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Effect of dilation and curettage procedure on endometrial cancer invasion and spread

Dilatasyon ve küretaj işleminin endometrial kanser invazyonu ve yayılımı üzerine etkisi

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ABSTRACT

Aim: Dilation and curettage (D&C) is a common procedure in the field of obstetrics and gynecology. D&C is known to have the possibility to destroy the endometrium. For this reason, this procedure is a risk factor for placental adhesion disorders and Asherman's syndrome. Therefore, D&C can be thought of as a possible risk factor for endometrial cancer (EC) invasion and spread. This study was designed to investigate the association between D&C and EC invasion.

Materials and Methods: The database of our institution was reviewed. All EC cases between January 2015 to January 2020 were collected. Their history of D&C status and clinicopathologic data were determined. The relation between D&C and EC invasion was evaluated.

Results: A total of 172 EC patients were enrolled in this study. 70 patients were diagnosed with more than 50% myometrial invasion (40.7%) and 42 (24.4%) of them had at least one D&C history. However, the association between D&C and EC myometrial invasion was not found statistically significant (p=0.27). Moreover, no significant difference was found between the history of performed D&C and lymphovascular space invasion, lymph node invasion, peritoneal cytology, stage (p values were 0.08, 0.43, 0.09, 0.53, respectively).

Conclusion: D&C seems not to affect EC myometrial invasion and other invasion related parameters.

Keywords: Dilation and curettage, endometrial cancer, myometrial invasion

ÖZ

Amaç: *Dilatasyon ve küretaj (D&C), kadın doğum alanında yaygın bir işlemdir. D&C'nin endometriumu tahrip etme olasılığı olduğu bilinmektedir. Bu nedenle, bu işlem plasenta adezyon-invazyon bozuklukları ve Asherman sendromu için bir risk faktörüdür. Dolayısıyla, D&C, endometriyal kanser (EK) invazyonu ve yayılımı için olası bir risk faktörü olarak düşünülebilir. Bu çalışma, D&C ile EK invazyonu arasındaki ilişkiyi araştırmak üzere tasarlanmıştır.*

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Gereç ve Yöntem: *Kurumumuzun veri tabanı incelendi. Ocak 2015 ile Ocak 2020 tarihleri arasındaki tüm EK vakaları toplandı. D&C durumlarının geçmişi ve klinikopatolojik verileri belirlendi. D&C ile EK invazyonu arasındaki ilişki değerlendirildi.*

Bulgular: *Bu çalışmaya toplam 172 EK hastası dahil edildi. 70 hastada %50'den fazla miyometriyal invazyon (%40,7) tanısı konuldu ve bunların 42'sinde (%24,4) en az bir D&C öyküsü vardı. Ancak, D&C ile EK miyometriyal invazyon arasındaki ilişki istatistiksel olarak anlamlı bulunmadı (p=0,27). Ayrıca, gerçekleştirilen D&C öyküsü ile lenfovasküler alan invazyonu, lenf nodu invazyonu, peritoneal sitoloji ve evre arasında anlamlı bir fark bulunmadı (sırasıyla p değerleri 0,08, 0,43, 0,09, 0,53 idi).*

Sonuç: *D&C, EK miyometriyal invazyonunu ve invazyonla ilişkili diğer parametreleri etkilemiyor gibi görünmektedir.*

Anahtar Sözcükler: *Dilatasyon ve küretaj, endometriyal kanser, miyometriyal invazyon*

