

Postoperative Ovarian Reservation Salpingectomy with Ovarian Preservation during Hysterectomy based on AMH Measurement Before and After Surgery: A Systematic Review and Meta-analysis

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Abstract

Introduction: To the best of our knowledge, there is no strong evidence for the effect of salpingectomy on the surgical outcome of a standard hysterectomy. Therefore, we decided to conduct a study entitled ovarian reservation after salpingectomy with ovarian preservation during hysterectomy based on AMH measurements before and after surgery as a review until 2019.

Materials and Methods: In addition to the 503 studies found in the initial database search, two more studies identified through a reference list of related articles and a Google Scholar search were added. After removing duplicates, the titles and abstracts of the remaining 475 studies were reviewed and 30 studies were selected to review the full text. Then seven studies were deleted and finally 12 studies were reviewed and 11 of them were meta-analyzed.

Results: AMH levels before and after salpingectomy were compared with patients in 12 studies. Compared with AMH before salpingectomy, AMH levels after salpingectomy were significantly lower (SMD = -0.35); 95% confidence interval (CI95%): -0.55 - -0.15 (p = 0.001). The results of studies on differences in AMH levels before and after salpingectomy did not show a statistically significant diffusion bias (Egger's P-value = 0.304).

Conclusion: The present study showed that the level of AMH hormone was significantly reduced after salpingectomy. One of the limitations of the present study was the lack of surgical complications, the amount of intraoperative bleeding and the duration of surgery in most studies.

Keywords: Salpingectomy, AMH, Hysterectomy.

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INTRODUCTION

Salpingectomy has been one of the most prevalent surgical procedures in gynecological surgery globally since its debut by Lawson Tait. Ectopic pregnancy and salpingitis are both common causes (for example symptomatic hydro- or pyosalpinx). Salpingectomy for women with asymptomatic hydrosalpinx who require in vitro fertilization (IVF) has lately been commonly acceptable. Salpingectomy is also becoming more common during hysterectomy in women who want to keep their ovaries because new data suggests that ovarian cancer has a tubal genesis [1-7].

Because of the near closeness of the tubal and ovarian arteries, there has been increased worry over

salpingectomy's potentially harmful effect on ovarian reserve. As a result, it has been proposed that salpingectomy could disrupt ovarian blood supply, affecting ovarian blood flow and resulting in a decrease in ovarian reserve. A prior study indicating post-salpingectomy reduction of ovarian blood flow on the operated side supports this theory. Following Filshie clip sterilization, another study revealed an increase in vascular resistance in the ovarian arteries [4-10].

Because the majority of women who need a salpingectomy are still young and want to keep their fertility, it will be crucial to assess any prospective ovarian reserve impairment. This will benefit both the practitioner and the

patient when deciding whether or not a salpingectomy is necessary [8-10].

Despite the fact that there are multiple indicators for ovarian reserve, the circulating anti-Müllerian hormone (AMH) is currently widely accepted as the most trustworthy test. It has been discovered to be highly correlated with the actual histological count of ovarian follicles. Furthermore, the relatively minor changes in ovarian reserve following salpingectomy make blood AMH a suitable measure for detecting relatively small changes in ovarian reserve following salpingectomy [9-12].

Several studies have been conducted to date on the effect of salpingectomy on ovarian reserve. Given the small sample sizes of these investigations, more evidence is needed to resolve this critical issue. As a result, the goal of this meta-analysis was to see how salpingectomy affected ovarian reserve as measured by serum AMH levels.

MATERIAL AND METHOD

Type of Study

This study is a systematic review and meta-analysis study to evaluate the findings of studies that have studied ovarian reservation after salpingectomy with ovarian preservation during hysterectomy based on AMH measurements before and after surgery.

