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Original Article

Is it possible to predict outcomes of surgical treatment of female stress urinary incontinence with maximum urethral closure pressure: a meta-analysis and systematic review

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Abstract: Objective: We aimed to search whether the maximum urethral closure pressure (MUCP) can be used to predict outcomes of surgical treatment of stress urinary incontinence. Materials and methods: All eligible studies in PubMed and EMBASE. Data on patient clinical characteristics, the numbers of patients before surgery and the surgical outcome of each group were extracted. We used odds ratio (OR) to measure the MUCP < or > boundary values of predicting the outcome of female stress urinary incontinence (SUI). Results: The meta-analysis has included 7 articles which 4 were prospective studies and 3 retrospective studies. The fixed-effect model OR was 0.41 (95% CI 0.28-0.58; P<001), suggesting that MUCP < than the boundary value is statistically superior to MUCP > boundary value for predicting the outcomes of surgical treating SUI despite different subgroup of boundary threshold. Conclusions: This meta-analysis provide an available evidence suggests that preoperative MUCP < than the boundary value may add insight into outcomes in patients with SUI after surgical treatment.

Keywords: Maximum urethral closure pressure, stress urinary incontinence, prediction, prognosis, meta-analysis

Introduction

Urinary incontinence (UI) is a common condition associated with a significant quality-of-life burden and economic costs in women. Stress urinary incontinence (SUI) is the most common type of UI, affecting an estimated half of all incontinent women, and the prevalence of SUI in the general population is between 12% and 46% [1-3]. This leads to a potentially debilitating social problem with significant cost implications to the individuals and a substantial level of health care resource use, including personal containment products, conservative treatment, surgery and management of complications. The estimated annual cost to the healthcare system in the UK exceeds GBP 700 million and in USA it is over USD 20 billion [4-6]. There is also significant cost borne by women on an individual basis, with estimates of more than GBP 178 million annually [7-9].

One form of sphincter evaluation is through urethral pressure profile, such as maximal urethral closure pressure (MUCP). It is not known whether this measure or other urodynamic study (UDS) measures predict results of MUS surgeries [10]. And some argue that urodynamic evaluation is invasive, costly and does not change clinical decision making [11, 12]. MUCP, which is the highest pressure generated along the length of the urethra above baseline intravesical pressure, is believed to correspond to the rhabdosphincter at the level of the midurethra and represent the ability of urethra to resist leakage [13]. Although MUCP does not provide information about the integrity of the proximal urethra (bladder neck), it is thought to represent some indication of the integrity of the distal urethral closure mechanism and is a resting measurement. Most frequently, MUCP and Valsalva leak point pressure (VLPP) are the urodynamic parameters can use to grade the

severity of SUI. Several authors have demonstrated that values of <20 cm H_2O of MUCP would be suggestive of sphincter defect [14, 15]. Having a low MUCP may be associated with persistent urgency incontinence after tension-free vaginal tape (TVT) in women with mixed urinary incontinence [16]. MUCP has also been chosen as a prognostic factor in the success of various surgical techniques for SUI [17, 18].

MUCP test before stress urinary incontinence surgery has rarely been analyzed in systematic reviews. At present, some argue that MUCP values make itself utility limited in clinical decision making, with increasing cost of health care and the risk of invasive manipulation. Others have figured out that MUCP values can provide important information of SUI. Some prospective studies and retrospective studies have been taken to explore whether MUCP values are predictive of outcomes after SUI surgery. However, their conclusions showed difference.

To help resolve this controversy, we systematically reviewed the literature on the ability of preoperative MUCP values before to predict the surgical outcomes of patients with SUI.

Materials and methods

Search strategy

PubMed and EMBASE were searched for the last time on July, 2015 using the search terms "maximum urethral closure pressure", "MUCP", "stress urinary incontinence", "SUI", "treatment". The conference abstracts and some other content-independent articles were not included in this systematic review. We combined the search results and removed duplicate articles in order to obtain an initial set of potentially eligible studies.