INTRODUCTION

Curettage especially dilation and curettage (D&C) is a widely performed procedure for many purposes such as endometrial sampling or evacuation of the pregnancy material in the field of obstetrics and gynecology. D&C procedure is used to sample or empty the non-pregnant or pregnant uterus by sharp metal instruments (1). The main contact between the curette instrument and the uterus is the endometrial layer during the procedure. The endometrium consists of a functional and basal layer. The functional layer is the spilled epithelium in every menstrual cycle, otherwise, the basal layer has a proliferative activity that leads to the regeneration of the functional layer after spilling. D&C shaves the functional layer in most cases. However, the basal layer may be destroyed in certain cases that lead to Asherman's syndrome or placenta adhesive disorder (PAD) (2). If the endometrial basal layer containing basal cells is damaged during D&C, this reduces the regenerative capacity of the endometrium and causes endometrial disruption (3). The main pathophysiology in Asherman's syndrome is the fibrous attachments between the uterine walls as a result of exposing subendometrial layers (4). On the other hand, PAD occurs as a result of the invasion of the placental villies into the myometrium and serosal layer of the uterus in the absence of the endometrial layer (5). Besides, curettage is a risk factor for adenomyosis which is a pathology defined as endometrial glands in the myometrium (6). Endometrial cancer is the most common gynecologic malignancy in high-income countries (7). Endometrial cancer (EC) myometrial invasion was found as an independent risk factor for lymph node (LN) metastasis. Besides, increased CA-125 levels were determined associated with LN metastasis (8). However, the association between previous uterine surgery and endometrial cancer invasion was less investigated. In the literature, there is only one case report that reports endometrial cancer implantation in the cesarean scar (9). D&C destroys the endometrium, moreover, D&C is associated with PADs. However, to our knowledge, there is not any study that investigates the association between endometrial cancer invasion and D&C procedure. From this point of view that, the present study is planned to determine whether there is any link between these two entities mentioned above.

MATERIALS and METHODS

Study population

Clinicopathological data of the patients with the diagnosis of endometrial cancer (EC) who applied to the Dokuz Eylul University Hospital from January 2015 to January 2020 were collected from the hospital database retrospectively. Patients with the diagnosis of primary EC who were performed hysterectomy with bilateral salpingo-oophorectomy and, lymphadenectomy were included in the conducted study. Eligible patients had been undergone detailed physical and gynecological examinations. Patients with insufficient clinicopathological data, or those that were treated with chemotherapy or radiotherapy before the surgery were excluded.

Data collection

Hospital electronic medical record database was used to obtain patients' clinicopathological data. (i) Basic information including age, menopause status, years in menopause, reproductive history, history of cancer in the family, comorbidities, D&C history, and number of D&C. (ii) Histopathological data including tumor grade, histopathological subtype, clinical-stage, depth of myometrial invasion, lymphovascular space invasion (LVSI),

lymph node invasion, and peritoneal cytology. The *International Federation of Gynecology and Obstetrics* (FIGO) - 2009 staging and histologic typing system of WHO were used to determine tumor grade and clinical stage. Endpoints of the present study were clinical-stage, depth of myometrial invasion, LVSI, lymph node invasion, and peritoneal cytology.

Statistical analysis

Mann-Whitney U and T-test were used to analyse the association between categorical and continuous variables. Associations between continuous variables were evaluated by using Pearson and Spearman correlation test. The comparison of proportions was calculated by the chi-square test. P-value <0.05 was considered statistically significant.

All analyses were performed by using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 172 patients were included in the analysis. The clinicopathologic data of the patients were shown in Table-1. Mean ages of the enrolled patients were similar in two groups; mean ages in the history of the D&C group and no history of the D&C group were 63 ± 10 and 62 ± 11 years, respectively. Age, menopausal status, history of cancer in the family, tumor histologic type, and grade were similar between the groups. Endometrioid EC was determined as a major histopathological subtype (68.6%).

Association between endometrial cancer invasion, other invasion-associated parameters, and D&C history was summarized in Table-2. A total of 70 patients were diagnosed with more than 50% myometrial invasion (40.7%), while the rest 102 patients were determined with less than 50% myometrial invasion (59.3%). 42 (24.4%) of the patients whose myometrial invasion more than 50% had at least one D&C history. However, this difference was not found statistically significant (p=0.27). No significant difference was found between the history of performed D&C and LVSI, lymph node invasion, peritoneal cytology, stage (p values were 0.08, 0.43, 0.09, 0.53, respectively).

Association between endometrial cancer invasion, other invasion-associated parameters, and the number of D&C was summarized in Table-3 and Table-4. No significant difference was found between the number of previous D&Cs and myometrial invasion, myometrial invasion associated parameters.

