EVALUATION OF EFFICACY OF HYSTEROSALPINGOGRAPHY IN DIAGNOSING TUBAL BLOCKAGE IN INFERTILE WOMEN

BY

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CERTIFICATION

This is to certify that the research work for this project and the subsequent write up by Okagbare Ogenevwoke Luckyjane, with matriculation number BMS2005203 were carried out under my supervision.

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DEDICATION

I dedicate this research project to my beloved parents, who instilled in me the desire to work hard and excel and supported me morally and financially.

ACKNOWLEDGMENT

All gratitude and appreciation to Almighty God who gave me the wisdom, courage, opportunity, and good health to undergo this study.

I would like to express my heartfelt gratitude to my supervisor, Dr. Olayiwola Kemisola for her guidance, patience, and valuable support throughout the project. Her insights and expertise were important in determining the direction and focus of this study. May God reward her and her family abundantly.

I would also like to express my sincere gratitude to all my lecturers, the HOD, Mrs. Fanny Igbenedion, our lecturers, especially Dr. G.N Okungbowa and all non-academic staff may God bless you for the immense support to see this program became successful.

My heartfelt gratitude goes to my parents, for their care, love, support, prayers, sacrifice, and encouragement. My appreciation also goes to my siblings and relatives. My classmates and friends, I appreciate your support and prayers. Thank you.

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ABSTRACT

Introduction: Infertility is a global reproductive health challenge, and tubal blockage remains one of its major causes. Hysterosalpingography (HSG) is widely used for evaluating tubal patency. This study assessed the diagnostic efficacy of HSG in detecting tubal blockage among infertile women at the University of Benin Teaching Hospital (UBTH).

Methodology: A retrospective study design was used. Archived HSG reports of 217 infertile women were retrieved from the Radiology Department, of which 200 met the inclusion criteria. Data were extracted using a structured collection sheet and analysed with SPSS version 29. Descriptive statistics summarized the findings, while Chi-square tested associations between variables at a significance level of $p < 0.05$.

Results: The mean age was 36.3 years, with most 107 (53.5%) aged 30-39 years. Secondary infertility was predominant 152 (76%), followed by primary infertility 38 (19%). Normal uterine cavities were observed in 90 (45%) women, while pelvic adhesions 45 (22.5%) and fibroids 37 (18.5%) were common abnormalities. The right and left fallopian tubes were blocked in 64 (32%) and 82 (41%) women, respectively. Overall, 88 (44%) had unilateral or bilateral tubal blockage, while 104 (52%) showed bilateral patency. Significant associations were found between age and type of infertility ($p < 0.001$).

Conclusion: Secondary infertility and tubal blockage were prevalent among the women. HSG is still an effective and accessible procedure for evaluating tubal patency and uterine abnormalities in infertile women. However, its limitations including inability to detect peritoneal factors and lack of laparoscopic confirmation necessitate additional diagnostic methods.

Keywords: Hysterosalpingography, infertility, tubal blockage, diagnostic efficacy, fallopian tubes.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Infertility affects millions of people worldwide and remains a major public health concern. Contrary to popular belief, secondary infertility is more prevalent than primary infertility (Malik *et al*., 2024). Globally, infertility affects between 10% and 15% of couples of reproductive age, with structural abnormalities of the female reproductive tract accounting for a significant proportion of cases (Agrawal & Fayyaz, 2019; Malik *et al*., 2024). In the Western world, approximately one in seven couples experience infertility, while in developing countries, the rate is as high as one in four (Vander Borght & Wyns, 2018).

Several factors contribute to female infertility, including advancing maternal age, hormonal imbalances, infections, immunological disorders, previous pelvic surgeries, and congenital abnormalities. Among these, tubal factor infertility, particularly fallopian tube blockage, remains a leading cause, responsible for approximately 30–40% of cases (Heuser *et al*., 2023).

The fallopian tubes play a vital role in natural conception by serving as the site of gamete transport and fertilisation. Damage or obstruction to the tubes—often resulting from pelvic inflammatory disease (PID), sexually transmitted infections (STIs), endometriosis, or prior surgical interventions—can severely impair fertility (Ambildhuke *et al*., 2022; Igbodike *et al*., 2022). Infections caused by Chlamydia trachomatis or Neisseria gonorrhoeae are particularly implicated, leading to salpingitis, scarring, hydrosalpinx, and eventual tubal occlusion. It is estimated that fallopian tube

abnormalities contribute to 15-20% of primary infertility and up to 40% of secondary infertility (Malik *et al*., 2024).

