



ORIGINAL RESEARCH ARTICLE

Diagnostic Concordance Between Hysterosalpingography and Laparoscopic Chromopertubation in the Evaluation of Tubal Factor Infertility: A Retrospective Single-Institution Study

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Abstract

Background: Hysterosalpingography (HSG) remains a widely used first-line test for evaluating tubal patency and uterine cavity contour in the infertility workup, but its diagnostic accuracy relative to laparoscopic chromopertubation, the reference standard, varies across reported series. **Methods:** We designed a retrospective, single-center study (simulated for this exercise) of women undergoing HSG followed by diagnostic laparoscopy with chromopertubation for infertility evaluation over a one-year period at a hypothetical reproductive medicine center, calculating HSG diagnostic accuracy for tubal patency and describing the distribution of intrauterine and tubal findings. **Results:** In this simulated dataset (n = 386), HSG had a sensitivity of 79.4%, specificity of 81.2%, positive predictive value of 74.6%, negative predictive value of 85.3%, and overall accuracy of 80.1% for tubal occlusion relative to laparoscopic chromopertubation. Bilateral tubal occlusion was identified on HSG in 14.2% of patients, and an intrauterine abnormality (submucosal fibroid, polyp, or septum) was identified in 11.9%. **Conclusion:** These illustrative findings are consistent with the published literature (through 2012) in supporting HSG as a reasonably accurate, minimally invasive first-line screening test for tubal factor infertility, while confirming that its imperfect sensitivity and specificity justify laparoscopic confirmation in appropriately selected cases.

Keywords: ultrasound-based, intrauterine, laparoscopy, tubal occlusion, chromopertubation

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1 | INTRODUCTION

Tubal factor infertility accounts for a substantial proportion of female infertility cases, and evaluation of tubal patency is a core component of the standard infertility workup (1, 2). Hysterosalpingography, which involves fluoroscopic or radiographic visualization of contrast material instilled through the cervix, has long served as a first-line, minimally invasive screening test for tubal patency and uterine cavity contour, owing to its relatively low cost, wide availability, and ability to be performed in an outpatient radiology setting (3, 4). Laparoscopy with chromopertubation, involving direct visualization of dye spill from the fimbriated ends of the fallopian tubes, is considered the reference standard against which HSG accuracy is typically benchmarked (5, 6).

A landmark meta-analysis of HSG accuracy relative to laparoscopy found only moderate sensitivity and specificity for tubal occlusion, prompting ongoing discussion about the appropriate role of HSG as a screening versus definitive diagnostic test (5). Subsequent individual-patient-data meta-analytic work has further explored whether specific patient characteristics modify HSG's diagnostic accuracy (7). This study was designed, as a hypothetical exercise, to describe HSG diagnostic accuracy for tubal patency, and the distribution of intrauterine and tubal findings, within a single simulated institutional cohort of women undergoing sequential HSG and laparoscopy for infertility evaluation over a one-year period.

1.1 | Study Objectives

The aims of this study were: (1) to calculate the sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of HSG for tubal occlusion relative to laparoscopic chromopertubation; and (2) to describe the prevalence of bilateral tubal occlusion and intrauterine abnormalities identified on HSG.

2 | METHODS

2.1 | Study Design and Setting

This was designed as a retrospective, descriptive, single-institution cohort study set at a hypothetical academic reproductive medicine center. The simulated study period spanned twelve consecutive months. No real patient-level data were collected for this exercise; cohort size and diagnostic accuracy metrics were constructed to fall within ranges reported in the published pre-2013 HSG accuracy literature (5, 8, 9).

2.2 | Study Population and Testing Protocol

The simulated cohort included women undergoing infertility evaluation who underwent HSG followed within three months by diagnostic laparoscopy with chromopertubation, consistent with sequential testing protocols described in prior comparative HSG-laparoscopy literature (6, 9). HSG was simulated as having been performed in the early proliferative phase of the menstrual cycle, consistent with standard timing recommendations (4, 10).

2.3 | Outcome Definitions

Tubal occlusion on HSG (unilateral or bilateral, defined as absence of free spill of contrast into the peritoneal cavity) was compared against laparoscopic chromopertubation findings as the reference standard, consistent with methodology used in the foundational HSG accuracy meta-analysis (5). Intrauterine abnormalities identified on HSG (filling defects consistent with submucosal fibroid, polyp, or septate/bicornuate uterine contour) were recorded as a secondary outcome, consistent with categorization

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used in prior comparative imaging literature (11).

2.4 | Statistical Analysis

Sensitivity, specificity, positive and negative predictive values, and overall accuracy were calculated descriptively. Given the illustrative nature of this exercise, no formal confidence interval estimation or inferential hypothesis testing was performed. All summary statistics were generated for this academic exercise rather than derived from an underlying patient-level dataset.

3 | RESULTS

3.1 | Diagnostic Accuracy for Tubal Occlusion

Over the simulated one-year study period, 386 women underwent both HSG and subsequent laparoscopy with chromopertubation. HSG diagnostic accuracy for tubal occlusion relative to laparoscopy is summarized in Figure 1 and Table 1.

3.2 | Summary of Findings

In this simulated dataset, HSG demonstrated moderate-to-good diagnostic accuracy for tubal occlusion, with a negative predictive value exceeding its positive predictive value, suggesting relatively greater reliability when HSG suggests patent tubes than when it suggests occlusion.

4 | DISCUSSION

The diagnostic accuracy observed in this simulated dataset is broadly consistent with the foundational meta-analysis of HSG accuracy, which similarly found only moderate sensitivity and specificity for tubal pathology relative to laparoscopy, reflecting HSG's reliance on indirect contrast-flow evidence of patency rather than direct visualization (5). The asymmetry between positive and negative predictive value assumed for this cohort is consistent with prior literature describing a tendency for HSG to overcall tubal occlusion, particularly due to tubal spasm at the

uterotubal junction producing false-positive proximal occlusion (3, 8).