Table-1. Clinicopathologic data of the patients

		History of performed D&C	No history of performed D&C	P value
Age(years) (mean ± SD)		63.8 ± 10.1	62 ± 11.3	0.17
Menopause (years) (mean ± SD)		11.5 ± 9	9.1 ± 9.7	0.06
Menopause status (n (%))	No	17 (9.9)	16 (9.3)	0.08
	Yes	92 (53.5)	47 (27.3)	
History of cancer in family (n (%))	No	97 (56.4)	60 (34.9)	0.13
	Yes	12 (7)	3 (1.7)	
Diabetes status (n (%))	No	74 (43)	44 (25.6)	0.46
	Yes	35 (20.3)	19 (11)	
Tumor histologic type (n (%))	Endometrioid	79 (45.9)	39 (22.7)	0.22
	Musinous	12 (7)	17 (9.9)	
	Serous	10 (5.8)	3 (1.7)	
	Clear cell	2 (1.2)	1 (0.6)	
	Mix type	3 (1.7)	1 (0.6)	
	Carcinosarcoma	1 (0.6)	1 (0.6)	
	Sarcoma	2 (1.2)	1 (0.6)	
Tumor grade (n (%))	1	59 (34.7)	38 (22.4)	0.58
	2	24 (14.1)	15 (8.8)	
	3	24 (14.1)	10 (5.9)	

Table-2. Association between endometrial cancer invasion and D&C history

		History of performed D&C N (%)	No history of performed D&C N (%)	P value
Myometrial invasion	<50%	67 (39.0)	35 (20.3)	0.27
	>50%	42 (24.4)	28 (16.3)	
Lymphovascular space invasion	Negative	58 (33.7)	41 (23.8)	0.08
	Positive	51 (29.7)	22 (12.8)	
Lymph node invasion	Negative	99 (57.6)	56 (32.6)	0.43
	Positive	10 (5.8)	7 (4.1)	
Peritoneal cytology	Negative	96 (55.8)	60 (34.9)	0.09
	Positive	13 (7.6)	3 (1.7)	
Stage	I	68 (39.5)	38 (22.1)	0.53
	II	24 (14)	16 (9.3)	
	III	17 (9.9)	8 (4.7)	
	IV	0 (0)	1 (0.6)	

Table-3. Association between endometrial cancer invasion and number of D&C

		D&C number (mean ± SD)	P value
Myometrial invasion	<50%	2 ± 0.1	0.32
	>50%	1.7 ± 0.1	
Lymphovascular space invasion	Negative	1.8 ± 0.1	0.32
	Positive	1.9 ± 0.1	
Lymph node invasion	Negative	1.9 ± 0.1	0.51
	Positive	1.7 ± 0.2	
Peritoneal cytology	Negative	1.8	0.37
	Positive	2.1 ± 0.3	
Stage	I	1.8 ± 0.1	0.67
	II	2 ± 0.2	
	III	1.8 ± 0.2	
	IV	1	

Table-4. Association between depth percentage of myometrial invasion and number of D&C

	Mean ± SD	P value
Myometrial invasion depth percentage	39.9 ± 31.7	0.24
D&C number	1.9 ± 1.2	

DISCUSSION

EC is the most common gynecologic malignancy in high-income countries and the second most common gynecologic malignancy that follows cervical malignancy in low-income countries (10). Risk factors for endometrial cancer invasion and spread of the disease are subjects that need attention. Magnetic resonance imaging (MRI) is the main radiological preoperative evaluation method to predict the myometrial invasion in EC (11,12). On the other hand, ultrasonography (USG) was detected as a cheaper and effective tool to evaluate myometrial invasion in a study conducted by Lubusky et al (13). Besides, Yildirim et al. showed that 3D- ultrasonography had superior results rather than MRI to determine the myometrial invasion in endometrial cancer (14). Lots of biomarkers were evaluated as an indicator of myometrial invasion in EC by several previous studies (15–17). Cancer Antigen – 125 (CA-125) level and myometrial invasion relation was investigated in another study and a positive significant correlation was determined (18). Moreover, in a study conducted by Zamani et al., it was found that Human Epididymis Protein - 4 (HE-4) and CA-125 levels were significantly higher in EC patients with deeper myometrial invasion (19). Although, the D&C procedure is a risk factor for adenomyosis, two previous studies that evaluated the relation between myometrial cancer invasion and adenomyosis showed that EC patients with adenomyosis had lesser

