Review / Derleme

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A meta-analysis of fertility and adverse outcomes in oil- and water-based contrast for hysterosalpingography

Histerosalpingografide kullanılan yağ ve su bazlı kontrast maddenin doğurganlık ve olumsuz sonuçlar üzerine etkisinin meta-analizi

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Abstract

Infertility is the inability to conceive after one year of regular unprotected intercourse. There is a debate about the therapeutic effect of hysterosalpingography (HSG) and whether the selection of contrast materials makes a difference in the chance of subsequent conception. In this study, we aimed to compare the fertility-enhancing outcomes and adverse effects of oil and water-based contrasts in patients who underwent HSG. This systematic review and meta-analysis was conducted following the PRISMA guidelines. We searched the Web of Science, PubMed, and Scopus until September 2022. We included all primary randomized controlled trials evaluating the fertility-enhancing benefits of HSG in oil-based versus water-based contrast media in women of childbearing age with infertility. Eleven studies with 4,739 patients were selected. The pregnancy rate in the oil group was significantly higher than that in the water group [odds ratio (OR)=1.51 (1.23, 1.86), p<0.0001]. Our meta-analysis favored the oil group in abdominal pain and vaginal bleeding with the odd ratios of 0.73 (0.58, 0.91), (p=0.006) and 0.91 (0.46, 1.81), (p=0.79), respectively. Water-based contrast was associated with less intravasation [OR=2.09 (1.09-4.02), p=0.03]. There were no differences between the contrasts for miscarriage [OR=1.02 (0.71, 1.46), p=0.92], and ectopic pregnancy [OR=0.84 (0.27, 2.63), p=0.77]. HSG with oil-based contrast was related to a higher pregnancy rate, live birth rate, and intravasation rate. While HSG using a water-based contrast medium was associated with increased abdominal discomfort, vaginal bleeding, and the visual-analogue scale pain score.

Keywords: Hysterosalpingography, infertility, contrast media, pregnancy outcome

Öz

Kısırlık, bir yıl düzenli korunmasız ilişkiden sonra gebe kalamama durumudur. Histerosalpingografinin (HSG) terapötik etkisi ve kontrast madde seçiminin sonraki gebe kalma şansı üzerinde bir fark yaratıp yaratmadığı konusunda bir tartışma vardır. Bu çalışmada, HSG uygulanan hastalarda yağ ve su bazlı kontrastların doğurganlığı artırıcı sonuçlarını ve yan etkilerini karşılaştırmayı amaçladık. Bu sistematik inceleme ve meta-analiz, PRISMA yönergeleri izlenerek yapılmıştır. Eylül 2022'ye kadar Web of Science, PubMed ve Scopus'ta arama yapılmıştır. Kısırlığı olan doğurganlık çağındaki kadınlarda su bazlı ve yağ bazlı kontrast maddelerin kullanıldığı HSG uygulamalarının doğurganlığı artıran faydalarını karşılaştıran tüm primer randomize kontrollü çalışmalar dahil edilmiştir. Dört bin yedi yüz otuz dokuz hasta ile 11 çalışma dahil edilmiştir. Yağ grubundaki gebelik oranı, su grubundan anlamlı olarak yüksekti [tahmini rölatif risk (RR)=1,51 (1,23, 1,86), p<0,0001]. Meta-analizimiz, sırasıyla 0,73 (0,58, 0,91), (0,006) ve 0,91 (0,46, 1,81), (p=0,79) tahmini RR değerleri ile karın ağrısı ve vajinal kanama açısından yağ grubu lehine sonuçlandı. Su bazlı kontrast daha az intravazasyon ile ilişkilendirildi [RR=2,09 (1,09-4,02), p=0,03]. Düşük [RR=1,02 (0,71, 1,46), p=0,92] ve dış gebelik [RR=0,84 (0,27, 2,63), p=0,77] açısından kontrastlar arasında fark yoktu. Yağ bazlı kontrastlı HSG, daha yüksek gebelik oranı, canlı doğum oranı ve intravazasyon oranı ile ilişkiliydi. Su bazlı bir kontrast madde kullanan HSG, artmış karın rahatsızlığı, vajinal kanama ve görsel-analog skala ağrı skoru ile ilişkilendirildi.

Anahtar Kelimeler: Histerosalpingografi, infertilite, kontrast madde, gebelik ile sonlanım

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Introduction

Infertility is the term used to describe a patient who fails to conceive after one year of regular unprotected intercourse. Infertility affects 12% of reproductive-aged women worldwide. Female factors represent about 46% of infertility causes[1,2]. Fertilization occurs in the fallopian tubes. Hence, functioning fallopian tubes are essential for conception[3]. One-third of infertility cases are attributable to fallopian tube obstruction. Tubal damage frequently a results from adhesions, where proximal tubal occlusion is associated with endometriosis, while distal tubal occlusion is commonly caused by pelvic inflammatory disease[4].

Laparoscopy is the gold standard investigation for the diagnosing of tubal diseases, whereas minimally invasive Hysterosalpingography (HSG) is the first line of radiological evaluation for tubal patency. HSG detects tubal blockage using a contrast medium to visualize the endometrial cavity and fallopian tubes[5]. The sensitivity and specificity of HSG in detecting tubal obstruction are 65% and 83%, respectively, with an accuracy rate of 71%[3,4].