Study inclusion/exclusion criteria

Studies were considered eligible if they met all the following inclusion criteria: (i) The articles selected the SUI women patients as sample. (ii) Analyzed data about MUCP was showed in the articles. (iii) The treatment of the SUI patients was surgical treatment, not drug therapy or material testing. The exclusion criteria were: (i) The MUCP values were not clearly expressed. (ii) The outcomes of surgical treatment were not incomplete. In addition to this, some articles which had the objective to investigate the choice of SUI operation were included as long as they had data statistics about MUCP.

Data extraction

Articles after removing duplicate were assessed independently by two authors (TW, XZ) for possible inclusion. They also extracted data on first author, publication year, patient sources, study design, study size, ethnicity of study population, mean age of patients, follow-up years, patient number of lost to follow-up, surgery type, whether to receive preoperative clinical and urodynamic evaluation, and other clinical characteristics. However, people had disagreement to define the appropriate boundary values of preoperative MUCP. And their studies had used different evaluation criteria for MUCP. Consequently, different articles had different boundary values. We read these articles and summarized 3 main boundary values which were accepted by most people and divided them to 3 subgroups, MUCP threshold value = 20 cm H_20 group, MUCP threshold value = 30 cm H_20 group and MUCP threshold value = 40 cm H_20 group. And also, the numbers of patients before surgery and the surgical outcome of each group were extracted. The surgical outcome represented the patients who were cured by the surgery and had no SUI.

Quality assessment of included studies

Each included article was appraised by two reviewers (T.W and X.Z), who assessed the methodologic quality of selected studies independently with the Newcastle-Ottawa Scale (NOS) [19]. Two reviewers assessed and scored the representative and applicability of study groups, comparability of the groups, evaluation of outcomes, and adequacy of follow-up. And we defined score of 6-9 was high methodological quality and low quality as a score <6.

Statistical methods

All calculations and data manipulations were performed using RevMan 5.3 (Cochrane Collaboration, Oxford, UK). Survival data were log-transformed and pooled results were expressed in terms of the log (OR) and standard error of

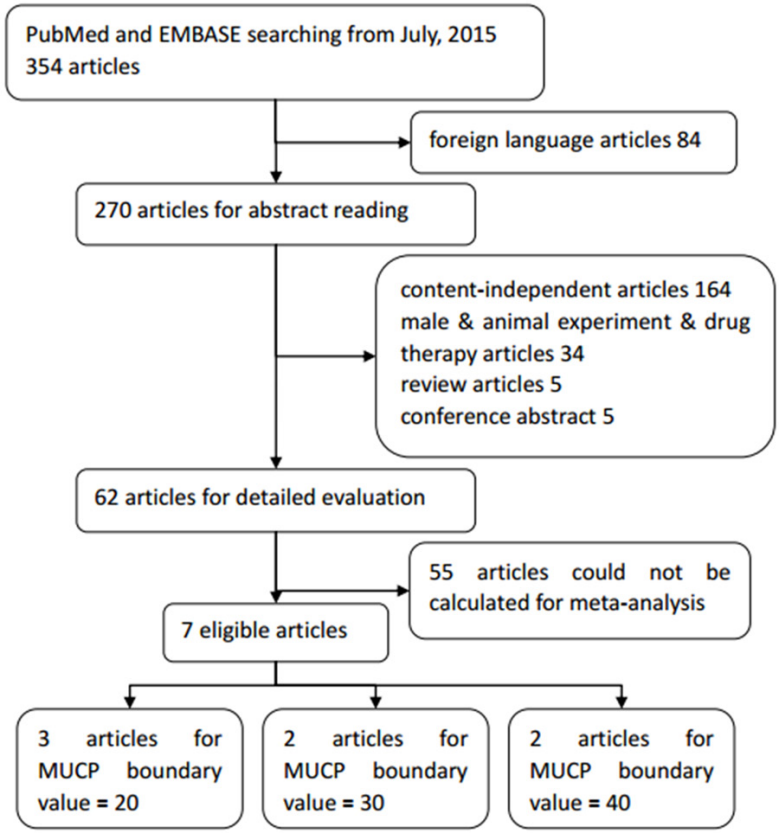

Figure 1. Flowchart for records selection process of the meta-analysis.