Hysterosalpingography (HSG) is a fluoroscopic imaging technique used to evaluate the uterine cavity and fallopian tube patency. During the procedure, an iodinated contrast medium is introduced into the uterine cavity through the cervical canal (Tan *et al*., 2021). HSG provides detailed visualization of the uterus, cervical canal, fallopian tubes, and peritoneal spillage, making it an essential diagnostic tool in infertility assessment. It is relatively safe, cost-effective, minimally invasive, and readily available particularly in low-resource settings like Nigeria (Makwe *et al*., 2021). Reported sensitivity and specificity for detecting tubal blockages range from 65-94% and 83-92%, respectively (Khalil *et al*., 2024; Van Welie *et al*., 2022).

Beyond diagnosis, HSG may also have therapeutic value, as the passage of contrast media can help clear minor obstructions such as mucus plugs or debris, potentially enhancing fertility (Igbodike *et al*., 2022; Ling *et al*., 2023). However, its limitations include discomfort during the procedure, exposure to ionising radiation, risk of allergic reactions to contrast media, and inability to detect subtle peritoneal pathologies such as endometriosis or adhesions (Ling *et al*., 2023).

Other imaging modalities for evaluating female infertility include transvaginal ultrasound, saline infusion sonohysterography (SIS), hysterosalpingo-contrast sonography (HyCoSy), magnetic resonance imaging (MRI), hysteroscopy, and laparoscopy with chromopertubation. While laparoscopy remains the gold standard for assessing pelvic anatomy and tubal function, it is invasive, costly, and requires general anaesthesia, making it less suitable as a first-line investigation (Heuser *et al*., 2023). Non-invasive methods like HyCoSy and 4D-HyCoSy eliminate radiation exposure but are operator-dependent and less standardised (Wu *et al*., 2024).

Despite advances in alternative modalities, HSG remains the first-line investigation for evaluating uterine and tubal abnormalities in most parts of the world especially in resource-limited settings due to its accessibility, affordability, and diagnostic reliability (Makwe *et al*., 2021). Given the rising prevalence of infertility and the critical contribution of tubal factors, evaluating the diagnostic efficacy of HSG in detecting tubal blockages among infertile women is essential to improving reproductive outcomes.

1.2 Statement of research problem

Infertility affects approximately one in seven couples in developed regions and one in four couples in developing countries (Vander Borght & Wyns, 2018). Among its various causes, fallopian tube blockage is a major contributor, accounting for 30-45% of infertility cases (Heuser *et al*., 2023). Diseases affecting the fallopian tubes are estimated to cause about 25% of female subfertility (Tamblyn & Jeve, 2022).

Although HSG is widely used to assess tubal patency, uncertainties persist regarding its diagnostic accuracy in detecting tubal blockages, especially when compared to more advanced or invasive modalities. This raises questions about its reliability as a diagnostic method in infertility evaluation, particularly in low-resource settings where alternative methods may not be readily available.

Therefore, this study seeks to assess the diagnostic efficacy of hysterosalpingography in detecting tubal blockage among infertile women, with the goal of providing evidence to guide clinical decision-making and improve fertility management strategies.

1.3 Research questions

- How effective is hysterosalpingography (HSG) in detecting tubal blockage among infertile women?
- What is the prevalence of tubal blockage among infertile women undergoing HSG?
- What are the common patterns and anatomical locations of tubal blockage identified on HSG?

1.4 Research hypothesis

Null Hypothesis (H_0)

Hysterosalpingography (HSG) has no diagnostic efficacy in identifying tubal blockage among infertile women.

Alternative Hypothesis (H_1):

Hysterosalpingography (HSG) has diagnostic efficacy in identifying tubal blockage among infertile women.

1.5 Aim and objectives of the study

The aim of the study was to the determine the diagnostic efficacy of hysterosalpingography (HSG) in detecting tubal blockage among infertile women.

Specific Objectives:

1. To determine the prevalence of tubal blockage among infertile women undergoing HSG
2. To identify the common patterns and anatomical locations of tubal blockage as detected through HSG.
3. To evaluate the diagnostic accuracy of HSG in detecting tubal blockage among infertile women.

1.6 Scope of the study

This study included infertile women who have undergone HSG at University of Benin Teaching Hospital, Benin. Only patients who have undergone HSG between January 2024 - July 2025 were included in the study.

