Tactile Electrosurgical Ablation: A New Technique for Endometrial Ablation-A Preliminary Study

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Abstract

Objectives: To experimentally study the feasibility of performing endometrial electrocoagulation without hysteroscopy or distension media.

Design: We constructed an insulated probe that was named tactile electrosurgical ablation probe (TEA probe) with a ball shaped end that works like the roller ball when it comes in direct contact with the thinned endometrium guided by tactile sense.

Setting: Department of Obstetric & Gynecology and Department of Pathology Faculty of Medicine, and Department of Histology Faculty of Veterinary Medicine, Assiut University, Assiut.

Subjects: The present work included in vitro studying of 13 hysterectomy specimens by the TEA probe and ex vivo study of 1 cases with dysfunctional uterine bleeding scheduled for hysterectomy.

Interventions: During the in vitro part of the study, fresh hysterectomy specimens were placed on the return electrode of diathermy and coagulated transcervically by the TEA probe for 5-10 minutes treatment time. The ex vivo phase of the study was done with the patient in dorsal lithotomy position. The abdomen was opened till exposure of the uterus, simultaneously a vaginal speculum is inserted, and the cervix is exposed, painted and grasped with a tenaculum then the insulated curette (IC) is introduced through the cervix. Dilatation is done if needed (up to Heger #7), then IC is connected to the diathermy active electrode socket and a 30 or 60 watt setting was used. The endometrial cavity was systemically coagulated. Then hysterectomy was performed and the uterus was opened, inspected for the depth of coagulation followed by comprehensive histopathologic examination.

Main outcome measure: The depth of thermal damage of the endo-myometrium, the presence of missed (non-coagulated) endometrium and the temperature of the serosal surface and utero-vesical pouch.

Results: When the power of coagulation were 30 W and 60 W respectively and operating time not prolonged more than 10 minutes, the thermal damage covered endometrium and 2-5 mm of myometrium in depth. At such wattage and operating time the deepest destruction was only 19.12% of uterine wall. Serosal temperature was not exceeding 41.9Cº at any time during the procedure. No full thickness injuries were demonstrated either histologically or suggested by the temperature studies. Missed foci of untreated endometrium were found but roughly not exceeding 5% of the endometrial surface area.

Conclusion: The results of this preliminary study confirms that tactile electrosurgical ablation probe (TEA probe) ablation produces a reproducible thermal injury without evidence of serosal heating or full thickness damage. Results suggest that the treatment time could be reduced to less than 10-min without detrimental effect on the depth of thermal damage. This hypothesis is currently being evaluated by clinical efficacy studies.

Key Words: Dysfunctional uterine bleeding – Electrosurgery – In vitro study.

Introduction

ABNORMAL uterine bleeding is one of the most commonly encountered problems in gynecologic practice as it approaches 20% of women who seek gynecologic care [1]. It significantly interferes with the daily activities and has a negative impact on quality of life (QOL). There are several treatment modalities including a long list of medical and hormonal agents that may fail to obtain a satisfactory response so hysterectomy becomes the ultimate cure. Although hysterectomy provides a definitive treatment, it is associated with increasing risks of morbidity and death [2,3]. Endometrial ablation has been performed with heat, cold, light, microwaves, chemicals, and radio frequency as sources of energy [4,5]. These methods are substantially distinct in the ease of use, learning curves, costs, efficacy, and safety Indeed, life-threatening complications have been reported [6-8].
Hysteroscopic endometrial ablation has been introduced for management of dysfunctional uterine bleeding with the advantages of short hospital stays, minimal complications and less patient discomfort. However, expensive equipment with high maintenance costs as well as adequate training is required for these procedures. In addition, the use of different types of distention media is sometimes attended with complications that may be life threatening. Hysteroscopic endometrial ablation has been introduced for management of dysfunctional uterine bleeding in our Department 2 decades ago. We carried out all types of electrosurgical endometrial ablation (transcervical endometrial resection, roller ball endometrial ablation and a combination of the previously mentioned two procedures). Both the caregivers and the majority of our patients were satisfied with the short and long-term outcomes. However, the number of trained personnel is still limited and special difficulties were encountered in the maintenance of the instruments. Thermal balloon ablation was also introduced in the last decade but still we are encountering a problem in obtaining the expensive disposable balloon. So the present preliminary study was designed to test the feasibility of performing endometrial electrocoagulation without hysteroscopy or distention media depending on the tactile sense of experienced gynecologists. This was at first being tried via insulating the conventional curet except its blunt end that well work like the roller ball when it comes in direct contact with the thinned endometrium. Then the procedure was conducted by a specially designed insulated curved probe with a ball like end 5 mm in diameter and a total exposed (active end) surface area of 43.6 mm². That was named tactile electrosurgical ablation probe (TEA probe).