the log (OR). According to the preoperative MUCP boundary values, the articles were divided into 3 subgroups, respectively. We compared the numbers of patients before surgery and the surgical outcome of each subgroup. Forrest plots were used to Meta-analyze the relationship between different preoperative MUCP threshold values and surgical outcome of SUI patients. Heterogeneity was defined as $p<0.10$ or $I^2>50\%$. When homogeneity was adequate ($p\geq0.10$ or $I^2\leq50\%$), data were meta-analyzed using a fixed-effects model [20]. Otherwise, data were meta-analyzed using a random-effects model. A pooled OR <1 indicated better surgical outcome for patients with lower boundary values of preoperative MUCP, and it was considered statistically significant if the corresponding 95% CI did not include one.

The Begg's test was performed and funnel plots were generated in STATA 13.0 (STATA Corp., College Station, USA) to assess the potential publication bias; $p>0.05$ was interpreted to indicate the absence of significant publication bias [21].

Results

Characteristics of included studies

We initially identified 354 potentially eligible publications in PubMed and EMBASE, and we eliminated 84 in non-English articles. Of the remaining 270 studies after determining from the titles and abstracts, 164 were excluded because they did not focus on our research question; 34 were excluded because their patients were male, or they were animal experimental studies, or they used drug therapy to treat SUI; 5 were excluded because they were review articles; another 5 were excluded because they were conference abstract. This left 62 potentially relevant studies that were read in full. After full-text review, 55 studies were excluded because they reported insufficient data to pool out desired outcomes, leaving 7 studies in the final meta-analysis [14, 17, 22-26] (**Figure 1**). According to the preoperative MUCP boundary values, we then divided them into the three subgroups: MUCP threshold value = 20 cm H_20 group, MUCP threshold value = 30 cm H_20 group, MUCP threshold value = 40 cm H_20 group.

The 7 eligible studies were published between 2005 and 2014 and they included 1,527 patients with a median of 191 patients per study (range, 65-387). Patient basic information, clinical characteristics and other useful information were summarized in **Tables 1** and **2**.

Surgical outcomes reported in the included studies

All studies reported the number of both preoperative and postoperative patients with MUCP < or > boundary values;

Overall analysis and subgroup analysis: correlation between MUCP and outcomes of surgical treatment of SUI.

Table 1. Characteristics of all included studies

First author	Years	Patients source	Study design	Patient (n)	Mean Age	Follow-up (years)	Lost to follow-up	Preoperative clinical and urodynamic evaluation	NOS score (Max:9)
Costantini	2010	Italy	Retro-	146	62.7, 57.8[a]	1.58	25	Y	8
Meschia	2005	Italy	Retro-	265	61, 55[b]	2.58	ND	Y	7
Houwert	2009	Netherlands	Retro-	387	52.8, 49.2[c]	1	78	Y	7
Abdel-fattah	2010	UK	Prospec	341	51.8	0.5	24	Y	6
Viereck	2006	Germany & Switzerland	Prospec	191	ND	3	ND	Y	8
Agarwal	2014	India	Prospec	72	ND	1	12	Y	7
Costantini	2009	Italy	Prospec	65	ND	46	6	Y	5

Abbreviations: Retro, retrospective study; Pro, prospective study; Y, yes; ND, no data. [a]The mean age of patients whose preoperative MUCP <20 were 62.7. The mean age of other patients whose preoperative MUCP >20 were 57.8. [b]The mean age of patients whose preoperative MUCP <20 were 61. The mean age of other patients whose preoperative MUCP >20 were 55. [c]The mean age of patients who received tension-free vaginal tape sling were 52.8. The mean age of other patients who received Monarc transobturator tape and transobturator inside-out sling were 49.2.