1.7 Significance of the study

The study will provide information on the diagnostic performance of hysterosalpingography in detecting tubal blockage mong infertile women at UBTH. The findings will help radiographers understand the strength and limitations of HSG in clinical practice. Gynaecologist will be enlightened and this will improve decision making in selecting appropriate examinations for patients. The findings of this study will also lead to more accurate diagnosis, and faster management of infertility due to tubal blockage. The research will contribute to the existing body of literature, particularly in Nigeria due to limited data on HSG accuracy. It will serve as a baseline for comparison

1.8 Operational terms

- **Infertility:** Inability to conceive after 12 months of regular, unprotected sexual intercourse.
- **Primary infertility:** Inability to conceive despite never having been pregnant.
- **Secondary infertility:** Inability to conceive after a previous pregnancy.
- **Tubal blockage:** Obstruction in one or both fallopian tubes that prevents fertilization.
- **Hysterosalpingography (HSG):** An X-ray procedure to examine the uterus and fallopian tubes using contrast medium.
- **Fallopian tubes:** Tubes that transport ova from the ovaries to the uterus.
- **Patency:** The state of being open; in this context, open fallopian tubes.
- **Diagnostic efficacy:** The effectiveness of a test to correctly detect or rule out a condition.
- **Contrast medium:** A radiopaque fluid injected during HSG to visualize reproductive structures.

- **Uterine cavity:** The interior space of the uterus assessed during HSG.
- **Spillage:** The flow of contrast medium from the fallopian tube into the peritoneal cavity, indicating patency.
- **Cornual blockage:** Obstruction near the junction of the uterus and fallopian tube.
- **Fimbrial blockage:** Obstruction near the distal (outer) end of the fallopian tube.
- **Hydrosalpinx:** A condition where a fallopian tube is filled with fluid due to blockage.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents both conceptual and empirical reviews related to the study. The conceptual review discusses related terms and theoretical concepts, while the empirical review evaluates studies relevant to the diagnostic use of hysterosalpingography in evaluation of tubal blockage.

2.1 Conceptual review

2.1.1 Infertility

Infertility affects about 10% of the world's population and has been recognized as the 5th highest global disability (Bobmanuel *et al*., 2023). Infertility is defined as the inability of a couple to conceive after one year of regular, unprotected sexual intercourse(Abebe *et al*., 2020). Sterility, by contrast, indicates an absolute incapacity to conceive due to irreversible factors. Studies indicate that approximately 80% of couples achieve pregnancy within one year of regular unprotected intercourse (Ambildhuke *et al*., 2022). Infertility is broadly classified into primary and secondary infertility.

i. Primary infertility

When a woman has primary infertility, they are unable to conceive after a year without using birth control (Zaidi *et al*., 2024).

ii. Secondary infertility

There is at least one conception but fails to repeat**.** This means that during the period of 12 months of having unprotected sexual intercourse, the woman go conceives but after that conception doesn't happen again.(Abebe *et al.*, 2020)**.**

iii. Subfertility

This is the delayed ability to conceive. While natural conception remains possible in subfertility, it takes longer compared to fertile couples. Common causes include uterine abnormalities, ovarian dysfunction, tubal damage, genetic factors, systemic conditions, or consequences of previous medical treatment (Grigovich *et al*., 2021).

2.1.2 Causes of infertility

The prevalence of infertility in reproductive aged women has been estimated to be one in every seven couples in the western world and one in every four couples in developing countries (Vander Borght & Wyns, 2018). The cause of infertility could be from uterine, ovarian, or fallopian tube origin (Table 2.1).

Table 2.1: Causes of infertility

Ovulatory disorders
Polycystic ovary syndrome (PCOS)
Hyperprolactinemia
Hypothalamic hypogonadism
Premature ovarian insufficiency (idiopathic or secondary to gonadal dysgenesis)
Hypothyroidism
Congenital adrenal hyperplasia
Fallopian tubal disease
Proximal or distal tubal obstruction
Pelvic adhesive disease
Uterine causes
Fibroids
Endometrial polyps
Mullerian anomalies
Cervical stenosis
Intrauterine adhesion

(Albogamy *et al*., 2020; McLaren, 2012)

2.1.3 Tubal factor infertility

Tubal blockage is one of the leading causes of female infertility (Ambildhuke *et al*., 2022). Tubal causes are can be the reason for both primary and secondary infertility with higher prevalence in secondary type making routine tubal evaluation in

secondary infertility a recommendation (Aziz *et al*., 2015). Tubal damage may account for approximately 12% of infertility cases, increasing to 23% following pelvic inflammatory disease. Inflammation and infections of the reproductive system are primary contributors to oviduct obstruction (Albogamy *et al.*, 2020). It is estimated that 30% to 40% of infertile women have fallopian tube obstruction or hydrosalpinx (Ambildhuke *et al*., 2022). Most commonly, tubal disease arises in the distal segment (80%) manifesting as hydrosalpinx, with 10-25% arising proximally (Tamblyn & Jeve, 2022). Tuboplasty (tubal microsurgery) is done for some young women with tubal blockage and prior tubal sterilization . Depending upon the site of the block, several tuboplasty procedures have been performed with successful pregnancy rates varying from 27% for fimbrial surgery to 50%-60% for isthmic blockage. Salpingectomy and IVF (In Vitro Fertilization) should be done in the case of large hydrosalpinx causing distal tubal disease.(Ambildhuke *et al*., 2022).