HSG is often conducted using either water-soluble or oil-soluble contrast as a medium. Although HSG is a diagnostic procedure, there is continuing debate about its therapeutic effect and whether the selection of contrast materials makes a difference in the chance of subsequent conception. Previous randomized controlled trials (RCT) suggested that an oil-based contrast medium is more favorable than a water-based contrast medium due to its fertility-enhancing effects and good image quality[6,7]. However, an oil-based contrast medium takes longer to deliver, causing prolonged discomfort and posing a theoretical risk of intravasation and embolism[8]. A systematic review with meta-analysis comparing the therapeutic effects of oil-based versus water-based contrast mediums in HSG was published in 2018. This review, with six trials and a total of 2,562 patients, concluded that an oil-based contrast medium has a higher pregnancy rate with an odd ratio of 1.47 compared with a water-based contrast medium[9]. However, there are three trials with an unknown bias profile. Since then, several RCTs with sample sizes greater than 1,000 and longer post-HSG follow-ups have been published.

The primary objective of this study was to conduct high evidence systematic review and meta-analysis of the scientific literature to determine the fertility-enhancing outcomes and adverse effects of oil-soluble contrast media versus water-soluble contrast medium in patients undergoing HSG.

Materials and Methods

This systematic review and meta-analysis was prepared based on the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA)[10].

Literature Searchs and Information Sources

Searches were carried out in the following major electronic databases: Web of Science, PubMed, and Scopus till Sept 2022, using the following strategy "hysterosalpingography" or "HSG" or "salpingogram" or "hysterosalpingogram" AND "Water-soluble contrast media" or "water-based contrast material (WBCM)" or "oil-soluble contrast media", or "oil-based contrast material (OBCM)" or "lipiodol" or "ethiodol", "Ethiodized" or "iotrolan" or "Tubal flushing". There were no search filters or language limitations.

Selection Criteria and Eligibility Criteria

We conducted the selection and inclusion process for the study in two stages. We screened the titles and abstracts in the first stage to identify potentially relevant articles. In the second stage, we evaluated relevant articles and included them based on our inclusion criteria. We included all primary RCTs comparing the enhancing-fertility effects of HSG in oil-based contrast medium against a water-based contrast medium in children-bearing aged women with infertility. Any RCTs, which did not evaluate the therapeutic effects of fertility were excluded. We also excluded studies that evaluated the effectiveness of HSG using a single contrast agent without any comparison. Any studies other than RCTs, such as case reviews, case reports, and case series were excluded.

Data Extraction

We extracted data from the included RCTs and plotted them on an extraction sheet. Other objective outcomes, such as pregnancy outcomes, discomfort, and adverse effects, were recorded. We also collected data on pregnancy rate, live birth, miscarriage, ectopic pregnancy, abnormal pain, vaginal bleeding, intravasation, pain VAS score, and duration between HSG and pregnancy. We also extract relevant data for quality assessments according to the Cochrane assessment tool[11].

Outcomes

The primary outcome is ongoing pregnancy, which is a positive fetal heartbeat on ultrasound at 12 weeks of gestation. The secondary outcome was the successful conception, which includes (1) gestation sac detection on ultrasonography, (2) live birth (defined as the birth of an infant with the signs of life after 24 weeks of gestation), (3) Miscarriage (defined as no evidence of foetal heartbeat detected on ultrasound or spontaneous loss of pregnancy before 20 weeks of gestation), and (4) ectopic pregnancy (defined as implantation occurs outside the uterus). The degree of pain after HSG is measured by the visual-analogue scale on a scale between 0 and 10, where a high value represents more severe pains.

Quality Assessment

Only RCTs were included in this study. Thus, they were assessed using the Cochrane risk of bias assessment tool[11]. We examined each study for identifiable biases, which are listed as follows: (1) no random sequence generation, (2) no blinding of participants and personnel, (3) no allocation concealment, (4) no blinding of outcome assessment, (5) incomplete outcome data, (6) selective reporting, and (7) other biases. For each

domain, trials could be classified as low, unclear, or high risk of bias.

Statistical Analysis

Statistical analyses were performed with RevMan 5.4.1 software to assess the retrieved data. Our study included continuous and dichotomous outcomes. We used the inverse variance method to analyze the continuous data using mean difference (MD) and 95% confidence intervals (CI), while dichotomous data were analyzed using Mantel-Haenszel method which were calculated using odds ratio (OR) and 95% CIs. The presence of heterogeneity among the studies was measured by the I^2 and the p-value of the chi-square test. Values of $p<0.1$ or $I^2>50\%$ were significant indicators of heterogeneity. We tried solving the inconsistency among data using the Cochrane leave-one-out method[12].

Results

Search Results and Characteristics of the Included Studies

The search results are illustrated in the PRISMA flow diagram (Figure 1). We included 11 studies[6,13,14-22], which met our inclusion criteria. We analyzed 4,739 patients who underwent HSG either by OBCM or WBCM. The average age of the included patients from both groups was 28.48 years.