Procedure

For this systematic review, first the search resources and strategy were prepared, and after conducting the search, the obtained studies were screened in terms of meeting the inclusion criteria, and finally the full text of the remaining studies that met the inclusion criteria by Two separate researchers were examined so that after assessing the risk of their bias, the required data were extracted and used in the analysis. According to the present study, articles published in foreign and domestic journals regarding ovarian reservation after salpingectomy with ovarian preservation during hysterectomy will be searched based on AMH measurement before and after surgery. In order to access related articles from national databases such as: Embase, Cochrane, Pubmed, Scopus and Google Scholar search engine with The keywords hysterectomy, ovarian reservation, salpingectomy and AMH were searched in Persian and their English equivalents. After reviewing the inclusion and exit criteria, the quality of the entered studies was measured and the required information was extracted from the qualified studies.

Inclusion and Exclusion Criteria

The following were the inclusion criteria:

1. Cross-sectional studies or cohorts

2. Studies comparing AMH data from patients before and after salpingectomy or reporting complications of this method.

The following were the exclusion criteria:

1. Reviews, letters to editors, animal studies, case collections, and case reports.
2. Studies with similar data unrelated to the objectives.
3. Failure to evaluate the level of AMH before and after salpingectomy with hysterectomy.

Search Strategies

The following commands were used in English sources as the basic search strategy.

("AMH" [All Fields] OR "anti mullerian hormone" [All Fields]) AND ("salpingectomy" [MeSH Terms] OR "salpingectomy" [All Fields] OR "salpingectomies" [All Fields]).

The following keyword combinations were used to search Persian databases.

("AMH" [all fields] or "anti-molar hormone" [all fields]) and ("salpenectomy" [MeSH condition] or "salpenectomy" [all fields] or "salpenectomy" [all fields]).

Evaluate the Quality of Studies

All collected articles were directly reviewed by two researchers in terms of methodological quality and articles with strong differences and minimum criteria for critical evaluation of articles were excluded and the disagreement between the two researchers was left to the third expert. The articles were designed by the researchers according to the study conditions and the type of study and based on the Cochrane guide using the Group Review Back C (CBRG) criteria. Based on this, the received score varies between 0 and 11 so that the score is less than 3. It has a low quality and between 3 and 6 indicates the average quality of the article and a high score of 6 indicates the quality of the article and also critical tools and studies were used.

Data Collection Tools

Data Extraction: At this stage, two researchers independently extracted the following data from the studies and entered them separately in Excel software and professors. The disagreement was left to the third expert.

Indicators extracted from the articles: Name of the first author, year of publication, sample size, antimullerian hormone level before and after salpingectomy with hysterectomy, duration of operation, bleeding volume, complications of salpingectomy.

Statistical Analysis

Data were analyzed using STATA software version 12. The normality of the data was assessed using K.s test and Q-Q

plot diagram. Frequency (percentage) was used to describe qualitative data, mean (standard deviation) was used for quantitative data, and median (25th and 75th percentiles) was used for non-normality. Forest Plot diagram was used to analyze the articles. A funnel diagram was used to prevent publication bias.

Differences in preoperative and postoperative AMH were assessed using a standardized mean difference (SMD) with a 95% confidence interval (CI). Mean, range or IQR was used to calculate the mean and standard deviation. Chi-square test (χ^2) and I² statistic were used to determine the degree of heterogeneity between the study results and I² statistic was used to determine the amount of inconsistency during the study.

27 I²75% and P-value test (χ^2) 0.05 were considered significant heterogeneity of findings. A meta-analysis of random effects was chosen in this study because both heterogeneities were significant between studies.

To detect potential diffusion bias, funnel diagram and Egger linear regression test were used and cases with P-value < 0.05 were considered to have significant diffusion

bias. STATA 12.0 software (Stata Corporation, College Station, TX, USA) was used for statistical analysis. Statistical significance was defined as the value of P less than 0.05.