2.1.4 Anatomy of female reproductive system

The female reproductive system comprises primary and accessory sex organs. The primary sex organs are the ovaries, which produce ova and secrete estrogen and progesterone. The accessory organs include the fallopian tubes, uterus, cervix, and vagina (Sembulingam & Sembulingam, 2012).

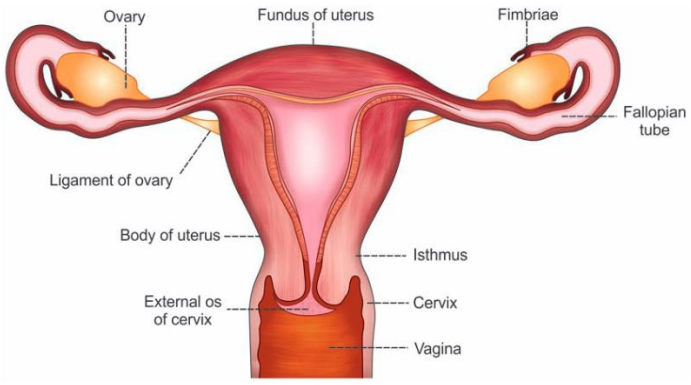

Figure 2.1: Schematic diagram of the female reproductive system (Sembulingam & Sembulingam, 2012).

i. OVARIES

The ovaries are almond-shaped organs responsible for producing oocytes (female gametes) and female sex hormones. They also function as endocrine glands (Moore *et al*., 2014).

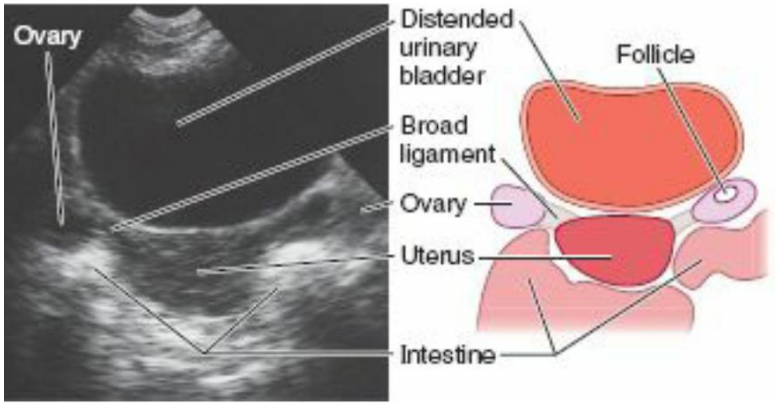

Figure 2.2: Image showing the female ovaries

(Moore *et al*., 2014).

ii. Uterus

The uterus is a hollow, muscular organ situated between the rectum and urinary bladder. It communicates with the vagina via the cervix and with the peritoneal cavity through the fallopian tubes. In a nulliparous woman, the uterus is typically pyriform in shape, measuring about 7.5 cm in length, 5 cm in width at the upper part, and 2.5 cm in thickness. It is divided into the body and the cervix. The uterus changes significantly during different stages of a woman's reproductive life, such as menstruation and pregnancy (Moore *et al.,*2014)).

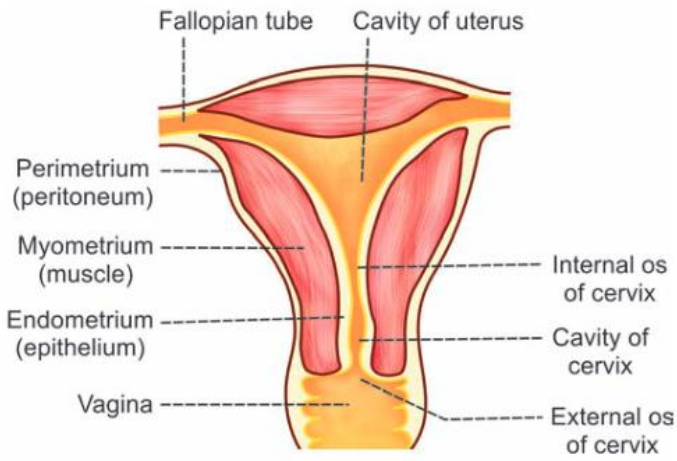

Figure 2.3: Section of the uterus

(Sembulingam & Sembulingam, 2012).

iii. Cervix

The cervix is the lower part of the uterus and is divided into the supravaginal and vaginal portions. The supravaginal portion connects with the uterine body via the internal os and contains mucus-secreting glands. The vaginal portion projects into the vagina and is lined with stratified epithelium.

iv. Vagina

The vagina is a short muscular tube lined with a mucous membrane composed of stratified squamous epithelium.