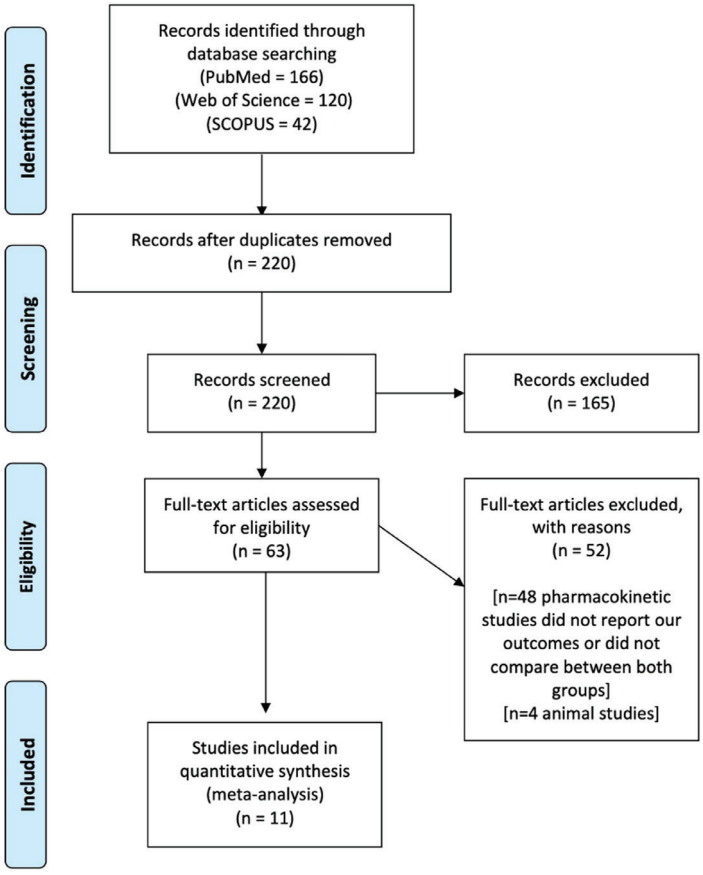

Figure 1. Shows the PRISMA flow diagram

Table 1 shows the baseline characteristics of the included studies.

Results of the Risk of Bias Assessment

All studies were evaluated according to Cochrane's tool[23]. Regarding randomization, six studies[6,13,15,16,21,22] reported proper randomization and were categorized as low risk of bias, while the other five studies[14,17-20] reported insufficient details regarding the randomization domain therefore they were categorized as unclear risk of bias. Concerning the performance bias, only Dreyer et al.[15] were categorized as high risk of bias, the remaining studies were categorized as unclear risk of bias. In detection bias, all studies were categorized as unclear risk of bias, except Zhang et al.[6] who reported adequate blinding of the outcome investigators. Figure 2 shows a detailed illustration of the risk of bias of the included studies.

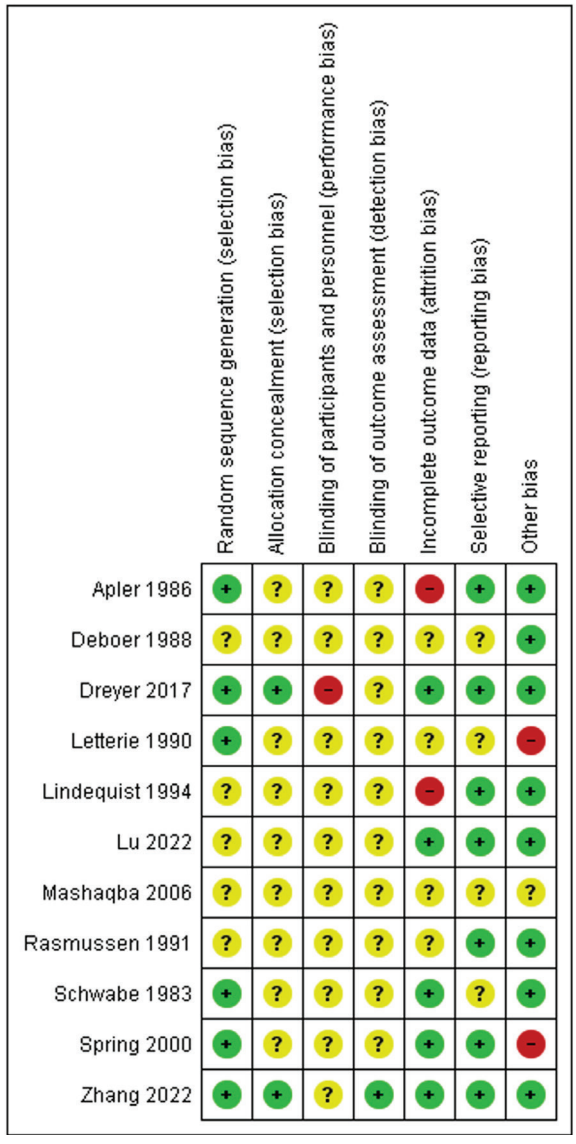

Figure 2. Shows a detailed illustration of the risk of bias of included studies

Analysis of Outcome

1. Pregnancy Rate

Eleven studies[6,13,14-21,22] reported this outcome. The overall analysis showed that the pregnancy rate was significantly higher in the oil group than in the water group [OR=1.51 (1.23, 1.86), (p<0.0001)]. Data were heterogeneous (p=0.05); I^2=46% (Figure 3A). We solved the heterogeneity by excluding Spring et al.[22] (p=0.85); I^2=0%. The combined estimate after solving the heterogeneity also favored the oil group [OR=1.64 (1.43, 1.89), (p<0.00001)] (Figure 3B).

2. Live Birth

This outcome was reported by four studies[6,15,20,22]. We divided the four studies into two subgroups. The first subgroup included two studies that used HSG for therapeutic reasons[6,15]. The overall OR in this subgroup favored the oil group significantly [OR=1.55 (1.28, 1.86), (p<0.00001)]. data were homogeneous (p=0.58); I^2=0%.