RESULT

Select Studies

Figure 1 shows the process of identifying and selecting research evidence in this systematic review. In addition to the 503 studies found in the initial database search, two more studies identified through a reference list of related articles and a Google Scholar search were added. After removing duplicates, the titles and abstracts of the remaining 475 studies were reviewed and 30 studies were selected to review the full text. Then seven studies were omitted and finally 11 of them were meta-analyzed.

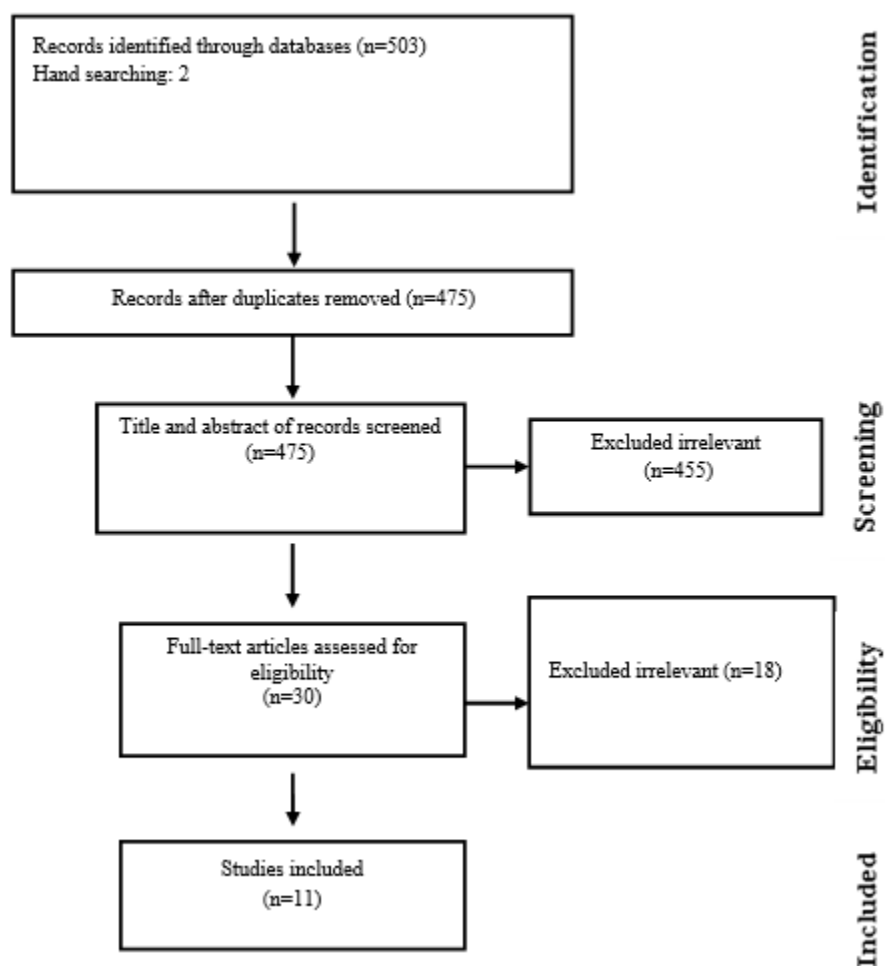


Figure 1. Flow chart of study selection for inclusion in the systematic review

Meta-analysis of Differences between AMH Levels Before and After Salpingectomy

AMH levels before and after salpingectomy were compared with patients in 11 studies. Compared with AMH before

salpingectomy, AMH levels after salpingectomy were significantly lower (SMD = -0.35); 95% confidence interval (CI95%) = 0.55 - up to 0.15- (P = 0.001) (Figure 2).