v. Fallopian Tubes

Also known as uterine tubes or salpinges, the fallopian tubes are paired structures that transport gametes and serve as the usual site of fertilization. During embryonic development, they arise from the cranial portions of the paramesonephric (Müllerian) ducts. Each tube measures approximately 8–12 cm in length and 0.5–1.2 cm in diameter, extending from the ovary to the uterus (Grigovich *et al*., 2021; Seraj *et al*., 2024). The fallopian tube is subdivided into four anatomical parts:

i. Infundibulum: Funnel-shaped distal end with fimbriae that capture the ovulated oocyte.

ii. Ampulla: The longest and widest part; common site of fertilization.

iii. Isthmus: Narrow, thick-walled part adjacent to the uterus.

iv. Uterine part (interstitial): Passes through the uterine wall and opens into the uterine cavity (Moore *et al*., 2014).

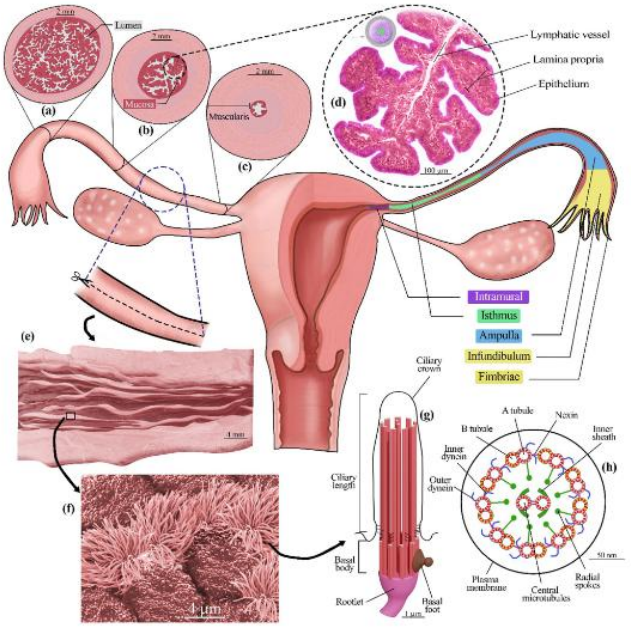

Figure 2.4: Schematic drawing of the fallopian tubes

(Seraj *et al*., 2024)

2.1.5 Diagnostic tests for fallopian tube evaluation.

Several diagnostic modalities are used to evaluate tubal patency. These methods may or may not involve ionizing radiation (Ambildhuke *et al*., 2022; Grigovich *et al*., 2021).

Table 2.2 Diagnostic tests for fallopian tubes evaluation

Procedures without ionising radiation	Procedures with Ionising Radiation
US HyCoSy with air-saline	HSG with WSCM
HyCoSy with microbubble contrast material	HSG with OSCM
HyFoSy	Virtual CT HSG
MRI MR HSG	
Dilation and insufflation test (DI)	
Laparoscopy and chromopertubation	
Falloscopy	

HyCoSy = hysterosalpingo-contrast sonography, HyFoSy = hysterosalpingo-foam sonography, HSG = hysterosalpingography, OSCM = oilsoluble contrast medium, WSCM = water-soluble contrast medium (Ambildhuke *et al*., 2022; Grigovich *et al*., 2021).

2.1.6 Hysterosalpingography (HSG)

HSG is a fluoroscopic examination that assesses uterine morphology and tubal patency through contrast instillation into the uterine cavity via the cervix. Despite being over a century old, it remains a cornerstone investigation in infertility workups due to its accessibility and diagnostic value (Wong *et al*., 2023)

It is considered the first-line test for assessing fallopian tube patency, offering an effective, minimally invasive alternative to laparoscopy. Though newer imaging technologies such as MRI and ultrasound-based techniques have emerged,

conventional HSG remains useful, particularly for evaluating tubal structure and congenital anomalies (Ahmadi *et al.*, 2012).

However, the reliability of HSG in diagnosing tubal occlusion can be limited by factors such as tubal spasm, which may mimic obstruction. Additionally, patients may experience significant discomfort or pain during the procedure (Lee *et al*., 2016).

Table 2.3: The most common indications and contraindications for HSG.