Setting:
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Aim of the work:
The present work is aiming at studying the efficacy and safety aspects of a newly designed endometrial coagulator for tactile electrosurgical endometrial ablation on hysterectomy specimens.

Material and Methods
This experimental work involved 13 hysterectomy specimens during the in vitro phase and one case of dysfunctional uterine bleeding during ex vivo part of the study. During the in vitro phase, fresh hysterectomy specimens were placed on the return electrode of diathermy and coagulated transcervically by the TEA probe for 5 or 10 minutes treatment times. During the procedure of in vitro coagulation, the uterine serosal surface was inspected for blanching as a sign of full thickness damage and surface temperature was recorded using a digital thermometer. The ex vivo phase was supposed to include 7 cases (half the number of total cases) but only included a single case scheduled for hysterectomy that gave consent. An ultrasonic examination is carried out for measurement of endometrial thickness (ET) immediately preoperative to detect if there was a need for preparatory curettage (if ET ≤ 5 mm). In the in vivo cases, the patient was placed in dorsal lithotomy position, sterilized and draped as usual for abdominal and vaginal operation. The abdomen was opened till exposure of the uterus, simultaneously a vaginal speculum was inserted, and the cervix was exposed, painted and grasped with a tenaculum then the TEA probe was introduced through the cervix. Dilatation was done (up to Hegar #7), then TEA probe was connected to the diathermy active electrode socket and a 60 watt setting was used. The endometrial cavity was systemically coagulated as follow, the coagulating probe was introduced till the resistance of the fundus was felt. Then the TEA probe was directed to press gently on the anterior wall and the diathermy was activated while the TEA probe was slowly withdrawn till the internal os. Then with diathermy off, the IC was reintroduced till the fundus and the procedure was repeated working from the right to the left till complete coagulation of the anterior wall. After that, the posterior uterine wall was coagulated in the same manner. Lastly, TEA probe was passed across the fundus slowly working from the right to the left uterine cornual ends to ensure complete coagulation of the whole endometrium.

The pressure exerted on the uterine wall was guided by the tactile sense of the surgeon and it is generally similar to the pressure exerted during conventional curettage.

Through the abdominal incision the uterus was observed during the coagulation procedure for the pressure force of the TEA probe and for any color changes e.g. blanching. Also, the temperature of the uterovesical pouch as well as the temperature of uterine serosa was measured using a digital thermometer. Treatment time is calculated from the onset of starting coagulation till withdrawal of the TEA probe when the surgeon judged the coagulation being completed.
After in vitro completion of the procedure or hysterectomy, the uterus was bisected and inspected for grossly visible thermal damage. Then the specimen was fixed in 10% formaline and send for histopathologic examination, where 6-8 blocks were randomly 2-4 sections were obtained and paraffin sections (4-5 μm thick) were cut and stained with haemtoxylin and eosin for full histopathologic examination under light microscopy. Morphometrical evaluation was carried out on the stained sections using computer assisted image analysis system (Leica Q 500 MB Computerized Image Analyzer) where the following points were explored:

The depth of thermal necrosis on the treated uterine endomyometrium.

Focal areas of undamaged endometrium.

Measurements of depth were done as follow:

The slide was subjected after careful orientation depending on the presence of foci of endometrium (damaged or healthy) under light microscopy using magnification powers X2 objective to X25 according to the situation as to give the clearest distinction between the healthy and damaged cells. The depth was measured after transfer of the image to the computer with adjustment of the program on 2X objective then several measurements (8-10) of the depth of tissue damage were taken with subsequent calculation of mean and standard deviation

Results

Preoperative data:

Table (1) showed that there were no significant differences in age, parity, duration of bleeding or endometrial thickness, between cases whose uteri were treated in vitro at either 30 or 60-watt setting.