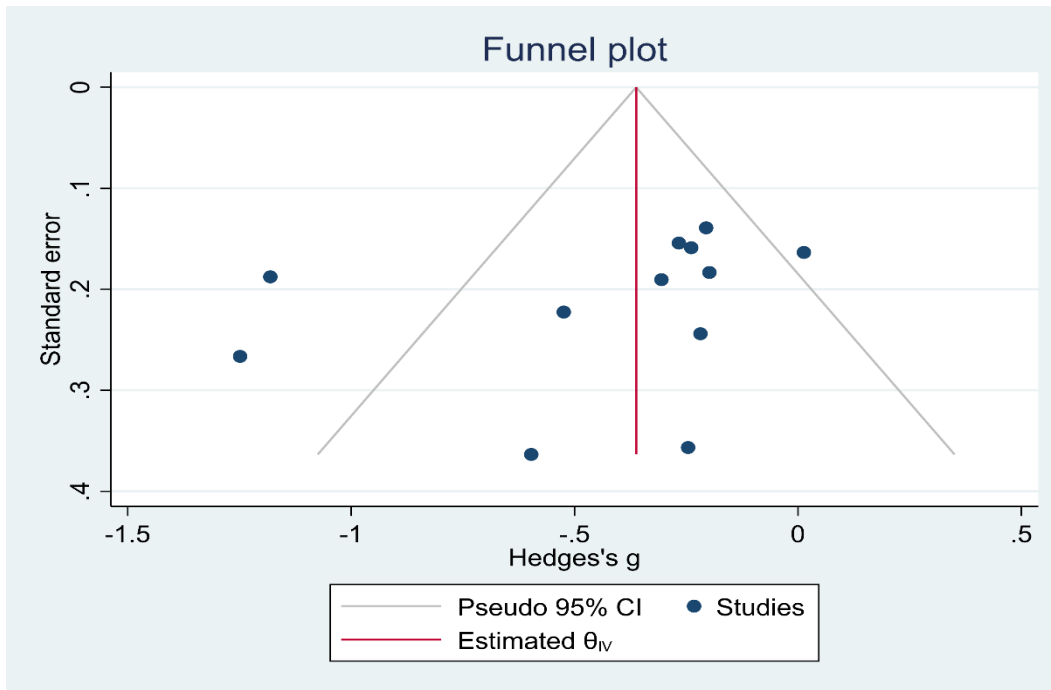


Figure 2: Examining the bias of studies with fan-plot diagrams

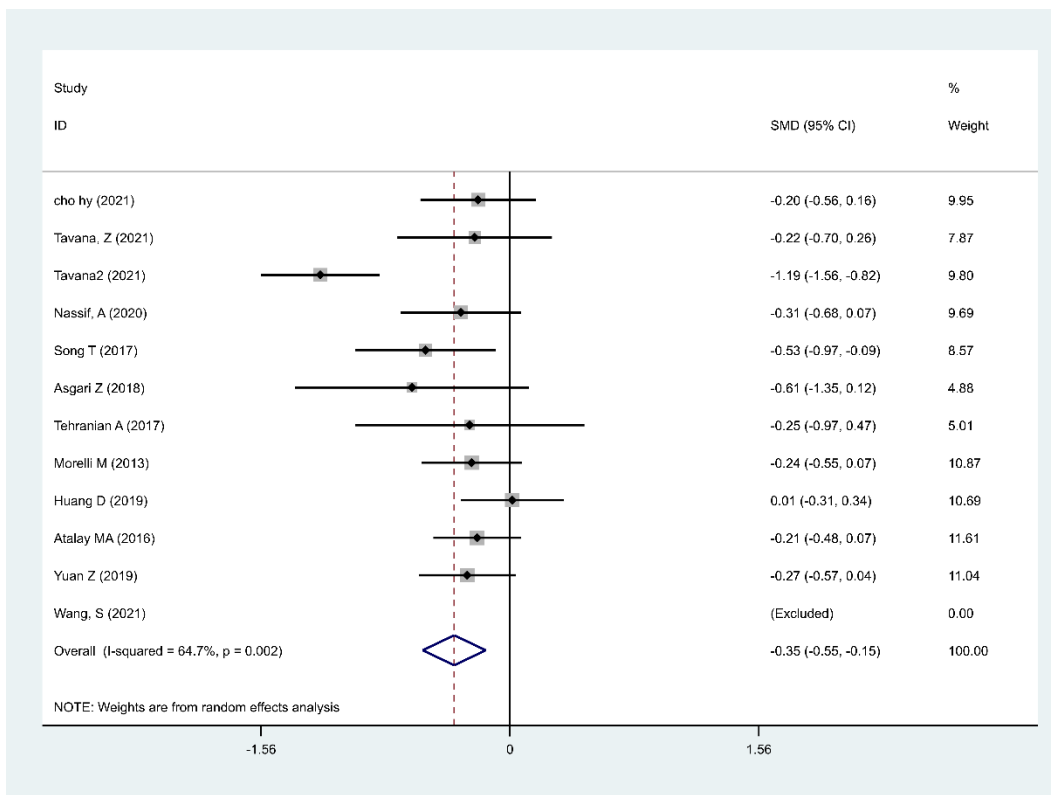


Figure 3: Results of meta-analysis of AMH differences before and after salpingectomy

Table 1: Details of studies included in the meta-analysis

	year	Patients age	n	Duration of operation	AMH Pre operation	AMH Post operation	Post-operative complication	Bleeding volume
Cho HY	2021	44/1 ± 3/73	59		1/1± 1/72	0/8±1/25		
Tavana, Z	2021	45/15 ± 3/79	33		0/40 ±0/55	0/29±0/44		114/5± 12/3
		44/57± 63/3	33		0/92± 1/23	0/15±0/31		304/2 ± 28/8
Wang, S	2021	41/54± 2/67	373	92/89±41/84	0/87± 0/47	0/45±0/00		86/90±49/12
Nassif, A	2020	45/63 ± 8/51	55	140 ± 80	0/6 ± 0/51	0/57±0/21	%23/6	350± 230
Song T	2017	43/1± 2/3	41	79 ±25	1/2± 0/86	0/88±54/0	%4/2	94 ±43
Asgari Z	2018	8/39± 3/72	15		0/1 ± 0/3	0/8± 0/35		
Tehrani A	2017	39/8 ± 3/72	15	54/22± 0/33	1/2 ± 0/9	0/97 ± 0/92		12/15± 0/66
Morelli M	2013	45/8 ± 2/4	79	81/7 ±14/8	0/49 ± 0/4	0/42±0/1	0	
Huang D	2019	31/01 ± 4/31	74		2/75 ±1/52	2/77 ± 1/49		
Atalay MA	2016	42±7	103		11/07	10/24		35/6± 8/3
Yuan Z	2019	41/61 ± 0/62	84		1/63	1/14± 1/44		

Dissemination Bias and Small Study Effect

The results of studies on differences in AMH levels before and after salpingectomy did not show a statistically significant diffusion bias (Egger's P-value test = 0.304).

DISCUSSION

Hysterectomy is a major surgical procedure that is the second most common in the United States, behind cesarean section [1,2]. By assessing serum AMH levels, the first purpose of this study was to examine if ovarian reserve was swiftly depleted following hysterectomy with bilateral ovarian preservation, and the results showed that postoperative AMH levels were significantly lower than preoperative levels in all of the individuals.

It's uncertain if hysterectomy with ovarian preservation improves ovarian reserve [3]. The assessment of ovarian reserve using serial AMH level measurement is thought to be a useful tool for evaluating ovarian function after hysterectomy [3,11], and several studies have been conducted to see if the postoperative AMH level drops when compared to the preoperative level, but the results are mixed [11,12,13,14,15,16,17]. According to several studies, hysterectomy with ovarian preservation can hasten ovarian failure [8,9,10]. According to Ahn et al. [10], the average age of women who had hysterectomy (46.3 3.0 years) was considerably lower than the control group (48.1 3.2 years).