Regarding the second subgroup, which included two other studies[20,22] that used HSG for diagnostic reasons, there was no significant variation between both groups [OR=1.76 (0.48, 6.44), (p=0.39)]. We faced a significant heterogeneity in this subgroup (p=0.0002); I^2=93%.

The overall analysis of the four studies showed that live birth is significantly higher in the oil group than in the water group [OR=1.59 (1.09, 2.33), (p=0.02)] (Figure 4).

3. Miscarriage

2,668 patients were analyzed from four studies[6,15,19,22], which reported the incidence of miscarriage. The combined estimate showed very similar values [OR=1.02 (0.71, 1.46), (p=0.92)]. We found a moderate heterogeneity among studies (p=0.10); I^2=56% (Figure 5).

4. Ectopic Pregnancy

Our analysis of data retrieved from three studies[15,19,22] showed that both groups are associated with similar ectopic incidence [OR=0.84 (0.27, 2.63), (p=0.77)]. Our results were homogeneous (p=0.54); I^2=0% (Figure 6).

5. Abnormal Pain

This outcome was reported by two studies[6,18]. The overall OR favored the oil group over the water group [OR=0.73 (0.58, 0.91), (p=0.006)]. Data were homogeneous (p=0.31); I^2=3% (Figure 7).

6. Vaginal Bleeding

Three studies reported vaginal bleeding[6,17,18]. We found no variation between both groups [OR=0.91 (0.46, 1.81), (p=0.79)]. Although we found heterogeneity among studies (p=0.01); I^2=77% (Figure 8A), we could solve this heterogeneity by excluding Lindequist et al.[17] (p=0.88); I^2=0%. The overall analysis after solving heterogeneity showed that the oil group had less incidence of vaginal bleeding [OR=0.67 (0.52, 0.86), (p=0.002)] (Figure 8B).

Table 1. Shows the baseline characteristics of the included studies

Study	Country		Sample size		Age, years mean (SD or IQR)		Duration of infertility		Intervention	
	OBCM	WBCM	OBCM	WBCM	OBCM	WBCM	OBCM	WBCM	OBCM	WBCM
Alper[13]	Canada		46	60	29.3 (4.6)	29.1 (2.9)	NR	NR	Lipiodol	Renographin
de Boer[14]	Netherlands		87	88	29 (19-44)	29 (19-44)	37 (26.2)		Lipiodol	Iopamidol
Dreyer[15]	Netherlands		554	554	32.8 (30-36)	33.0 (30-36)	19.8 (16.0-26.3)	19.6 (15.4-27.4)	Lipiodol	Telebrix
Letterie[16]	USA		15	14	27 (3.5)	25 (4.1)	NR	NR	Ethiodized oil	Conray-60
Lindequist[17]	Denmark		121	121	29.9 (21-43)	29.5 (20-40)	40	41	Lipiodol	Iotrolan
Lu[18]	China		500	500	29.0 (24.3-32.0)	27.0 (24.0-32.0)	24 (12-36)	24 (12-36)	Ethiodized poppy seed oil	Ioversol
Mashaqba[19]	Jordan		35	40	28 (3)	28 (4)	NR	NR	NR	NR
Rasmussen[20]	Denmark		98	300	22.0 (4.5)	22.4 (5.5)	NR	NR	Lipiodol	Iohexol, ioxaglate, diatrizoate
Schwabe[21]	USA		56	65	NR	NR	NR	NR	Ethiodol	Sinografin
Spring[22]	USA		273	260	29.3 (4.6)	29.1 (2.9)	37.8 (38.1)	37.5 (36.3)	Lipiodol	Diatrizoate, iodipamide
Zhang[6]	China		473	479	30.5 (3.7)	30.8 (3.6)	20.4 (13.32)	20.24 (19.93)	Ethiodized poppyseed oil	Iohexol, Iopromide, Ioverol

OBCM: Oil-based contrast material, WBCM: Water-based contrast material, NR: Unreported, SD: Standard deviation, IQR: Interquartile range.

