaesthesia's protocol. Two square-section plastic water bottles (250 ml) were strapped together with strong rubber bands and the ultrasound probe placed in the center. The strapped ultrasound probe could now be placed where needed and further anchored with roller gauze or even plastic strings to the sidewall of the operating table [Figure 2]. The probe could be elevated or lowered to adjust to the thickness of the patients' abdominal wall with support towels [Figure 3]. This was to accommodate the various shapes and curves of women's abdominal contours.

RESULTS

Between December 2006 and December 2015, 2680 patients were operated on by a single surgeon at the Kawasaki Municipal Hospital, Kawasaki, Japan, who served as a referral center for all submucosal myomas within the Tokyo and Kanagawa Prefecture of Japan. These patients underwent and completed therapeutic hysteroscopy for various endometrial/uterine pathologies. The patient numbers for different indications are given in Table 1.

Of the 2680 cases, 4 cases of uterine perforation^[11,12] were encountered, giving a complication rate of 0.15%. Two thousand six hundred and eighty patients underwent surgery,

and only one patient (0.04%) complained of horizontal indurated reddish welt streaks post procedure [Figure 6]. We investigated and found out later she had a latex allergy^[13] which was never picked up. Although we encountered only one case of latex allergy, this serves as a reminder to ask about latex allergy before the procedure and upon notification, the handle can be improvised to a latex-free solution. Compression indentation marks were of negligible concern as they resolved spontaneously within 1–2 h postsurgery [Figure 4].

On our further *post hoc* analysis of the hysteroscopy procedure done on submucosal fibroid ($n = 2378$) alone, the majority were graded as G0 or G1 ($n = 1557, 65.5%$) as demonstrated in Table 2. The mean operative time (minutes) to complete these surgeries was 29.2 ± 17.5 (range: 2.0–147.0). In addition, the mean weight (grams) of the submucosal fibroid

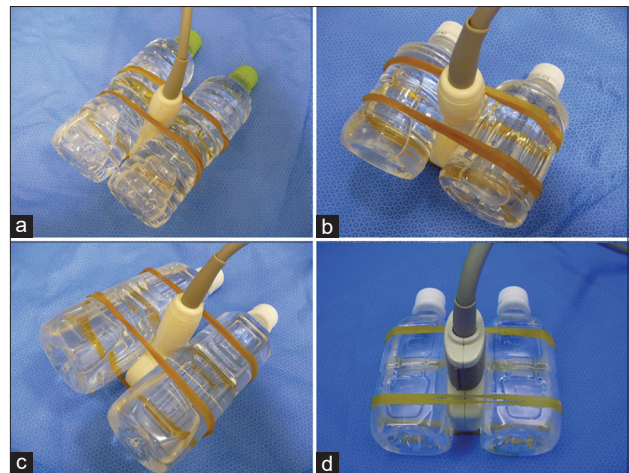


Figure 2: (a) First prototype: standard cylindrical-based 500 ml water bottles. (b) Second prototype: two hundred and fifty milliliter cylindrical-based water bottles. (c) Third prototype: standard square-based 500 ml water bottles. Stable but bulky. (d) Final design: two hundred and fifty milliliter square-based water bottles strapped together with rubber bands, with the probe fitted snugly in between. Stable and compact



Figure 1: Assisted ultrasound



Figure 3: Stepped Lin's self-retaining abdominal ultrasound probe

Table 1: Statistics (number of patients) for Operative Therapeutic Hysteroscopy using Lin's Self-Retaining Ultrasound Probe from 1st December 2006 - 31st December 2015

Year of procedure	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Indications (n)											
Submucosal myoma	21	291	258	272	263	271	267	273	237	225	2378
Polyps	0	10	19	16	24	18	20	31	33	24	195
Septums	0	4	12	6	4	5	4	2	8	7	52
Asherman's syndrome	0	1	4	5	6	9	8	8	6	6	53
Endometrial ablation	0	0	0	1	0	0	0	0	1	0	2

Table 2: Post hoc analysis, submucosal fibroid (n=2378) grade, operative time, and specimen weight

Submucosal fibroid grade, n(%)	
G0 and G1	1557 (65.5)
G2	821 (34.5)
Operative time (min) [mean±SD, range]	29.2±17.5, 2.0–147.0
Specimen weight (g) [mean±SD, range]	7.9±18.8, 0.1–380.0

resected was 7.9 ± 18.8 (range: 0.1–380.0) as illustrated in Table 2.