Table (1): Patient characteristics and preoperative data.

<table>
<thead>
<tr>
<th></th>
<th>30 watt cases</th>
<th>60 watt cases</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age years (Mean ± SD)</td>
<td>40.34±4.4</td>
<td>42.04±3.4</td>
<td>NS</td>
</tr>
<tr>
<td>Parity (Mean ± SD)</td>
<td>4.74±5.4</td>
<td>5.34±3.1</td>
<td>NS</td>
</tr>
<tr>
<td>Uterine size (weeks)</td>
<td>8.34±20</td>
<td>8±3.4</td>
<td>NS</td>
</tr>
<tr>
<td>Uterine sounding (cm)</td>
<td>8.30±1.3</td>
<td>8.4±1</td>
<td>NS</td>
</tr>
<tr>
<td>Duration of bleeding (month)</td>
<td>20.34±4.4</td>
<td>18.34±3.4</td>
<td>NS</td>
</tr>
<tr>
<td>Endometrial thickness (mm)</td>
<td>4.34±2.4</td>
<td>4.3±2.4</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table (2) showed that there were no significant differences in serosal temperatures serosal injury, full thickness coagulation or apparently untreated endometrium between cases whose uteri were treated in vitro at either 30 or 60-watt setting.

Table (2): Comparison between treatment results of uterine specimens treated at 30 watt and 60 watt setting.

<table>
<thead>
<tr>
<th></th>
<th>30 watt cases</th>
<th>60 watt cases</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serosal temperature</td>
<td>39-42 (41.03)</td>
<td>39-43 (41.83)</td>
<td>NS</td>
</tr>
<tr>
<td>Serosal injury</td>
<td>none</td>
<td>none</td>
<td>NS</td>
</tr>
<tr>
<td>Full thickness coagulation</td>
<td>none</td>
<td>none</td>
<td>NS</td>
</tr>
<tr>
<td>Apparently untreated endometrium</td>
<td>5-10%</td>
<td>5-10%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table (3) showed that there were no significant differences in serosal temperatures serosal injury, full thickness coagulation or apparently untreated endometrium between cases whose uteri were treated in vitro at either 30 or 60-watt setting.

Table (3): Comparison between uterine specimens treated for 5 minutes and 10 minutes time.

<table>
<thead>
<tr>
<th></th>
<th>5 minutes cases</th>
<th>10 minutes cases</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serosal temperature</td>
<td>40-42 (41.03)</td>
<td>41-43 (42.03)</td>
<td>NS</td>
</tr>
<tr>
<td>Serosal injury</td>
<td>none</td>
<td>none</td>
<td>NS</td>
</tr>
<tr>
<td>Full thickness coagulation</td>
<td>none</td>
<td>none</td>
<td>NS</td>
</tr>
<tr>
<td>Apparently untreated endometrium</td>
<td>10%</td>
<td>5%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Histopathological examination of the uterine specimens to assess the extent of thermal damage showed complete tissue destruction of the whole endometrium with thermal coagulation of the adjacent myometrium in all examined uteri. Missed foci of untreated endometrium were found in all examined uteri but in 5-10% of examined sections. No full thickness injuries were demonstrated either by gross or microscopic examination or even suggested by temperature studies. In the endometrium tissue destruction included the surface epithelium, endometrial glands and endometrial stroma. Some focal endometrial areas showed partial sloughing of its superficial parts with its lamina epithelial (Fig. 1).
The affected parts of the myometrium showed deeply stained cytoplasm with densely packed deeply stained pyknotic nuclei. Their muscle fiber becomes indistinct from each other forming a pink stained homogenous tissue. Thus the demarcation between the affected and healthy tissues were clear form the normal myometrium where all the myometrial cells appeared live or healthy.

Table (4): Relation between 5 and 10 minutes treatment times, 30 and 60 watt power setting and the depth of tissue damage.