The causes for the decline in postoperative ovarian reserve after a simple hysterectomy, even when both ovaries are maintained, are unknown. The blockage of the ovarian

branch of the uterine artery, which leads to the disruption of blood supply to the ovaries [3,11,12], is one widely recognized theory for why ovarian reserve decreases after hysterectomy. The decrease in ovarian reserve after hysterectomy, according to Atabekolu et al. [11], could be related to acute hypoxia in the ovaries caused by the interruption of the uterine arteries during surgery. However, based on Doppler ultrasonography data, Lee et al. [12] found that hysterectomy had no effect on ovarian arterial blood flow indices (pulsatile and resistance indices).

According to Doppler ultrasonography findings, hysterectomy had no effect on ovarian arterial blood flow indices (pulsatile and resistive indices). Furthermore, this hypothesis hardly explains why postoperative ovarian reserve changes differ depending on the type of hysterectomy used in investigations.

The second idea is that the electro-thermal radiation from laparoscopic surgery instruments like bipolar forceps or LigaSure can have negative effects on ovarian tissue and vasculature, resulting in further ovarian function loss. Only one study that we are aware of compared changes in ovarian reserve after laparoscopic hysterectomy (LH) versus non-laparoscopic hysterectomy (NLH) (non-LH). Cho et al. [18] They compared the occurrence of a substantial drop in blood AMH levels at postoperative 2 months in the LH (total LH or LAVH) and non-LH (vaginal hysterectomy or AH) groups (43.9 percent vs. 20.0 percent). They claimed that electro-thermal devices used to control bleeding during laparoscopic surgery can cause additional ovarian function loss, which is similar to our findings. After laparoscopic

cystectomy for endometrioma, two investigations found that the rate of reduction of AMH levels in the bipolar group was considerably higher than in the suture group [19,20], supporting this concept. The postoperative fall of serum AMH level in the LAVH group was larger than that in the AH group in the Cho et al trial. [18]

A prospective cohort study of 83 individuals with symptomatic uterine fibroids who had LH with both ovaries preserved found that serum AMH levels were considerably lower four months following LH [15]. Abdelazim et al. [16] found that the preoperative AMH level (1.75 4.61 ng/mL) of the 220 women investigated did not differ substantially from the AMH level 6 and 12 months after AH (1.78 2.45 ng/mL and 1.81 2.19 ng/mL, respectively).

Only AMH levels were used as an indication of ovarian reserve in this meta-analysis study. Of course, AMH is the most informative ovarian reserve marker, and serum AMH measurement is useful for counseling patients about ovarian reserve change after gynecological surgery, but it would have been better if we had included other ovarian reserve indicators in our study, such as FSH or antral follicle counts.

It's challenging to know when the best moment is to examine early postoperative ovarian reserve loss after gynecologic surgery. It's possible that an AMH measurement taken 7-30 days after surgery was too early to assess the impact of surgery on ovarian reserve. The majority of previous studies took repeated AMH measurements at least 1 week after surgery [21]. However, Griesinger et al. [22] found that serum AMH levels drop to the minimal detection limit within 84 hours after bilateral oophorectomy. This finding backs up a prior study's idea that 3 days following surgery could be an appropriate time point for assessing early postoperative ovarian reserve loss.

In conclusion, our findings imply that hysterectomy has an immediate effect on ovarian reserve reduction, and that this effect may be affected by the type of surgery used. The ovarian reserve may be harmed further by electro-thermal energy from laparoscopic surgical devices. To corroborate these preliminary findings, more prospective large-scale trials are needed.

One of the strengths of the current study is the extensive search in various information sources based on the search strategy, which has led to studies that have the conditions to enter this systematic review and also the review of studies has been done based on valid guidelines. The same tools are used.

In the studied studies, heterogeneity in the studied population and non-uniformity of the measured outcomes and differences in the measurement time of AMH have reduced the quality of meta-analysis of the findings of these studies.

