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Risk factors for coexistence of cervical elongation in uterine prolapse

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ABSTRACT

Objective: To identify factors predicting cervical elongation in women with uterine prolapse.
Study design: The medical records of women with uterine prolapse who underwent vaginal hysterectomy were reviewed. Multivariable logistic regression analysis was performed to identify predictors of cervical elongation.
Results: Of 295 women with uterine prolapse, 136 (46.1%) patients had cervical elongation, according to Berger et al. Classification (i.e., cervical length >3.38 cm and/or cervix-to-corpus lengths ratio >0.79). Multivariable analysis revealed that lower parity (odds ratio = 0.85, 95% confidence interval [CI] = 0.73 to 0.99, P = 0.04) and advanced stage of uterine prolapse (odds ratio = 1.97, 95% CI = 1.35–2.88, P < 0.001) were predictors for cervical elongation. Based on a receiver operating characteristic curve (ROC) analysis, the following optimum cut-off values were determined for cervical elongation: (1) parity ≤3, ROC area = 0.60 (95% CI = 0.53 to 0.66); (2) stage of uterine prolapse ≥3, ROC area = 0.63 (95% CI = 0.56 to 0.69). Thus, the predicted logit(p) for a given parity (*a*) and stage of uterine prolapse (*b*) can be denoted by logit (p) = -1.26 - 0.16 x *a* + 0.68 x *b*. The optimum cut-off values of logit(p) ≥-0.18 to predict cervical elongation were determined using ROC analysis (area = 0.66, 95% CI = 0.59 to 0.73). For women with parity ≤6, we can use either (1) stage 2 uterine prolapse and parity ≤1, or (2) ≥ stage 3 uterine prolapse as criteria to predict cervical elongation.
Conclusions: Lower parity and advanced stage of uterine prolapse are predictors of cervical elongation in women with uterine prolapse. Thus, stage of uterine prolapse ≥3 or logit(p) ≥-0.18 may be useful for predicting cervical elongation.

Introduction

The presence of cervical elongation in women with uterine prolapse may decrease the patients' satisfaction with uterine-sparing surgery [1], and it may be classified as recurrence of pelvic organ prolapse (POP) after surgery [2,3]. Furthermore, additional surgery such as Manchester surgery may be needed to solve the problem [2–4]. Cervical elongation has also been reported to have a negative impact on successful salpingo-oophorectomy at the time of vaginal hysterectomy [5]. In addition, the presence of cervical elongation is associated with an increase in operative time [6]. Thus, it is important to identify cervical elongation in women scheduled for pelvic organ prolapse surgery.

The pathophysiological mechanism of cervical elongation is obscure. Estrogen and progesterone receptor levels were found to be greater in women with hypertrophic cervical elongation compared to those with a normal cervix [7]. A lack of adequate fixation of the uterosacral ligament and counter pressure to form an adequate pelvic floor may account for the etiology of cervical elongation [8].

Ultrasound-derived cervical length was found to be poorly correlated with anatomic cervical length [9]. Additionally, magnetic resonance imaging is impractical for the measurement of cervical length owing to its expensive cost [8,10].Thus, it is important to identify a useful method to predict cervical elongation, especially for women requesting uterine-sparing surgery for POP. Therefore, the aim of this retrospective study was to identify predictors for cervical

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Table 1
Baseline characteristics of women with uterine prolapse (n = 295).

Variables	Values
Age (years)	58.5 ± 11.6
Menopause	206 (69.8)
Parity	3.4 ± 1.8
BMI (kg/m^2)	23.9 ± 3.2
DOS (months)	50.4 ± 86.8
Diabetes Mellitus	30 (10.2)
Hypertension	65 (22.0)
Constipation	11 (3.7)
SUI	46 (9.3)
Myoma	111 (37.6)
Stage of UP	2.6 ± 0.7
Cervical length (cm)	3.28 ± 1.16
Corpus length (cm)	6.03 ± 2.56
Uterine length (cm)	9.24 ± 2.94
Cervix-to-corpus lengths ratio	0.64 ± 0.57
Cervical length >3.38 cm	124 (42.0)
Cervix-to-corpus lengths ratio >0.79	69 (23.4)
Cervical length >3.38 cm or cervix-to-corpus lengths ratio >0.79	136 (46.1)

Values are expressed as the mean ± standard deviation or number (percentage). BMI = body mass index; DOS = duration of symptoms; SUI = stress urinary incontinence; UP = uterine prolapse.

elongation by comparing clinical data and anatomic parameters and then deducing a useful tool to detect coexistent cervical elongation in women with uterine prolapse.

Materials and methods

All women with uterine prolapse who underwent vaginal hysterectomy between January 1994 and October 2014 in our medical centre were included in this study. Medical records, including age, body weight, body height, onset of prolapse symptoms, medical co-morbidity, coexistent stress incontinence, Pelvic Organ Prolapse Quantification (POP-Q) stage of uterine prolapse, and lengths of cervix and corpus measured by pathologists were reviewed. The hospital's research and ethics committee approved the protocol (No. 201503073RIND).

