Significance of preoperative calculation of uterine weight as an indicator for preserving the uterus in pelvic reconstructive surgery

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Abstract: Recently, increasing evidence has shown that uterus preservation is beneficial for pelvic organ prolapse (POP) patients, both physiologically and psychologically. However, the preoperative indicators for uterus preservation have rarely been examined. The current study was designed to determine the relationship between the preoperative evaluated uterus weight and the operation selection (preserving the uterus or not) in pelvic reconstructive surgery (PRS) using vaginal meshes. First, in a series of 96 patients undergoing hysterectomy, the uterine weight was calculated by preoperative ultrasound measurements, and was then compared with the postoperative actual weight of the uterus. Subsequently, in a series of 65 patients undergone PRS using vaginal meshes and preserving the uterus, the uterine weight was calculated by preoperative ultrasound measurements. Lastly, in a series of 43 patients with a uterine weight > 56.12 g who had undergone PRS using vaginal meshes, the operation success rate in patients with a preserved uterus was compared to patients for whom the uterus was not preserved. The results showed that uterus weight can be evaluated by ultrasound and used as a preoperative indicator for whether the uterus should be preserved or not in PRS when using vaginal meshes. It was indicated that preoperative evaluation of uterine weight is beneficial for surgical planning and guidance.

Keywords: Uterine weight, pelvic organ prolapse, pelvic reconstructive surgery, ultrasound

Introduction

Pelvic organ prolapse (POP) is the descent of female pelvic structures (including vagina, uterus, bladder and bowel) due to pelvic tissue degradation, trauma, or congenital dysplasia [1, 2]. POP is a common gynecological condition, which severely affects the patients' quality of life [3, 4]. For patients with symptomatic prolapse, surgical treatment is generally considered to be necessary and hysterectomy has been considered standard practice for treating POP [5, 6]. In the recent years, pelvic reconstructive surgery (PRS) using vaginal mesh is increasingly performed for POP patients [7, 8]. This makes it possible to preserve the uterus during surgical intervention for POP patients without previous CIN (cervical intraepithelial neoplasia), post-menopausal bleeding, abnormal cervical smears, or organic diseases. Uterus preservation has the advantage of shorter operative time, less blood loss, fewer days with an indwelling urethral catheter [5], and better stability of the pelvic floor structure [9]. Moreover, uterus preservation contributes positively to women's confidence, self-esteem and sexuality [10]. However, indications for uterus preservation have rarely been reported.

Generally, the uterine weight is thought to be among the major factors in uterine descent [5, 11]. Vaginally placed synthetic meshes can replace weak support structures, leading to improved anatomical and functional results. Therefore, it is reasonable to propose that, in PRS using vaginal meshes, the weight of the uterus might play a central role in preserving the uterus. Driven by this consideration, the present study was designed to investigate the relationship between the weight of the uterus and operation selection, in hope of determining indicators for uterus preservation and getting more information about selecting an operation for PRS using vaginal meshes.
Patients and methods

Patients

Ninety-six patients underwent hysterectomy due to symptomatic grade III-IV uterovaginal prolapse or benign uterine disease, 65 patients underwent PRS using vaginal meshes with preservation of the uterus, and 43 patients underwent PRS using vaginal meshes with a uterine weight of more than 56.12 g. Patients were recruited from the Department of Obstetrics and Gynecology of Fuzhou General Hospital from 2010 to 2013. The ethics committees of Fuzhou General Hospital approved the study and all patients gave their informed consent before entering the study.

Ultrasound measurements

All patients were in a supine position and the bladder was maintained in an empty state. The prolapsed pelvic organs were returned to their normal position. Preoperative pelvic images of each patient were obtained by an ultrasound sector scanner (Voluson 730, General Electric Co., USA) with a 5 MHz transvaginal probe. A 3.5 MHz abdominal probe was used for a large uterus. Three dimensions of the uterine corpus including the length (L), the width (W) and the anteroposterior diameter (AP) were measured in longitudinal and transverse views. In the longitudinal view, the length was determined from the highest fundus in the midline axis to the internal os of the cervix. The anteroposterior diameter was taken at the widest diameter. In the transverse view, the width was the largest transverse dimension.

Table 1. Uterine corpus dimensions (cm) of preoperative evaluation and postoperative measurement

<table>
<thead>
<tr>
<th></th>
<th>preoperative evaluation</th>
<th>postoperative measurement</th>
<th>P</th>
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<tbody>
<tr>
<td>L</td>
<td>6.15±1.02</td>
<td>6.12±0.96</td>
<td>0.81</td>
</tr>
<tr>
<td>W</td>
<td>5.76±0.75</td>
<td>5.67±1.05</td>
<td>0.78</td>
</tr>
<tr>
<td>AP</td>
<td>4.87±0.81</td>
<td>5.01±0.72</td>
<td>0.37</td>
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Table 2. Cervix dimensions (cm) of preoperative evaluation and postoperative measurement