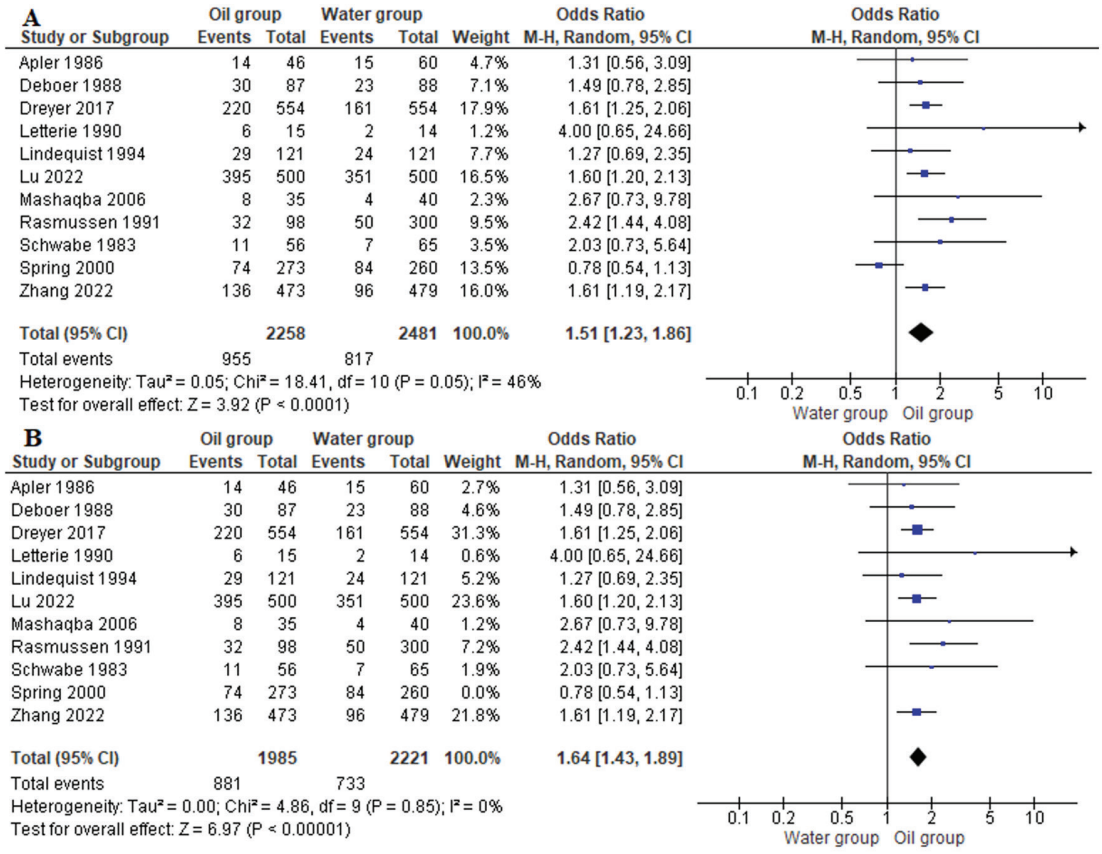

Figure 3. Shows the outcome of pregnancy rate-part A includes 11 studies[6,13,14-22] & part B excludes Spring et al.[22]

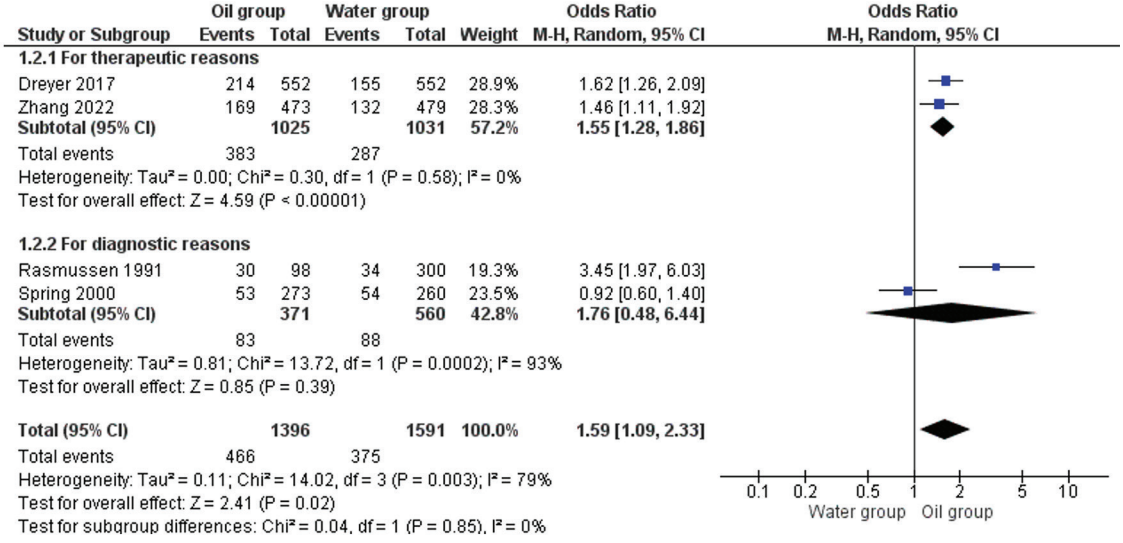

Figure 4. Shows the outcome of live birth

7. Intravasation

2,516 patients were analyzed from five studies[6,13,15,17,19] that investigated this side effect. We found that HSG by water-based contrast was associated with a lower incidence of intravasation than oil-based contrast [OR=2.09 (1.09, 4.02), (p=0.03)]. The overall analysis was homogenous (p=0.33); I^2=12% (Figure 9).