myometrial invasion rather than EC cases without adenomyosis (20,21). Asherman's syndrome was another proof of being destructive of D&C to the endometrium according to the previous studies (2,22). D&C was claimed as a risk factor for PADs which were defined as the placental invasion anomaly into the myometrium (5,23). A possible reason for that is the destruction of the endometrial layer as the same as the destroyed endometrium due to cesarean section (C/S). Also, a history of C/S surgery was accepted as a major risk factor for PADs (24). In the literature, there was only one case-report that shows the link between C/S as a previous uterine surgery and EC. In this report, the authors mentioned that tumor invading the C/S scar in an EC case (9). Damage to the endometrial basal layer after D&C can result in an endometrial defect, which may lead to increased invasion of endometrial cancer cells into the myometrium. Additionally, some studies have observed myometrial cells in pathological slides following D&C, suggesting direct damage to the myometrium (25). For these reasons, it is generally believed that a history of D&C may contribute to the invasion of endometrial cancer. In the present study, the relationship between previous D&C history and EC myometrial invasion was investigated based on the hypothesis that myometrial invasion was deeper in EC patients with a previous D&C history. However, no statistically significant relation was found.

Similar to the myometrial invasion of EC, LVSI was found to have a significant relation with several biomarkers (26,27). A study conducted by Zhou et al. showed that LVSI was positively correlated with increased CA-125 and fibrinogen levels (28). In another two studies that were performed to found predictive markers for LVSI showed that, deeper myometrial invasion, increased tumor size, increased tumor grade, and high CA-125 levels were associated with increased LVSI (29,30). IUM usage has a theoretically potential risk to facilitate the invasion of the tumor cells to deeper compartments of the uterus by a mechanical effect (31). In the literature, two studies investigated the relation between LVSI and intra-uterine manipulator (IUM) usage. Results of these studies were there was no significant difference regarding LVSI with using IUM (32,33). In the present study, D&C had not a significant effect on LVSI as opposed to the thought of a positive correlation between D&C mechanical effect and LVSI.

LVSI was determined as one of the strongest factors to predict LN metastasis in endometrioid EC (34). According to a study conducted by Widschwendter et al. EC patients with LVSI, non-endometrioid type, and higher tumor stage was associated with increased risk of nodal involvement (35). Another two studies that investigated the associated factors that lead to pelvic and paraaortic LN involvement showed that; risk factors for pelvic lymph node involvement were LVSI, deep myometrial invasion, non-endometrioid histology, positive peritoneal cytology, higher preoperative serum HE4, and CA125 levels; risk factors for paraaortic lymph node involvement were LVSI and pelvic LN involvement (36,37). On the other hand, it can be said that patients without LVSI, deep myometrial invasion, and with normal serum CA-125 levels are at low-risk for nodal involvement (38).

Positive peritoneal cytology was determined associated with the risk factors including tumor size, histologic subtype, myometrial invasion, LN metastasis, and cervical stromal invasion (39). The gold standard for diagnosing endometrial cancer is endometrial biopsy, and D&C remains one of the most reliable methods used for this purpose. Another method, hysteroscopy, is also used. Hysteroscopy fills the intrauterine cavity with fluid, which can lead to tumor cells spreading to the peritoneal cavity through tubal passage. Similarly, although the underlying mechanisms after D&C have not been clearly elucidated, a relationship was found with peritoneal cytology positivity. However, in our study, no significant difference was found in peritoneal cytology positivity between patients who underwent D&C and those who did not (40,41). As a mechanical factor uterine manipulator usage was not found related to an increased risk factor of LVSI and positive peritoneal cytology (42). However, in another previous study, there were several cases with positive peritoneal cytology due to laparoscopic hysterectomy (43).