Indications	**Contraindications**
Infertility	Pregnancy
Recurrent abortion	Active pelvic infection
Irregular menstrual cycles	Vaginal bleeding
Irregular vaginal bleeding	
Congenital abnormalities or anatomic variants	
Prior to or after tubal surgery	
Tubal adhesions	
Postoperative uterine cavity	
Before assisted reproductive cycles (ART)	
Uterine fibroids	
Cervical incompetence	
Sequelae of ectopic pregnancy	

(Ahmadi *et al.* (2012).

a) Preparation

i. HSG investigations should be performed during the follicular phase of the menstrual cycle, between days 5 and 11, after cessation of vaginal bleeding.

ii. Patients should avoid intercourse from day 1 of the menstrual cycle to exclude the possibility of disrupting a potential pregnancy (Grigovich *et al*., 2021).

iii. A urine or serum pregnancy test can be performed. The patient may take nonsteroidal anti-inflammatory medication to reduce discomfort and tubal spasm and may be given prophylactic antibiotics, particularly if there is a history of pelvic inflammatory disease (PID) or demonstration of hydrosalpinx.

iv. Warming and lubricating a metal speculum or using a plastic one may alleviate discomfort.

v. After slow and gentle insertion of the speculum, the cervix is cleansed and evaluated for abnormalities.

vi. A variety of different catheters are available for performing tubal patency tests (eg, 5- or 7-French balloon catheters, acorn catheters, or cervix adaptors). The catheter should be flushed with sterile fluid or contrast material to avoid introducing air during the examination.

vii. After transcervical catheterization, a secure seal ensures adequate intracavitary pressure during the injection of fluid or contrast material and improves distention of the endometrial cavity and fallopian tubes while minimising leakage from the cervix.

viii. Contrast material is instilled slowly and gently under imaging guidance (Grigovich *et al*., 2021).

b) TECHNIQUE

i. The patient should change into a clean hospital gown and be positioned in a lithotomy position for pelvic examination.

ii. Aseptic procedure, including the cleanliness and draping of the perineum, a speculum inspection to visualise the cervical os, and subsequent removing of the ectocervix and vagina, is essential prior to catheter insertion to reduce the risk of infection that ascends.

iii. Different catheters can be used for an HSG, including infant Foley catheter (8 Fr) or any other available type.

iv. Typically, water-soluble contrast agents like iodixanol or iohexol are utilised.

v. Air bubbles entry into the uterus can be minimised by flushing the Foley catheter and any extension tubes to remove dead space prior to catheterisation.

vi. It is necessary to place in the catheter and then slowly and gently inflate the balloon with approximately 1-3 mL of water to secure it. Compared to women who have previously been pregnant, nulliparous patients often tolerate a lesser volume of balloon distension.

vii. With successful catheterisation, the patient is repositioned supine for fluoroscopic examination (Wong *et al.*, 2023).

c) Radiographs/image acquisition

The standard set in each HSG study should contain four images:

i. Earlier uterine filling (to evaluate minor flaws in uterine filling)

ii. Late tubular and uterine refilling (to evaluate tubal pathology and uterine shape)

iii. Peritoneal leakage (for tubal patency documentation)

iv. A picture obtained following the removal of the catheter and deflation of the Foley balloon (to evaluate the endocervical canal and lower uterine section) (Ahmadi *et al*., 2012).

However, if tubal blockage is suspected, manoeuvres such as delayed screening, decubitus position, and use of spasmolytic agents (glucagon or hyoscine butylbromide) should be performed in an attempt to determine if it is genuine (Wong *et al.*, 2023).

2.1.7 Results of hysterosalpingography

A. Typical anatomy

There is no long-lasting refilling deficiency and the uterine cavity has a smooth, well-defined margin with an inverse triangle form.

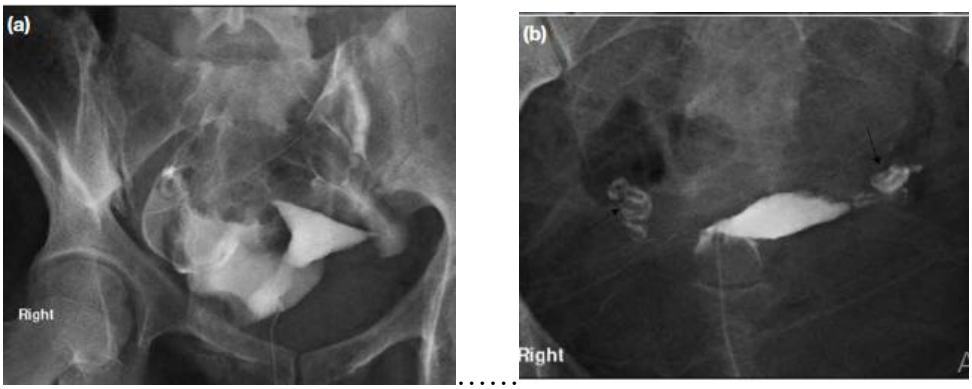

Figure 2.5: Normal fallopian tube appearance triangular uterine cavity without filling defect.on HSG

From figure 2.5a above, The fallopian tubes are visible as long, thin, smooth lines that vary in location in the pelvis and broaden towards the ampullary part. Mucosal folding can be seen to verify opacification of the ampullary part of the fallopian tubes. (Figure 2.5b). Free peritoneal contrast spillage from the fimbrial end indicates tubal patency (Wong *et al.*, 2023).