In general, the evidence from this meta-analysis was low because most of the studies were of low methodological quality and in most cases were not accurate enough due to

limitations due to the quality of the study methodology and differences in the parameters. For this reason, in order to obtain credible evidence, as in any systematic review study, it is necessary to exclude some studies in the search process.

CONCLUSION

The present study showed that the level of AMH was significantly reduced after salpingectomy. One of the limitations of the present study was the lack of surgical complications, the amount of intraoperative bleeding and the duration of surgery in most studies. However, due to the benefits of salpenectomy such as reducing the risk of ovarian cancer, salpenectomy along with hysterectomy is still recommended according to the patient's condition and with the patient's consent.

AUTHOR CONTRIBUTION

All authors contributed to the study conception and design. Material preparation, data collection and acquisition were performed by all authors. All authors read and approved the final manuscript.

COMPLIANCE WITH ETHICAL STANDARDS

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Informed Consent: Informed consent was obtained from the participant prior to the study for publication of this article.

Conflict of Interests: The authors declare no potential conflict of interest.

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REFERENCES

- Cho HY, Kyung MS. Comparison of Postoperative Ovarian Reserve Function Following Laparoscopic Hysterectomy and Laparoscopic Myomectomy: A Prospective Comparative Pilot Study. *J Clin Med.* 2021; 10(14): 3077. Published 2021 Jul 12. doi: 10.3390/jcm10143077
- Tavana, Z., Askary, E., Poordast, T. et al. Does laparoscopic hysterectomy + bilateral salpingectomy decrease the ovarian reserve more than total abdominal hysterectomy? A cohort study, measuring anti-Müllerian hormone before and after surgery. *BMC Women's*