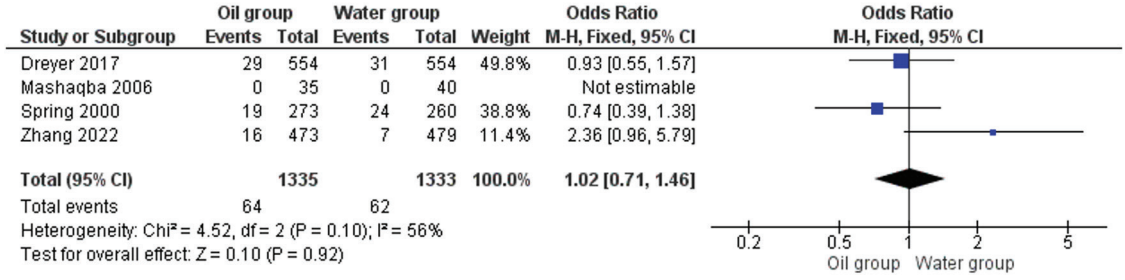

Figure 5. Shows the outcome of miscarriage

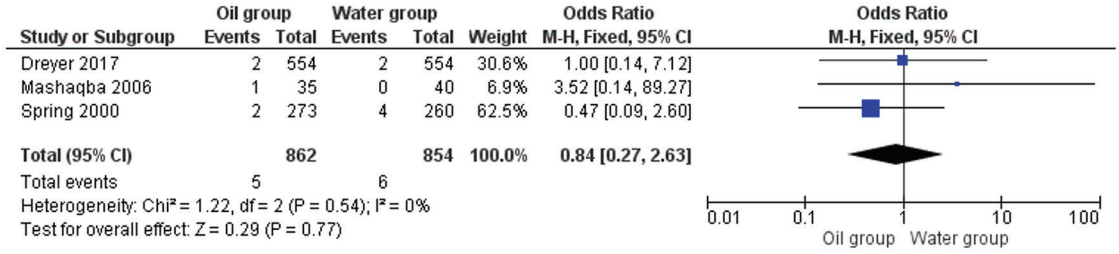

Figure 6. Shows the outcome of ectopic pregnancy

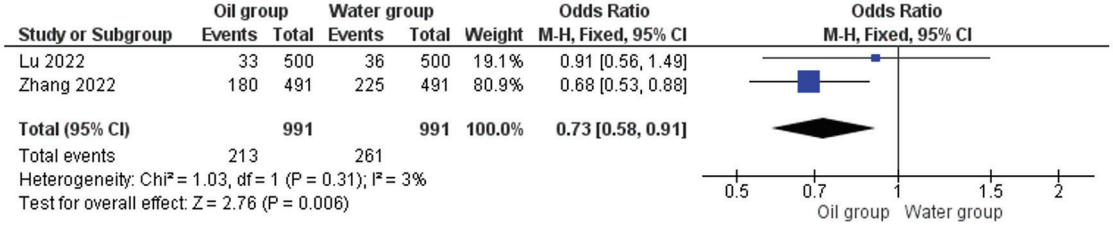

Figure 7. Shows the outcome of abnormal pain

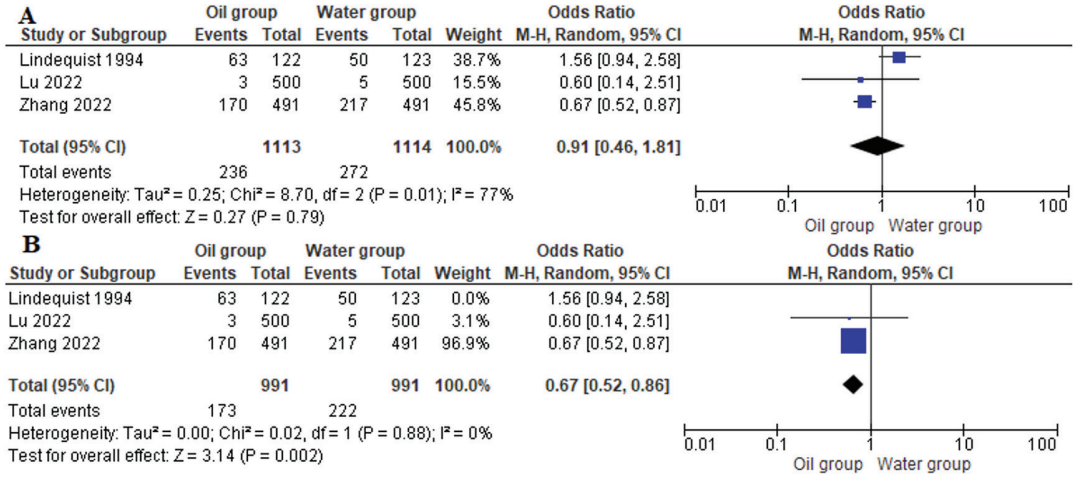

Figure 8. Shows the outcome of vaginal bleeding-part A includes three studies[6,18,19] & part B excludes Lindequist et al.[17]

8. Pain VAS Scores

Three studies[6,13,15] assessed the pain VAS score among the included patients. The overall mean difference showed that the pain VAS score was significantly lower in the oil group than in the water group [MD=-0.40 (-0.56, -0.24), (p<0.00001)]. We found no heterogeneity among data (p=0.25); I^2=28% (Figure 10).

9. Duration Between HSG and Pregnancy (Weeks)

This outcome was reported by four studies[6,15,18,19]. The combined estimate showed no difference between both groups [MD=-1.08 (-3.43, 1.28), (p=0.37)]. The analysis showed major heterogeneity (p=0.0002); I^2=85% (Figure 11A). We could solve this heterogeneity by excluding Zhang et al.[6] (p=0.19); I^2=41%. The overall analysis after solving this heterogeneity also showed similar values in both groups [MD=0.41 (-0.72, 1.55), (p=0.48)] (Figure 11B).