<table>
<thead>
<tr>
<th>Treatment time (micrometers)</th>
<th>Significance p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of coagulation at 5 min.</td>
<td>1742±333</td>
</tr>
<tr>
<td>Depth of coagulation at 10 min.</td>
<td>2332±493</td>
</tr>
<tr>
<td>Significance</td>
<td>.04</td>
</tr>
</tbody>
</table>

Discussion

With hysteroscopic methods of endometrial ablation, hysterectomy can be avoided in 90% of patients with menorrhagia and a normal uterine cavity [9]. There is, however, some morbidity attached to endometrial ablation [10]. Hysteroscopic surgery also requires significant technical skills and training to conduct it with safety and efficacy.

Easier methods of endometrial ablation, without the inherent complications associated with uterine distention, are being explored. Endometrial ablation with a cryoprobe was one of the first methods of endometrial ablation to be described [11,12]. The clinical application of this technique ceased soon after the publication of reports on pelvic abscesses after cryosurgery [13]. Despite technical alterations, such as the use of a distention medium, clinical results remained unsatisfactory [14]. Thermal balloon ablation that represents the latest development [15] and the most popular easier method of endometrial ablation still suffering problems of availability and affordability in poor countries.

In the present study endometrial ablation was experimentally performed on hysterectomy specimens using a well-known energy source but with a novel way of introducing electrosurgical energy into the uterine cavity guided by tactile rather visual sense of the gynecologist. The technique of tactile electrosurgical ablation in similar to a great extent to dilatation and curettage procedure both principally and practically. Hence the basic requirements for its performance are the general awareness with electrosurgical principals together with basic experience for performing dilatation and curettagge. The present technique couples the advantages of electrosurgical ablation as an attractive alternative to hysterectomy and the technical simplicity of the procedure as well as the additional safety of avoiding the distention media and its related complication. In the present study the influence of electrosurgical
ablation was investigated with special reference to the ability of total destruction of the endometrium and the thermal action on the myometrium and serosal surface. The present study comprised examination of 13 hysterectomy specimens treated in vitro by TEA probe and one case treated during hysterectomy (in vivo). The depth of tissue destruction as measured by the image analyzer has been considered as an evidence the efficacy and reproducibility of the procedure. Several studies indicate that tissue destruction of the endometrium and the adjacent 2-4 mm of the myometrium are required to avoid endometrial regeneration [16,17].

In the present study a tissue destruction of the endometrium and 2-5 mm of the adjacent myometrium was achieved. These findings would suggest that our procedure provided a successful means of achieving endometrial ablation. These findings are in accordance with findings of other studies of thermal ablation showing that the depth of tissue destruction was recorded up to 6 mm [17-20]. However in the study of Anderson, et al. (1998) a maximum depth of 11.5 mm could be demonstrated by light microscopy and 15 mm by electron microscopy [21].

In the present study a tissue destruction of the full thickness of the endometrium and thermal affection of the adjacent myometrium was achieved. This may suggest that the possibility of deep lying endometrial tissue survival is unlikely. These finding are in agreement with other studies showing that the endometrial tissue was completely destroyed by electro thermal ablation [18,19,21,22].

It has been assumed that tissue destruction to a specific depth is required to ensure clinical efficacy, however in a previous study a significant drop in endometrial protein pp14 (placental protein 14) has been noted in patients with clinical improvement. This may suggest that in addition to morphological changes, functional disturbances of the endometrium contribute to clinical improvement [23].

Missed foci of preserved (untreated) endometrium were found in the examined uteri both grossly as well as microscopically but roughly it was in the range of 5-10% of the total endometrial surface area. This observation was also noticed by Taskin, et al. [24] and Wyss, et al. [22] who explained it as being an expected finding rather than being a failure of ablation. Moreover residual endometrium can be found by magnetic resonance imaging in women who are amenorrhoeic after endometrial ablation [25].

Conclusion: The results of this preliminary study confirm that tactile electrosurgical ablation probe (TEA probe) produces a reproducible thermal injury without evidence of serosal heating or full thickness damage. Results suggest that the treatment time could be reduced to less than 10-min without detrimental effect on the depth of thermal damage. This hypothesis is currently being evaluated by clinical efficacy studies.

References