Table 2. Summary of subgroups of 7 included studies

First author	Years	Surgery type	Preoperative MUCP < Boundary value		Preoperative MUCP > Boundary value	
			Total (n)	Result (n)	Total (n)	Result (n)
Boundary value = 20						
Costantini	2010	TOA	21	18	125	121
Meschia	2005	TVT	61	47	204	175
Houwert	2009	TVT, Monarc, TVT-O	31	23	305	241
Boundary value = 30						
Abdel-fattah	2010	TVT-O, ARIS	44	26	244	219
Viereck	2006	TVT	34	26	157	157
Boundary value = 40						
Agarwal	2014	Transobturator midurethral sling	23	18	7	6
Costantini	2009	TOT	35	24	24	18

Abbreviations: TOA, transobturator adjustable tape; TVT, tension-free vaginal tape; Monarc, Monarc transobturator tape; TVT-O, transobturator inside-out; ARIS, transobturator outside-in; TOT, transobturator tape.

The fixed-effect model OR was 0.41 (95% CI 0.28-0.58; P<001), suggesting that MUCP < than the boundary value is statistically superior to MUCP > boundary value for predicting the outcomes of surgical treating SUI despite different subgroup of boundary threshold (**Figure 2**).

Assessment of publication bias

The likelihood of publication bias was assessed by applying Begg's test and generating funnel plots. No significant publication bias appeared in the meta-analysis of different preoperative (**Figure 3**).

Discussion

All studies in our study that is used composite cure as an outcome demonstrated effects favoring high preoperative UDS values as predictive of SUI after surgery. Our study aimed to know the relationship between preoperative urodynamics study parameters and the outcomes of patients with surgical treatment and want to find an appropriate threshold UDS values between them. Some now presented studies only find the relationship between them, but not intended to propose an appropriate threshold DUS value for predicting SUI patients with surgical treatment.

The strength of this review lies in the systematic methodology used to evaluate the literature. Criteria for inclusion in the review were determined prior to study selection. This systematic review condensed the various findings of dedicated researchers and shed light upon the variation and inconsistencies that persist in the literature.