Discussion

This is the most recent meta-analysis comparing the results of HSG performed with OBCM and WBCM. Our meta-analysis revealed that the pregnancy rate in patients who had HSG with OBCM was 1.51 times greater than in those who had WBCM. This agrees with previous studies. In terms of pregnancy outcome, patients receiving OBCM are more likely to deliver a live birth than those receiving WBCM. There were no statistically significant differences between these two contrast materials for patients with miscarriage and ectopic pregnancy. There were

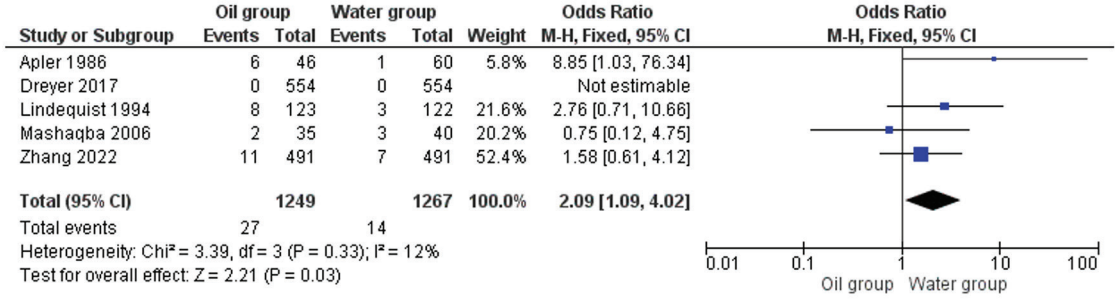

Figure 9. Shows the outcome of intravasation

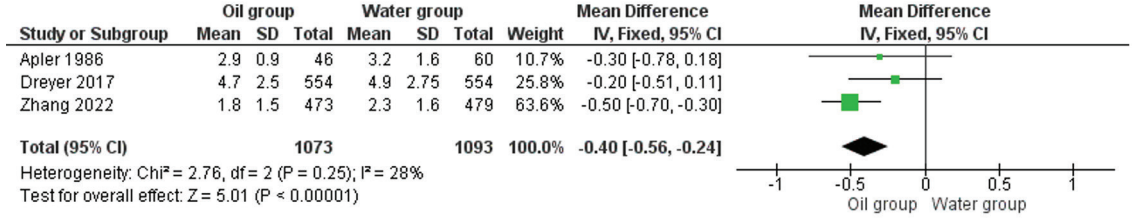

Figure 10. Shows the outcome of pain VAS score

VAS: Visual analog scale

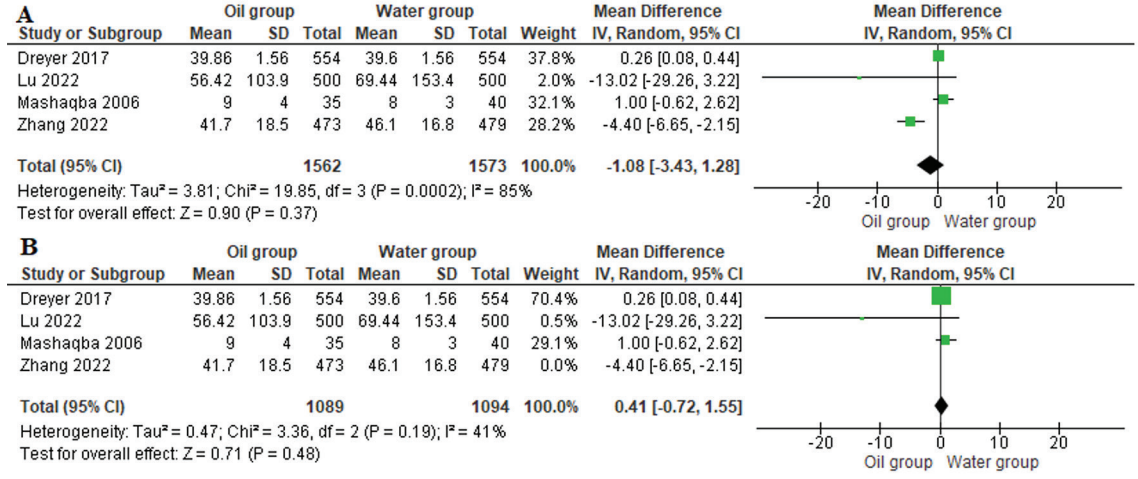

Figure 11. Shows the outcome of duration between HSG and pregnancy (weeks)-Part A includes four studies[6,16,19,20] & Part B excludes Zhang et al.[6]

HSG: Hysterosalpingography

diverse outcomes when it came to side effects. The oil group had a lower incidence of vaginal bleeding and abdominal pain than the water group, although OBCM was associated with more incidence of developing intravasation than WBCM.

A previously published meta-analysis, which was conducted in 2018, included six RCTs and 2,564 patients[9]. They showed that women who received HSG with OBCM had a greater pregnancy rate than women who underwent HSG with WBCM, but there were no statistically significant differences between patients with miscarriage and ectopic pregnancy. However, the population size was insufficient for evaluating the risk of publication bias and rare pregnancy outcomes, such as miscarriage and ectopic pregnancy. Two studies also included patients with co-treatment, which may have contributed to pregnancy outcome measurements. Another meta-analysis released in 2019 investigated the effectiveness of HSG on fertility outcomes using different materials[24]. However, most RCTs compare the fertility outcome of a single contrast medium to control. There are only five RCTs that directly compare WBCM and OBCM.

Early studies in the 1980s revealed that patients who underwent HSG with OBCM had a higher pregnancy rate than those who received HSG with WBCM. However, no statistically significant variations in pregnancy outcomes were found until two RCTs in the 1990s[16,20]. These findings are consistent with our meta-analysis finding of an odd ratio of 1.51 in OBCM versus WBCM. The mechanisms of fertility-enhancing effects in an oil-based contrast medium remain unknown. It is theorized that the bacteriostatic and fibrinolytic properties of oil-based contrast media minimize edema on the mucus membrane. In addition to the stimulation of ciliary activity, mechanical cleansing of the uterine cavity and fallopian tubes makes the environment more conducive to conception and spermatozoa penetration.