Cervical length is defined by the distance between the internal os and external os on the hysterectomy specimen. Several criteria have been proposed to define cervical elongation [8–11]. However, we adopted the definition by Berger et al. [10]. Cervical elongation is defined as the presence of cervical length >3.38 cm and/or cervix to corpus lengths ratio >0.79 [10].

STATA software (Version 11.0; StataCorp, College Station, Texas, USA) was used for the statistical analyses. Multivariable backward stepwise logistic regression analysis was performed using all statistically significant variables in the univariate analysis until all of the remaining variables in the model contributed significantly [12]. A P value of less than 0.05 was considered statistically significant. The receiver operating characteristic (ROC) curve analysis was performed to identify the optimal cut-off value for differentiation of cervical elongation. The optimal cut-off value was determined by the point on the ROC curve closest to the upper left-hand corner.

In addition, multivariable logistic regression analysis including all significant factors was performed to predict the probability of cervical elongation (p) and obtain the logit transformation (logit (p)) [13,14]. After deriving a value for each patient from the equation of logit(p), ROC curve analysis was performed to identify an optimum cut-off value.

Results

In total, 295 women with uterine prolapse were enrolled in this study (Table 1). The average cervical length was 3.28 ± 1.16 cm, and the average corpus length was 6.03 ± 2.56 cm. There were 136 (46.1%) patients who had cervical length >3.38 cm and/or cervix-to-corpus lengths ratio >0.79 including 57 (41.9%) patients with cervical length >3.38 cm and cervix-to-corpus lengths ratio >0.79, 67 (49.2%) patients with cervical length >3.38 cm only, and 12 (8.8%) patients with cervix-to-corpus lengths ratio >0.79 only (Table 1).

For predicting the presence of cervical length >3.38 cm, multivariable logistic regression analysis revealed that lower parity (odds ratio = 0.76, 95% confidence interval [CI] = 0.65 to 0.90, P = 0.002) and advanced stage of uterine prolapse (odds ratio = 1.95, 95% CI = 1.35–2.82, P < 0.001) were two independent predictors (Table 2).

For predicting the presence of cervix-to-corpus lengths ratio >0.79, advanced stage of uterine prolapse (odds ratio = 1.85, 95% CI = 1.20–2.85, P = 0.005) was the only predictor (Table 2).

For predicting cervical elongation (i.e., the presence of cervical length >3.38 cm and/or cervix-to-corpus lengths ratio >0.79), multivariable logistic regression analysis revealed that lower parity (odds ratio = 0.85, 95% CI = 0.73 to 0.99, P = 0.04) and advanced stage of uterine prolapse (odds ratio = 1.97, 95% CI = 1.35–2.88, P < 0.001) were two independent predictors for cervical elongation (Table 3). Based on the ROC analysis, the following

Table 2
Univariate and multivariable logistic regression analyses to predict the presence of cervical length >3.38 cm or cervix-to-corpus lengths ratio >0.79 in women with uterine prolapse (n = 295).

Variables	Cervical length >3.38 cm (n = 124)				Cervix-to-corpus lengths ratio >0.79 (n = 69)			
	Univariate analysis		Multivariable analysis†		Univariate analysis		Multivariable analysis†	
	Odds ratio	P	Odds ratio	P	Odds ratio	P	Odds ratio	P
Age (years)	0.99 (0.97–1.01)	0.27	–	–	1.03 (1.01–1.06)	0.008	–	–
Menopause	0.65 (0.39–1.07)	0.09	–	–	1.76 (0.93–3.33)	0.08	–	–
Parity	0.77 (0.66–0.90)	0.001	0.76 (0.65∼0.90)	0.002	1.10 (0.95–1.29)	0.20	–	–
BMI (kg/m2)	0.96 (0.89–1.03)	0.28	–	–	0.94 (0.86–1.02	0.15	–	–
DOS (months)	1.000 (0.998–1.000)	0.47	–	–	1.00 (1.00–1.00)	0.21	–	–
Diabetes	0.56 (0.25–1.27)	0.16	–	–	1.44 (0.62–3.30)	0.39	–	–
Hypertension	0.59 (0.33–1.05)	0.07	–	–	1.19 (0.63–2.23)	0.60	–	–
Constipation	1.16 (0.34–3.87)	0.82	–	–	0.35 (0.04–2.80)	0.32	–	–
SUI	0.78 (0.41–1.49)	0.45	–	–	0.53 (0.23–1.25)	0.15	–	–
Myoma	0.79 (0.46–1.35)	0.39	–	–	0.57 (0.30–1.08)	0.09	–	–
Stage of UP	1.98 (1.37∼2.88)	<0.001	1.95 (1.35∼2.82)	<0.001	1.85 (1.20–2.85)	0.005	1.85 (1.20–2.85)	0.005

Values are expressed as odds ratio (95% confidence interval). R^2 = 0.07 for cervical length >3.38 cm; R^2 = 0.03 for cervix-to-corpus lengths ratio >0.79. Abbreviations were the same as Table 1.
†Multivariable backward stepwise regression analysis was performed using all variables with P < 0.05 in the univariate analysis until all remaining variables were significant at P < 0.05.