DISCUSSION

Our intention was to solve the problem of depending on an assistant during surgery. An assistant would have to be well-trained in the art of ultrasound to be able to provide a reasonable ultrasonic image for the surgeon to work with. Being operator dependent, this may result in occasionally unsatisfactory images, poor guidance, as well as awkward staff interactions if the perfect visual is not achieved. Although there might be enough surgical assistants available, especially in the government or university hospitals, there may come a time when one is alone in the operating theater with no eager junior doctor around to lend a hand. The ultrasound probe holder was created for this very reason.

In 2006, the consultant surgeon who operated the whole case series (Dr. Lin Bao-Liang) conceptualized and systematized this low-cost method described here. The basic principle was to stabilize the ultrasound probe so it would stand on its own. A supporting structure needed to be created to keep the probe from falling to the left or to the right. This supporting structure has to be weighted equally bilaterally to allow central stability. Fluid could potentially be the weight element. In concept, it worked; however, the cylindrical 500 ml plastic bottle was too thin-walled, and the whole apparatus was big, clumsy, and cumbersome. Hence, the 500 ml bottles were replaced with the 250 ml bottles instead [Figure 5a and b]. Unfortunately, their rounded shape did not provide enough stability as they kept tilting to one side. This problem was solved by replacing the cylindrical plastic bottles with square-section ones.



Figure 4: Two bottles and the probe are bound with two elastic strings which were covered with latex-free material. The strings were removed from a discarded used drape. Two support towels are used to adjust and accommodate the women's abdomen

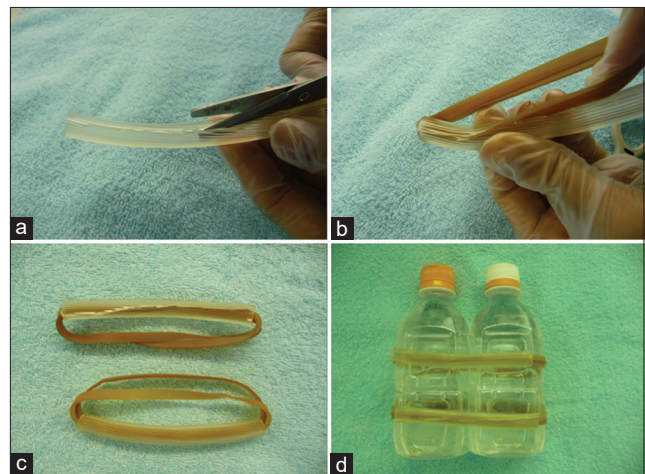


Figure 5: Latex-allergy solution

We have used this method successfully and to good effect, particularly in guiding us to avoid uterine perforations^[12,13] during dilation of the cervix as well as in the therapeutic hysteroscopy surgery itself. We believe that this device facilitates efficient and safe therapeutic hysteroscopic surgeries and in monitoring dilatation and curettage procedures as well as other possible intrauterine surgeries [Figure 7]. In addition,

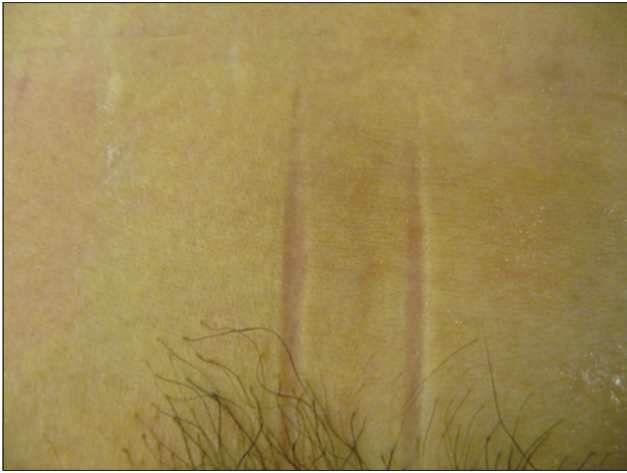


Figure 6: Indentation marks resolve after 1–2 h



Figure 7: Hands-free ultrasound-guided therapeutic hysteroscopy

this method encourages the reuse and recycling of plastic water bottles.

We recommend this use of this instrument to other centers and perhaps a future multicenter study could evaluate the efficacy and acceptance of our proposed method. If suitable and acceptable, manufacture of a proper holder (to replace the plastic bottles) could even be made commercially available.

CONCLUSION

Usage of Lin's self-retaining ultrasound probe method is practical, cheap, and not dependent on an assistant's help throughout the procedures.

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Conflicts of interest

There are no conflicts of interest.

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