<table>
<thead>
<tr>
<th></th>
<th>preoperative evaluation</th>
<th>postoperative measurement</th>
<th>P</th>
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<tbody>
<tr>
<td>CL</td>
<td>4.21±0.69</td>
<td>4.05±0.87</td>
<td>0.65</td>
</tr>
<tr>
<td>D</td>
<td>3.18±0.56</td>
<td>3.03±0.43</td>
<td>0.23</td>
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</tbody>
</table>

Figure 1. Uterine dimensions by transvaginal ultrasound. A: The uterine corpus dimensions of length (L) and anteroposterior (AP) in longitudinal view. B: The uterine corpus dimensions of width (W) in the transverse view. C: The cervical length (CL) and anteroposterior diameter (D) in the longitudinal view.
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The cervical length (from the internal to the external os of the cervix) and cervical anteroposterior diameter were measured in the longitudinal image. Each subject was reviewed by the same operator and all measurements were repeated three times.

Calculation of the volume and weight of uterus

The uterine volume comprises the corpus and cervix volume together. The volume of the uterine corpus was calculated using the geometric equation of a prolate ellipsoid (0.5236 × L × W × AP) and the volume of cervix was calculated by the geometric formula of a cylinder [π (D/2)^2 × CL]. The dimensions (L, W, AP, D and CL) were determined from ultrasound [9]. As the uterine density approximates that of water (1 g/cm^3), the weight of uterus in grams is about equal to the volume of uterus in cm^3 [12].

Measurements of the actual parameters of uterus

The total uterus (including the corpus and cervix) was immediately measured after hysterectomy. First, the cervix was removed from the uterus using a scalpel. Subsequently, the dimensions (L, W, AP, D and CL) were measured using calipers (0.02 mm, 0~150 mm). A digital scale (0.01 g, 0~300 g) was used to measure the weights of corpus and cervix, then the two weights were summed together.

Statistical analysis

Statistical analyses were performed by using SPSS 20.0 for Windows (SPSS Inc., Chicago, IL). All continuous data were compared using t-tests. Differences of success rates between the uterus-preserved group and the hysterectomy group were tested by Fisher’s exact test. P < 0.05 was considered to be statistically significant.

Results

The actual weight of the uterus can be accurately predicted by ultrasound preoperatively

Table 3. Total uterine weight (sum the corpus and cervix weights together) of preoperative evaluation and postoperative measurement

<table>
<thead>
<tr>
<th></th>
<th>preoperative evaluation</th>
<th>postoperative measurement</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>corpus weight</td>
<td>87.25±12.66</td>
<td>90.16±18.55</td>
<td>0.56</td>
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<tr>
<td>cervix weight</td>
<td>33.87±0.63</td>
<td>30.72±5.68</td>
<td>0.25</td>
</tr>
<tr>
<td>total uterine weight</td>
<td>123.16±20.72</td>
<td>121.59±18.65</td>
<td>0.83</td>
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Table 4. Uterine dimensions (cm) and weights (g) of preoperative evaluation in patients who preserved the uterus and had successful long-term therapy efficacy

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>AP</th>
<th>Weight</th>
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<tr>
<td>corpus</td>
<td>4.28±0.73</td>
<td>3.56±0.45</td>
<td>2.91±0.36</td>
<td>23.01±2.51</td>
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<tr>
<td>cervix</td>
<td>3.37±0.58 (CL)</td>
<td>-</td>
<td>3.11±0.25 (D)</td>
<td>26.10±3.62</td>
</tr>
<tr>
<td>total</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>53.12±7.23</td>
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Table 5. Pelvic reconstructive surgery success rate in groups that had preserved the uterus and undergone vaginal hysterectomy

<table>
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<tr>
<th></th>
<th>success</th>
<th>recrudescence</th>
<th>success rate (%)</th>
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<tbody>
<tr>
<td>preserved the uterus</td>
<td>16</td>
<td>5</td>
<td>76.19</td>
</tr>
<tr>
<td>vaginal hysterectomy</td>
<td>22</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

The cervical length (from the internal to the external os of the cervix) and cervical anteroposterior diameter were measured in the longitudinal image. Each subject was reviewed by the same operator and all measurements were repeated three times.

Preoperatively measured uterine dimensions by ultrasound were consistent with the actual dimensions (Figure 1A-C). In the present study, for the 96 patients undergone hysterectomy, no significant difference was observed between the preoperative mean ultrasonographic uterine corpus dimensions and the actual uterine corpus dimensions (P > 0.05, Table 1). In addition, no significant difference was observed between the mean ultrasonographic cervix dimensions and actual cervix dimensions (P > 0.05, Table 2). The preoperatively evaluated weight of the uterus using ultrasound was consistent with the actual weight of uterus (Table 3). According to ultrasonographic dimensions, there is no statistically significant difference between the mean weight of the uterine corpus calculated by the prolate ellipsoid formula and the postoperatively actual weight of uterine corpus (P > 0.05). In addition, there is no statistically significant difference between the mean weight of the cervix calculated by the cylinder formula and the postoperatively actual weight of the cervix (P > 0.05).
The uterine weight can be taken as a preoperative indicator for preserving uterus in PRS using vaginal meshes