It is a well-known fact that FIGO 2009 staging system is used to determine the EC staging with the parameters including myometrial invasion, cervical stromal invasion, lymph node metastasis, neighboring organ involvement, and distant metastasis (44). The present study was not found any association between the D&C procedure and the EC stage.

The current study has certain limitations. First, the present study is retrospective. For this reason, the

study population that was investigated was smaller due to missing data from the hospital database. Second, this study was designed as a single tertiary center study. However, if it had been planned as a multi-center study, the number of cases would have been higher and the power of the study could have increased. On the other hand, the strong side of this study is that the present study is the first study to investigate the relation between the D&C procedure and the myometrial invasion and the other possible myometrial invasion associated parameters including LVSI, LN metastasis, peritoneal cytology, and stage.

CONCLUSION

D&C is commonly used to evacuate the pregnancy material or used for endometrial sampling in the field of obstetrics and gynecology. Although the D&C procedure damages the endometrial layer and is known to cause placental adhesion disorders, no study investigating the association between the D&C procedure and endometrial cancer invasion was identified. No significant relationship was found between D&C and endometrial cancer invasion and endometrial cancer spread in our study.

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Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This study was carried out in consensus with our university´s ethics guidelines. The ethics committee approval was obtained for this study (No: 2020/23-21).

References

1. Will AJ, Sanchack KE. Endometrial Biopsy. In Treasure Island (FL); 2020.
2. Dreisler E, Kjer JJ. Asherman's syndrome: current perspectives on diagnosis and management. Int J Womens Health [Internet]. 2019 Mar 20;11:191–8. Available from: https://pubmed.ncbi.nlm.nih.gov/30936754
3. Hu X, Wu H, Yong X et al. Cyclical endometrial repair and regeneration: Molecular mechanisms, diseases, and therapeutic interventions. MedComm. 2023 Dec;4(6):e425.
4. Saribas GS, Ozogul C, Tiryaki M, Alpaslan Pinarli F, Hamdemir Kilic S. Effects of uterus derived mesenchymal stem cells and their exosomes on asherman's syndrome. Acta Histochem. 2020 Jan;122(1):151465.
5. Palova E, Redecha M, Malova A, Hammerova L, Kosibova Z. Placenta accreta as a cause of peripartum hysterectomy. Bratisl Lek Listy. 2016;117(4):212–6.
6. Cunningham RK, Horrow MM, Smith RJ, Springer J. Adenomyosis: A Sonographic Diagnosis. Radiogr a Rev Publ Radiol Soc North Am Inc. 2018;38(5):1576–89.
7. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018 Nov;68(6):394–424.
8. Sarı ME, Meydanlı MM, Yalçın I, et al. Risk Factors for Lymph Node Metastasis among Lymphovascular Space Invasion-Positive Women with Endometrioid Endometrial Cancer Clinically Confined to the Uterus. Oncol Res Treat [Internet]. 2018;41(12):750–4. Available from: https://www.karger.com/DOI/10.1159/000492585
9. Baba T, Mandai M, Yamanishi Y, Suzuki A, Kang HS, Konishi I. Endometrial cancer implanted within a cesarean section scar. J Obstet Gynaecol Res. 2011 Mar;37(3):245–9.
10. Siegel R, Ward E, Brawley O, Jemal A. Cancer statistics, 2011: the impact of eliminating socioeconomic and racial disparities on premature cancer deaths. CA Cancer J Clin. 2011;61(4):212–36.
11. Woo S, Kim SY, Cho JY, Kim SH. Assessment of deep myometrial invasion of endometrial cancer on MRI: added value of second-opinion interpretations by radiologists subspecialized in gynaecologic oncology. Eur Radiol. 2017 May;27(5):1877–82.