A. **Pathology of tubes**

True tubal disease or corneal smooth muscle spasm may be the cause of absence of opacification of a fallopian tube or lack of peritoneal contrast leakage. The sensitivity and specificity of assessing bilateral tubal patency or occlusion on HSG has been reported to be 92.1% and 85.7%, respectively (Khalil *et al*., 2024; Van Welie *et al*., 2022).

i. Tubal blockage

Figure 2.6: Distal left fallopian tube blockage without hydrosalpinx.

(Wong *et al.*, 2023)

Abrupt changes from the contrasting-filled proximal fallopian tube to a blank distal segment and the absence of peritoneal contrast leakage are signs of tubal obstruction.(figure 2.6). Tubal blockage can be due to pelvic adhesions from prior pelvic inflammatory disease, endometriosis, or less commonly to congenital Müllerian duct malformation (Wong *et al.*, 2023).

ii. Hydrosalpinx

Figure 2.7: Left hydrosalpinx, *lack of peritoneal contrast leakage consistent with dual tubal obstruction*

A dilated fallopian tube with copious fluid collection as a result of tubal obstruction is known as hydrosalpinx (Figure 2.7). It is linked to endometriosis, pelvic inflammation illness, previous tubal surgery (such as ligation), tubal pregnancy, and infrequently, tubal cancer.On HSG, hydrosalpinx manifests as contrast-filled dilated fallopian tubes without distal contrast spillage into the peritoneal cavity (Wong *et al.*, 2023).

iii. Pelvic peritoneal embedded collections and peritubal adhesion

Pelvic inflammatory disease can result in pelvic and peritoneal scarring and consequent adhesion bands around the pelvic organs.

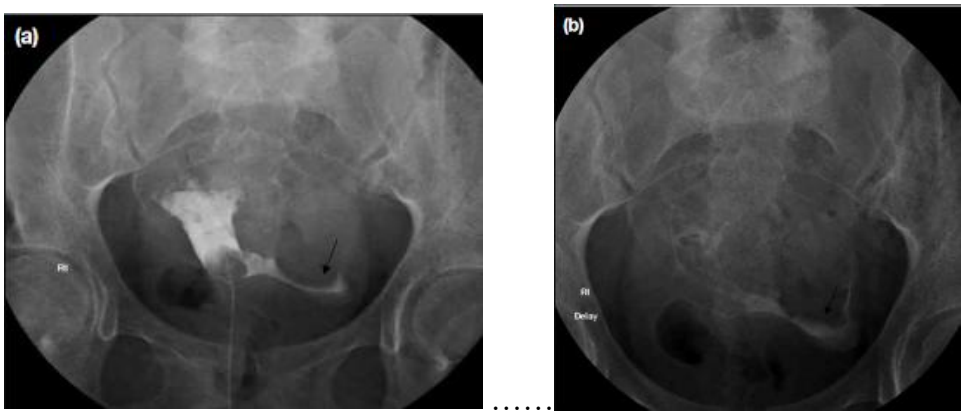

Figure 2.8: (a) ***Loculated fluid collection in hysterosalpingography (arrow). (a) A postponed film demonstrating the left pelvic region has persistent localised contrast draining***

Tubal obstruction with loculated contrast collection can be caused by adhesions surrounding the fallopian tubes. A loculated pelvic collection can manifest as a persistent localised contrast-filled region in delayed screening on HSG (figure 2.4) (Wong *et al.*, 2023).