The uterine weight can be taken as an indicator for preservation of the uterus in PRS using vaginal meshes. Of the 65 patients with PRS using vaginal meshes and preservation of the uterus, 60 cases were successful as long-term therapy in two-year follow-up (five cases relapsed), the success rate was 92.31%. On the basis of ultrasonographic dimensions, the mean total uterine weight calculated by ultrasonographic of 60 successful cases was 53.12±7.23 g (95% confidence interval, 48.36-56.12 g, Table 4). The relapsed patients had undergone a vaginal hysterectomy and the total weight of their uterus were 82.69 g, 85.24 g, 92.67 g, 96.58 g and 120.06 g, all of which were far heavier than the upper of 95% confidence interval of 56.12 g.

Further study showed that POP patients with a uterine weight of more than 56.12 g had a lower success rate preserving the uterus after PRS using vaginal meshes. Among the 43 patients with a total uterine weight of more than 56.12 g, the uterus of 21 patients was preserved and five patients relapsed. The success rate of PRS was 76.19%. The other 22 patients underwent vaginal hysterectomy and the success rate of PRS was 100% (Table 5).

Discussion

In the present study, we observed the feasibility of preoperatively evaluating the uterine weight by transvaginal ultrasound, and analyzed the efficacy of taking preoperatively estimated uterine weight as an indicator for whether or not the uterus could be preserved during PRS using vaginal meshes. The results showed that uterine weight can be accurately predicted by preoperative ultrasound evaluation. In addition, POP patients with a uterine weight of more than 56.12 g had a lower success rate preserving the uterus after PRS using vaginal meshes. All these findings suggest that the preoperatively-evaluated uterine weight can be taken as a preoperative indicator for the potential success of preserving the uterus after PRS using vaginal meshes.

Traditionally, bimanual examination is commonly performed to determine uterine weight or uterine size. However, the use of bimanual examination can yield a series of errors in estimation [13]. The development of medical imaging techniques has enabled clinicians to demonstrate clearer imaging of the uterus, which is helpful to better evaluate uterine weight. During the past decades, ultrasound examination has been introduced into routine gynecological practice with the attempt to more accurately assess the uterine size. Studies showed that preoperative ultrasonographic dimensions of the uterus are significantly correlated with the corresponding actual dimensions of uterine specimens [14], Rovio et al. reported that, with a formula combining the prolate ellipsoid (uterine corpus) and cylinder (uterine cervix), the weight of the total uterus could be accurately predicted by preoperative transvaginal ultrasound assessment [15]. In the present study, our data showed that no significant difference was observed between ultrasonographic and actual dimensions of the uterus, and no statistically significant difference was observed between the preoperatively calculated and the actual weights of the uterus. These results are consistent with previous reports, and indicate that the uterine weight can be preoperatively evaluated by ultrasound.

Recently, an increasing number of studies have focused on the importance of the uterine weight in operative procedures. Shiota et al. pointed out that the uterine weight could be the determining factor in choosing appropriate surgical methods for treating uterine myoma and uterine adenomyosis [16]. Mistrangelo et al. addressed whether the preoperative evaluation of uterine volume and weight can improve safety and efficacy of vaginal hysterectomy [17]. Hatta et al. found that evaluating uterine weight using MRI is beneficial for surgical planning and for guiding total laparoscopic hysterectomy [18]. The present study showed that, in 65 patients who had undergone PRS using vaginal meshes with preservation of the uterus, 60 cases had successful long-term therapy and five cases relapsed; the success rate was 92.3%. The mean total uterine weight calculated by ultrasonographic of 60 successful cases was 53.12±7.23 g (95% confidence interval, 48.36-56.12 g). The weight of every relapsed uterus was much heavier than 56.12 g. The data illustrate that a very large uterus cannot be preserved, and preservation of a uterus with an appropriate weight does not increased the
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risk of recurrence after PRS using vaginal meshes. In 43 patients whose uterine weights were heavier than 56.12 g, the success rate of the vaginal hysterectomy group was significantly higher than in the preserved uterus group (100% versus 76.19%; P < 0.01). The data illustrate that uterine weight can be the determining factor in whether the uterus is preserved in pelvic reconstructive surgery and preoperatively estimating the weight of the uterus by ultrasound might be useful to determine surgical options for PRS using vaginal meshes.

In conclusion, the present study demonstrates that uterine weight can be taken as a preoperative indicator of whether or not to preserve the uterus during PRS, and the preoperative evaluation of uterine weight by ultrasound is beneficial for surgical planning and guidance. However, there are some limitations in the study as follows. First, the relapse population was too small to get a standard weight range for preserving the uterus. Second, a multivariate analysis of factors associated with preserving the uterus was not done. Third, long-term consequences such as sexual function and urinary incontinence were not evaluated. To make up for those shortcomings, a comparative study with more patients, longer follow-up time, multivariate analysis, and questionnaires of quality of life would be required.

Disclosure of conflict of interest

None.

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References

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