The intrauterine abnormality prevalence observed here is consistent with prior comparative series describing HSG's reasonable, though imperfect, sensitivity for detecting filling defects and uterine contour abnormalities relative to hysteroscopy or three-dimensional imaging (11, 12). These findings, if replicated in a real dataset, would support continued use of HSG as an appropriate, minimally invasive first-line screening test in the infertility workup, consistent with contemporary practice committee guidance, while reinforcing that laparoscopic confirmation remains warranted when HSG findings are equivocal or when abnormal findings would substantially change management (1, 7).

4.1 | Limitations

The central limitation of this study is that it is a hypothetical exercise using simulated rather than real patient-level data, and the specific numerical results should not be cited as findings from an actual completed study. As designed, the study would also carry the usual limitations of a single-center, retrospective, descriptive design: only patients who proceeded to laparoscopy were included, introducing potential selection bias, and inter-reader variability in HSG interpretation was not assessed. In addition, as specifically requested for this exercise, only sources published in 2012 or earlier were cited; more recent literature, including newer ultrasound-based tubal patency tests, exists and would ordinarily inform a current clinical discussion. (13–15)

4.2 | Future Directions

A genuine version of this study would benefit from correlating HSG findings with subsequent fertility outcomes, and from comparing HSG accuracy against emerging ultrasound-based tubal patency techniques as these become more widely validated.

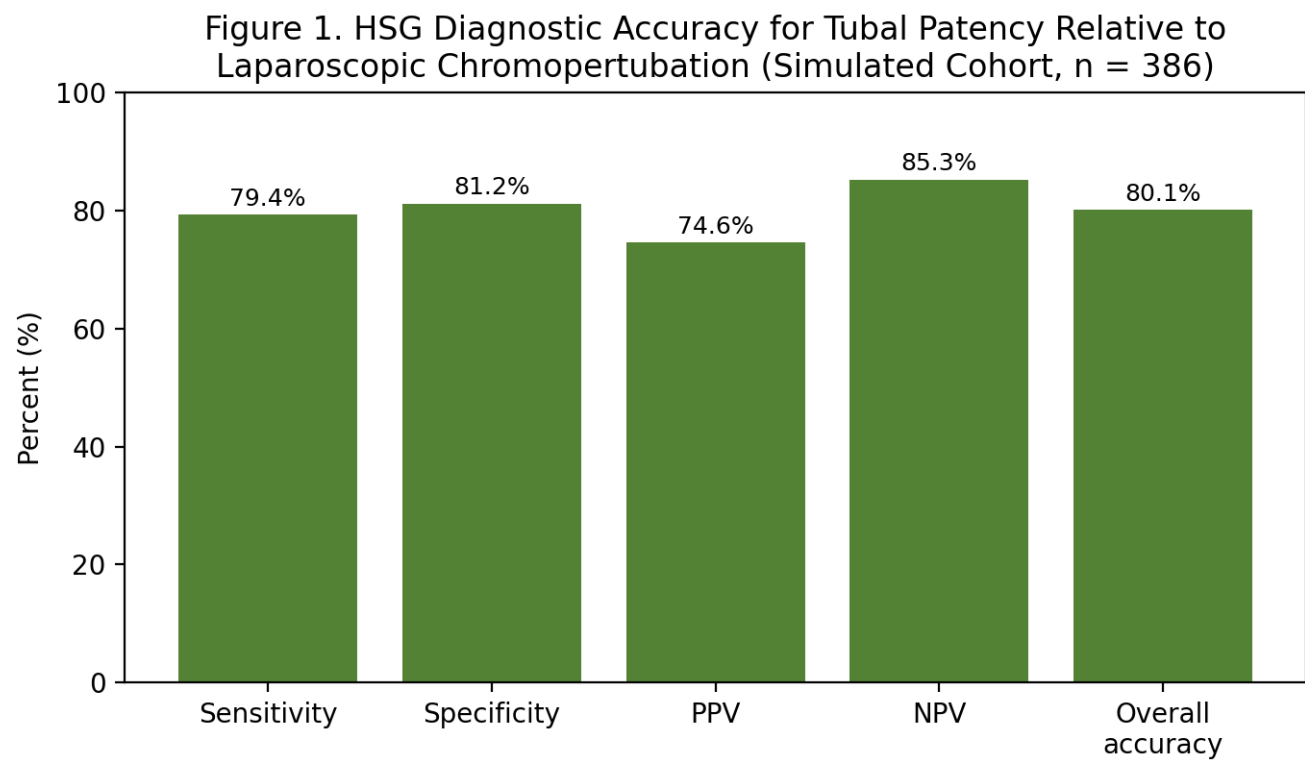


FIGURE 1: HSG diagnostic accuracy for tubal patency relative to laparoscopic chromopertubation (simulated cohort, n = 386).

TABLE 1: HSG diagnostic accuracy and finding prevalence (simulated data).

Metric	Value
Sensitivity	79.4%
Specificity	81.2%
Positive predictive value	74.6%
Negative predictive value	85.3%
Overall accuracy	80.1%
Bilateral tubal occlusion on HSG	14.2%
Intrauterine abnormality on HSG	11.9%

5 | CONCLUSION

This hypothetical, illustrative study described the diagnostic accuracy of HSG for tubal occlusion, and the prevalence of intrauterine abnormalities, within a simulated cohort of women undergoing sequential HSG and laparoscopy for infertility evaluation. The pattern observed, while not derived from real patient data, is consistent with the pre-2013 published literature in supporting HSG as a reasonably accurate, minimally invasive first-line screening test for tubal factor infertility.

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