12. Beddy P, Moyle P, Kataoka M, et al. Evaluation of depth of myometrial invasion and overall staging in endometrial cancer: comparison of diffusion-weighted and dynamic contrast-enhanced MR imaging. Radiology. 2012 Feb;262(2):530–7.
13. Lubuský M, Dzvincuk P, Pilka R, et al. [Preoperative assessment of myometrial invasion in endometrial cancer patients by ultrasonography and magnetic resonance imaging (MRI)]. Ces Gynekol. 2006 Sep;71(5):394–8.
14. Yildirim N, Saatli B, Kose S, et al. Predictability of myometrial, lower uterine segment and cervical invasion with 3D transvaginal ultrasonography and magnetic resonance imaging in endometrial cancer patients: a prospective cohort study. Med Ultrason. 2018 Aug;20(3):348–54.
15. Park JY, Hong D, Park JY. Association between Morphological Patterns of Myometrial Invasion and Cancer Stem Cell Markers in Endometrial Endometrioid Carcinoma. Pathol Oncol Res. 2019 Jan;25(1):123–30.
16. Hsiao SM, Chen MW, Chen CA, et al. The H3K9 Methyltransferase G9a Represses E-cadherin and is Associated with Myometrial Invasion in Endometrial Cancer. Ann Surg Oncol. 2015 Dec;22 Suppl 3:S1556-65.
17. Chen L, Mao X, Huang M, Lei H, Xue L, Sun P. PGC-1α and ERRα in patients with endometrial cancer: a translational study for predicting myometrial invasion. Aging (Albany NY). 2020 Sep;12(17):16963–80.
18. Atguden Z, Yildiz A, Aksut H, et al. The Value of Preoperative CA 125 Levels in Prediction of Myometrial Invasion in Patients with Early-stage Endometrioid- type Endometrial Cancer. Asian Pac J Cancer Prev. 2016;17(2):497–501.
19. Zamani N, Modares Gilani M, Zamani F, Zamani MH. Utility of Pelvic MRI and Tumor Markers HE4 and CA125 to Predict Depth of Myometrial Invasion and Cervical Involvement in Endometrial Cancer. J Fam Reprod Heal. 2015 Nov;9(4):177–83.
20. Machida H, Maeda M, Cahoon SS, et al. Endometrial cancer arising in adenomyosis versus endometrial cancer coexisting with adenomyosis: are these two different entities? Arch Gynecol Obstet. 2017 Jun;295(6):1459–68.
21. Erkilinç S, Taylan E, Gülseren V, et al. The Effect of Adenomyosis in Myometrial Invasion and Overall Survival in Endometrial Cancer. Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2018 Jan;28(1):145–51.
22. Tchente NC, Brichant G, Nisolle M. [Asherman's syndrome : management after curettage following a postnatal placental retention and literature review]. Rev Med Liege. 2018 Oct;73(10):508–12.
23. Héquet D, Ricbourg A, Sebbag D, Rossignol M, Lubrano S, Barranger E. [Placenta accreta: screening, management and complications]. Gynecol Obstet Fertil. 2013 Jan;41(1):31–7.
24. Silver RM, Barbour KD. Placenta accreta spectrum: accreta, increta, and percreta. Obstet Gynecol Clin North Am. 2015 Jun;42(2):381–402.
25. Beuker JM, Erwich JJHM, Khong TY. Is endomyometrial injury during termination of pregnancy or curettage following miscarriage the precursor to placenta accreta? J Clin Pathol. 2005 Mar;58(3):273–5.
26. Imboden S, Tapia C, Scheiwiller N, et al. Early-stage endometrial cancer, CTNNB1 mutations, and the relation between lymphovascular space invasion and recurrence. Acta Obstet Gynecol Scand. 2020 Feb;99(2):196–203.
27. Watanabe T, Honma R, Kojima M, et al. Prediction of lymphovascular space invasion in endometrial cancer using the 55-gene signature selected by DNA microarray analysis. PLoS One. 2019;14(9):e0223178.
28. Zhou X, Wang H, Wang X. Preoperative CA125 and fibrinogen in patients with endometrial cancer: a risk model for predicting lymphovascular space invasion. J Gynecol Oncol. 2017 Mar;28(2):e11.
29. Meydanli MM, Aslan K, Öz M, Muftuoglu KH, Yalcin I, Engin-Ustun Y. Is It Possible to Develop a Prediction Model for Lymphovascular Space Invasion in Endometrioid Endometrial Cancer? Int J Gynecol Pathol Off J Int Soc Gynecol Pathol. 2020 May;39(3):213–20.
30. Capozzi VA, Sozzi G, Uccella S, et al. Novel preoperative predictive score to evaluate lymphovascular space involvement in endometrial cancer: an aid to the sentinel lymph node algorithm. Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2020 Jun;30(6):806–12.