Despite its therapeutic potential, OBCM is associated with a higher risk of overall side effects. The introduction of foreign substances into the bloodstream via blood or lymph vessels is known as intravasation. Previous studies have shown that the risk of intravasation in OBCMs is higher than in WBCMs[25]. This is consistent with our research, which found an odd ratio of 2. Embolism is one of the most serious complications of intravasation. A systematic review of 31 studies involving 19,339 people[8] showed that only 18 women experienced oil embolism, with four cases including embolism to the brain and retina. None of the patients ended up with long-term complications.

The primary objective of pregnancy is a live birth. However, there are other possible pregnancy outcomes, such as miscarriage and ectopic pregnancy. A five-year follow-up study showed that OBCM improves live birth by 7.5% compared to WBCM (OR=1.11), and our findings support this with a stronger association (OR=1.51). Patients who received HSG for infertility have a baseline risk of miscarriage and ectopic pregnancy[26]. The same study with five years follow-up also showed that the association between miscarriage and ectopic pregnancy in the OBCM group was not statistically significant compared with the WBCM group[27]. OBCM could increase the rate of maternal subclinical hypothyroidism (SCH) because of its high iodine content. A large dose of OBCM is also related to thyroid dysfunction in Neonates[28]. However, another RCT on 140 neonates found no difference in thyroid function between OBCM and WBCM[29]. Women in early pregnancy with SCH had a higher chance of miscarriage[30,31]. A study suggested that up to 25% of HSG patients with OBCM-developed SCH, compared with 10% of those with WBCM[32]. The risk factors for ectopic pregnancy vary by the patient, including a history of pelvic inflammatory disease or surgery. Literature on ectopic pregnancy following HSG is limited, and our analysis showed that both materials are associated with the same ectopic incidence. The prevalence of miscarriage and ectopic pregnancy following HSG requires further research.

Most studies examined pregnancy or conception at a specific time but not cumulatively. An RCT of 5 years follow-up confirmed that the OBCM group had a higher cumulative spontaneous pregnancy rate than the WBCM group[27]. Another RCT concluded that the median time between HSG and pregnancy for OBCM and WBCM is 13 and 16 months, respectively[18]. However, our analysis with four RCTs found no statistically significant differences between OBCM and WBCM for the duration from HSG until pregnancy. The fertility-enhancing effect of HSG in the OBCM lasts for at least a year and is reduced over time. The therapeutic effects are expected to return to baseline in 2 years. The diminishing therapeutic effects in OBCM after an HSG may be attributed to other measures taken by patients to address their infertility problems, such as weight loss, starting IVF, or smoking cessation[18].

Lower abdomen pain and vaginal bleeding are other significant complications of HSG[33]. Only half of the HSG patients complained of abdominal pain and vaginal bleeding. Most pain is resolved within 24 h, and the amount of blood is typically less than menstruation[17]. No pre-procedural risk factors, including volume of contrast used, osmolality, or viscosity of contrast, are identified with worsening pain during HSG[34]. The expansion following contrast administration causes visceral sensory nerve stimulation, release of local prostaglandin and, subsequently, uterine contraction[35]. However, women with an abnormal HSG result reported more pain during and 30 min following treatment[36]. Previous literature suggested that OBCM resulted in less pain throughout the procedure. The incidence of delayed pain following HSG is lower in the OBCM group, which is consistent with our findings. In terms of vaginal bleeding, previous studies have shown that the occurrence and duration of vaginal bleeding are more significant in HSG patients with WBCM[17]. Our analysis supports this finding. The cause of vaginal bleeding after HSG still requires additional investigation. One explanation is that the overflow of OBCM in

the uterine umbrella tip region is gentler and less stimulating the peritoneum, resulting in less pain and vaginal hemorrhage[35]. Multiple RCTs support the use of ethiodized poppyseed oil-based contrast due to its potential therapeutic effects and common adverse effects, which is the material of choice for HSG[6,17]. Hysterosalpingo-foam sonography (Hyfosy) is a newly evolving alternative to HSG for determining tubal patency. The sensitivity of Hyfosy is similar to that of HSG, whereas one of the primary advantages of Hyfosy over HSG is the absence of radiation exposure, which removes patient anxiety and the risk of undetected early pregnancy[37,38]. However, no therapeutic effects of Hyfosy on infertility have yet been identified.

Study Limitations

The main limitation of our study was the heterogeneity found in some outcomes. However, we could solve them either by the leave-one-out method or by conducting a subgroup analysis. Five new RCTs with a total of 2,177 individuals have been included in our meta-analysis, including three and five-year follow-up studies in our qualitative synthesis and more recent studies with participants greater than 1,000. A larger population size enables us to provide a more accurate evaluation for uncommon pregnancy outcomes, such as miscarriage and ectopic pregnancy, and rare adverse effects, such as intravasation and embolism. This also allowed us to examine publication bias. There are several confounding factors during pregnancy. Increasing the number of RTCs will enable us to examine the influence of each variable and better understand its adverse effects.

Conclusion

To conclude, HSG using OBCM was associated with a higher incidence of pregnancy rate, live birth, and intravasation. While HSG using WBCM was associated with more abdominal pain, vaginal bleeding, and the overall VAS pain score. We found no significant difference between the groups regarding miscarriage, ectopic pregnancy, and the duration of HSG and pregnancy.

Ethics

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: A.A.S., Design: A.A.S., Data Collection or Processing: A.A.S., Analysis or Interpretation: A.A.S., Processing and Interpretation: S.T., Writing: S.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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