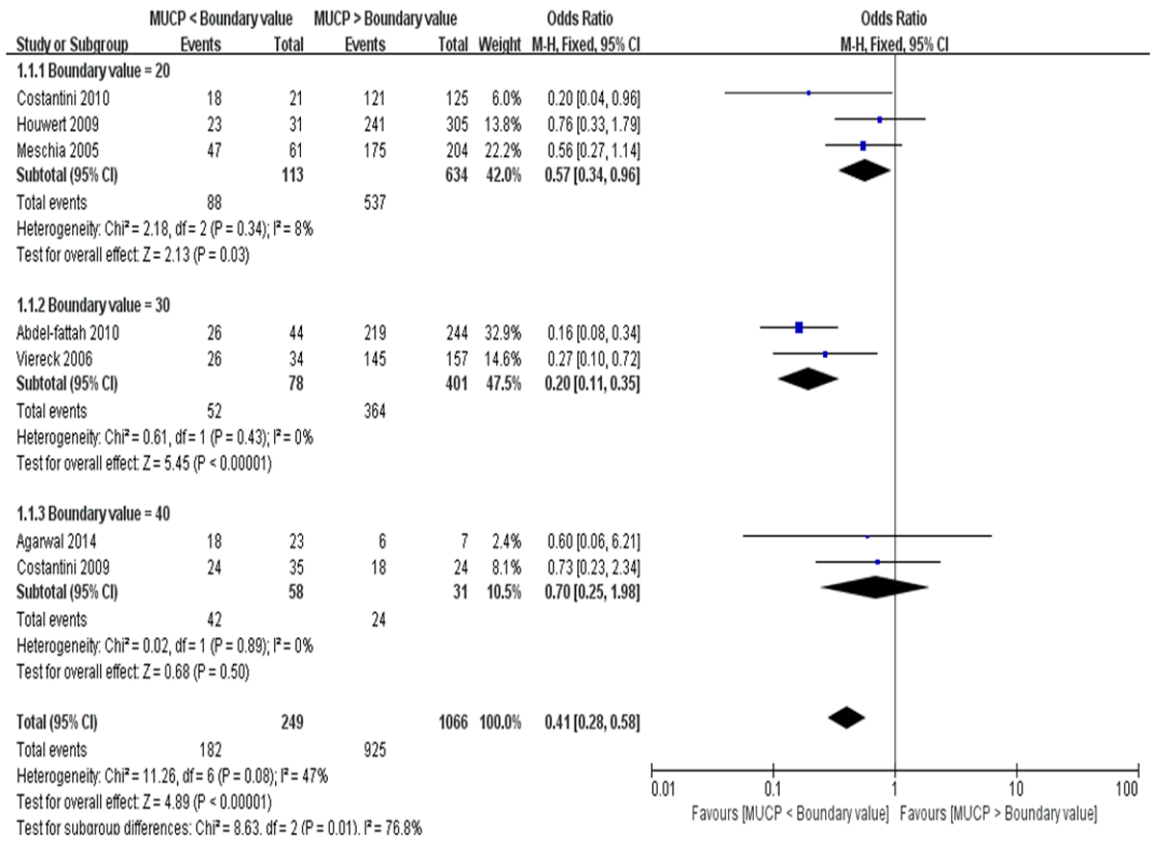

Figure 2. Pooled estimate of correlation between MUCP and outcomes of surgical treatment of SUI.

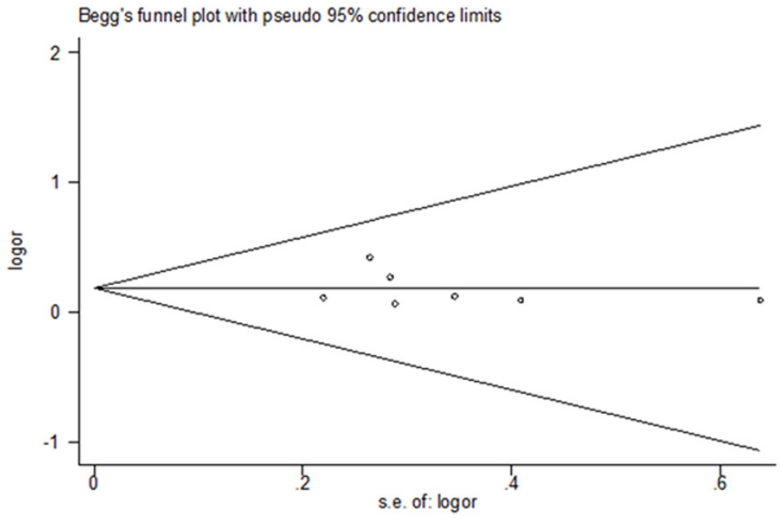

Figure 3. Funnel plot to detect publication bias.

By our systematic review study, we were intended an appropriate MUCP threshold value group (MUCP = 20 cm H_20 MUCP = 30 cm H_20 MUCP = 40 cm H_20) for predicting the SUI patients with surgical treatment ,we can find that The fixed-effect model OR was 0.41 (95% CI 0.28-0.58; P< 001), suggesting that MUCP < than the boundary value is statistically superior to MUCP > boundary value for predicting the outcomes of surgical treating SUI despite different subgroup of boundary threshold.

So we may use urodynamic study before SUI patients surgical treatment to predict the risk rate of persistent postoperative stress incontinence after surgical treatment, as our findings, if the patients with the MUCP threshold value = 30 cm H_20, it may predict the low risk rate after surgical treatment.

Limitations of our review are that a significant heterogeneity despite we performed the sub-

group analysis, the quantity index of the literature database is also too small, and the quantity of surgical way is also not wide enough. The summarize data abstracted from a variety studies, but most of them may do not have the UDS parameters or did not consider our objective in their research aims, so by our study exclusion criteria we may excluded some good studies.

Conclusion

This meta-analysis of available evidence suggests that preoperative MUCP elevated outcome can predict better outcome in patients with SUI, and the MUCP threshold values are 30 cm H_20. These findings should be confirmed in more adequately designed, prospective or retrospective studies.

Disclosure of conflict of interest

None.

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