- Health 21, 329 (2021). <https://doi.org/10.1186/s12905-021-01472-5>
- Wang, S., Gu, J. The effect of prophylactic bilateral salpingectomy on ovarian reserve in patients who underwent laparoscopic hysterectomy. *J Ovarian Res* 14, 86 (2021). <https://doi.org/10.1186/s13048-021-00825-w>
- Yuan Z, Cao D, Bi X, Yu M, Yang J, Shen K. The effects of hysterectomy with bilateral salpingectomy on ovarian reserve. *International Journal of Gynecology & Obstetrics*. 2019 May; 145(2): 233-8.
- Atalay MA, Demir BC, Ozerkan K. Change in the ovarian environment after hysterectomy with bilateral salpingectomy: is it the technique or surgery itself?. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2016 Sep 1; 204: 57-61.
- Asgari Z, Tehrani A, Rouholamin S, Hosseini R, Sepidarkish M, Rezaeinejad M. Comparing surgical outcome and ovarian reserve after laparoscopic hysterectomy between two methods of with and without prophylactic bilateral salpingectomy: A randomized controlled trial. *Journal of cancer research and therapeutics*. 2018 Apr 1; 14(3): 543.
- Huang D, Zhu Y, Chen J, Zhang S. Effect of modified laparoscopic salpingectomy on ovarian reserve: Changes in the serum antimüllerian hormone levels. *Laparoscopic, Endoscopic and Robotic Surgery*. 2019 Mar 1; 2(1): 8-11.
- Morelli M, Venturella R, Mocciano R, Di Cello A, Rania E, Lico D, D'Alessandro P, Zullo F. Prophylactic salpingectomy in premenopausal low-risk women for ovarian cancer: primum non nocere. *Gynecologic oncology*. 2013 Jun 1; 129(3): 448-51.
- Tehrani A, Zangbar RH, Aghajani F, Sepidarkish M, Rafiei S, Esfidani T. Effects of salpingectomy during abdominal hysterectomy on ovarian reserve: a randomized controlled trial. *Gynecol Surg.*, 2017; 14(1):17. doi: 10.1186/s10397-017-1019-z
- Song T, Lee SH, Kim WY, Heo EJ, Kim TJ. Opportunistic salpingectomy does not affect ovarian reserve or surgical outcomes in patients undergoing laparoscopic myomectomy. *Gynecologic and obstetric investigation*. 2017; 82(5): 468-74.
- Nassif, A., Elnory, M. Impact of prophylactic bilateral salpingectomy on ovarian reserve in women undergoing vaginal hysterectomy: A randomized controlled trial. *Evidence Based Women's Health Journal*, 2020; 10(2): 150-161. doi: 10.21608/ebwhj.2020.22949.1074
- Lee DY, Park HJ, Kim BG, Bae DS, Yoon BK, Choi D. Change in the ovarian environment after hysterectomy as assessed by ovarian arterial blood flow indices and serum anti-Müllerian hormone levels. *Eur J Obstet Gynecol Reprod Biol.*, 2010; 151: 82-85.
- Wang HY, Quan S, Zhang RL, Ye HY, Bi YL, Jiang ZM, et al. Comparison of serum anti-Müllerian hormone levels following hysterectomy and myomectomy for benign gynaecological conditions. *Eur J Obstet Gynecol Reprod Biol.*, 2013; 171: 368-371.
- Trabuco EC, Moorman PG, Algeciras-Schimnich A, Weaver AL, Cliby WA. Association of ovary-sparing hysterectomy with ovarian reserve. *Obstet Gynecol*. 2016; 127: 819-827.
- Yuan H, Wang C, Wang D, Wang Y. Comparing the effect of laparoscopic supracervical and total hysterectomy for uterine fibroids on ovarian reserve by assessing serum anti-müllerian hormone levels: a prospective cohort study. *J Minim Invasive Gynecol*. 2015; 22: 637-641.
- Abdelazim IA, Abdelrazak KM, Elbiaa AA, Farghali MM, Essam A, Zhurabekova G. Ovarian function and ovarian blood supply following premenopausal abdominal hysterectomy. *Prz Menopausalny*, 2015; 14: 238-242.
- Hehenkamp WJ, Volkers NA, Broekmans FJ, de Jong FH, Themmen AP, Birnie E, et al. Loss of ovarian reserve after uterine artery embolization: a randomized comparison with hysterectomy. *Hum Reprod.*, 2007; 22: 1996-2005.
- Cho HY, Park ST, Kyung MS, Park SH. Assessment of ovarian reserve after hysterectomy: laparoscopic vs. non-laparoscopic surgery. *Eur J Obstet Gynecol Reprod Biol.*, 2017; 210: 54-57.
- Song T, Kim WY, Lee KW, Kim KH. Effect on ovarian reserve of hemostasis by bipolar coagulation versus suture during laparoscopic single-site cystectomy for ovarian endometriomas. *J Minim Invasive Gynecol.*, 2015; 22: 415-420.
- Fedele L, Bianchi S, Zanconato G, Bergamini V, Berlanda N. Bipolar electrocoagulation versus suture of solitary ovary after laparoscopic excision of ovarian endometriomas. *J Am Assoc Gynecol Laparosc.*, 2004; 11: 344-347.
- Chun S, Cho HJ, Ji YI. Comparison of early postoperative decline of serum antiMüllerian hormone levels after unilateral laparoscopic ovarian cystectomy between patients categorized according to histologic diagnosis. *Taiwan J Obstet Gynecol.*, 2016; 55: 641-645.
- Griesinger G, Dafopoulos K, Buendgen N, Cascorbi I, Georgoulas P, Zavos A, et al. Elimination half-life of anti-Müllerian hormone. *J Clin Endocrinol Metab.*, 2012; 97: 2160-2163.
- Chang HJ, Han SH, Lee JR, Jee BC, Lee BI, Suh CS, et al. Impact of laparoscopic cystectomy on ovarian reserve: serial changes of serum anti-Müllerian hormone levels. *Fertil Steril.*, 2010; 94: 343-349.