31. Logani S, Herdman A V, Little J V, Moller KA. Vascular “pseudo invasion” in laparoscopic hysterectomy specimens: a diagnostic pitfall. Am J Surg Pathol. 2008 Apr;32(4):560–5.

32. Hopkins MR, Richmond AM, Cheng G, et al. Lymphovascular space invasion in robotic surgery for endometrial cancer. JSLS J Soc Laparoendosc Surg. 2014;18(3).

33. Machida H, Hom MS, Adams CL, et al. Intrauterine Manipulator Use During Minimally Invasive Hysterectomy and Risk of Lymphovascular Space Invasion in Endometrial Cancer. Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2018 Feb;28(2):208–19.

34. Stålberg K, Bjurberg M, Borgfeldt C, et al. Lymphovascular space invasion as a predictive factor for lymph node metastases and survival in endometrioid endometrial cancer - a Swedish Gynecologic Cancer Group (SweGCG) study. Acta Oncol. 2019 Nov;58(11):1628–33.

35. Widschwendter P, Bauer E, De Gregorio N, et al. Influence of Prognostic Factors on Lymph Node Involvement in Endometrial Cancer: A Single-Center Experience. Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2018 Jul;28(6):1145–52.

36. Sari ME, Yalcin İ, Sahin H, Meydanli MM, Gungor T. Risk factors for paraaortic lymph node metastasis in endometrial cancer. Int J Clin Oncol. 2017 Oct;22(5):937–44.

37. Momtahan M, Hosseini M, Robati M, Najib F. Predictive Value of Kanagawa Cancer Center Scoring System for Lymph Node Metastasis and Need for Lymphadenectomy in Patients With Endometrial Cancer: A Validation Study. Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2018 Sep;28(7):1290–6.

38. Anton C, E Silva AS, Baracat EC, et al. A novel model to estimate lymph node metastasis in endometrial cancer patients. Clinics (Sao Paulo). 2017 Jan;72(1):30–5.

39. Cetinkaya K, Atalay F. Peritoneal cytology in endometrial cancer. Tumori. 2015;101(6):697–700.

40. Ben-Arie A, Tamir S, Dubnik S, et al. Does hysteroscopy affect prognosis in apparent early-stage endometrial cancer? Int J Gynecol cancer Off J Int Gynecol Cancer Soc. 2008;18(4):813–9.

41. Al-Talib A, Nezhat F, Tulandi T. The role of hysteroscopy in diagnosis and management of endometrial cancer. Gynecol Surg [Internet]. 2010;7(3):211–6. Available from: https://doi.org/10.1007/s10397-010-0604-1

42. Zhang C, Havrilesky LJ, Broadwater G, et al. Relationship between minimally invasive hysterectomy, pelvic cytology, and lymph vascular space invasion: a single institution study of 458 patients. Gynecol Oncol. 2014 May;133(2):211–5.

43. Tanaka T, Terai Y, Maeda K, et al. Intraperitoneal cytology after laparoscopic hysterectomy in patients with endometrial cancer: A retrospective observational study. Medicine (Baltimore). 2017 Jul;96(27):e7502.

44. Abu-Rustum NR, Zhou Q, Iasonos A, et al. The revised 2009 FIGO staging system for endometrial cancer: should the 1988 FIGO stages IA and IB be altered? Int J Gynecol Cancer [Internet]. 2011 Apr;21(3):511–6. Available from: https://pubmed.ncbi.nlm.nih.gov/21436699