iv. Salpingitis isthmica nodosa

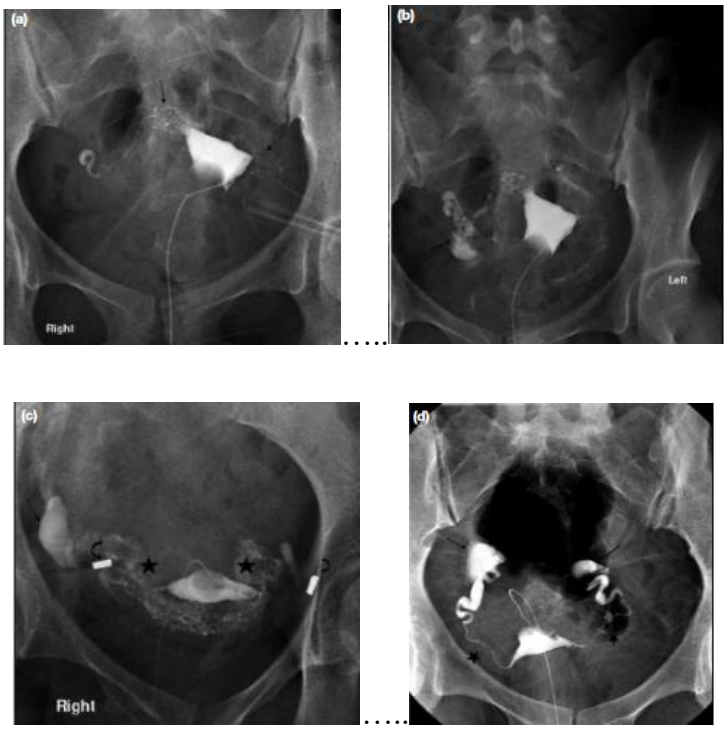

Figure 2.9: (a) Dual isthmic fallopian tubes with a little nodular outpouching filled with contrast (arrows). (b) Additional imaging reveals peritoneal contrast leakage from the patented right tube (arrow). (c) SIN with right hydrosalpinx (normal arrow) and previous bilateral tubal ligation. (d) Bilateral SIN and blocked distal tubes

Salpingitis isthmica nodosa (SIN) is a fallopian tube disease of unknown aetiology that is characterised by proximal tubal (isthmic portion) nodular thickening, associated diverticulosis of isthmic tubal epithelium invading into the muscular layer with secondary smooth muscle hypertrophy, and preserved smooth serosal surface (Figure2.5) (Wong *et al.*, 2023).

A. **Sonohysterosalpingography**

It is an alternative method to access the uterine cavity and evaluate the fallopian tubes' patency.(Ambildhuke *et al.*, 2022).

A. With ultrasound guidance, An eight-number foley catheter is used to gradually infuse around 200 millilitres of saline.

B. The passage of the saline solution through the fallopian tube and the fluid leaking from the fimbriae's ends act as indicators of the tube's condition.

C. The unrestricted spilling of liquid in the Douglas pouch is another indicator of clear fallopian tubes.

D. While contrast substances have evolved from negatives saline contrast substances to positive tiny bubble contrast agents, hysterosalpingo contrast sonography has advanced from 2D to 3D and even 4D imaging.

E. HyCoSy is advantageous because patients show better pain tolerance; it avoids the use of contrast agents containing iodine and prevents the use of ionizing radiation (Ambildhuke *et al.*, 2022).

D. The Insufflation Testing (the Rubin's testing)

Between day 7 to day ten of the cycle, the test is conducted during the postmenstrual period. If you have a pelvic infection, you shouldn't do it. The cervical canal and the peritoneal cavity are joined via a tube.When pushed through the cervix and enters the peritoneal cavity under pressure, the entry of air or carbon dioxide (CO_2) indicates that the fallopian tube is unobstructed (uncommon now) (Ambildhuke *et al.*, 2022).

E. **The Laproscopic chromopertubation;**

The most reliable method for assessing infertility brought on by fallopian tube issues is laparoscopic examinations (an authorised procedure). It typically occurs during the stage of proliferation. Tubal patency, blockage (size and position), motility, hydrosalpinx alterations, adhesions surrounding the tubal, and fimbriae agglutination can all be detected with it. Unfortunately, laparoscopic stained tubes remain the gold standard for tubal infertility assessment (Ambildhuke *et al.*, 2022).

D. **Falloscopy**

Using fragile, pliable fibre optic tools, the whole extent of the fallopian tube lumen is studied. A hysteroscope is used to perform it through the uterine cavity. It helps to directly observe the fallopian tube orifice, mucosal pattern, polyps, or fragments in the fallopian tube (Ambildhuke *et al.*, 2022).

2.2 Empirical review

Different authors have conducted studies to evaluated the diagnostic efficacy and pathological patterns identified through hysterosalpingography (HSG) in infertile women.

Asima *et al*. (2024) conducted a prospective study which compared the diagnostic performance of HSG and hysterosalpingoscintigraphy (HSSG) in 50 infertile women at a tertiary care hospital. The investigation was carried out for two years, from May 2017 to May 2019. As part of an evaluation for infertility, the study's participants received a referral to the nuclear medicine department for HSSG. HSG and HSSG techniques were carried out between days 6 and 12 of the menstrual cycle, which is the proliferative phase. An HSSG study was carried out on the days that followed the completion of the HSG study. Only once pregnancy was ruled out were the operations performed. HSSG demonstrated good diagnostic accuracy and was considered a useful complementary tool for evaluating tubal patency.

Edzie *et al*. (2024) retrospectively reviewed the medical records of women with infertility who underwent HSG at a tertiary hospital in Ghana between January 2018 and December 2022. Among 2,324 women, 1,685 (72.5%) had primary infertility, mainly younger women, while 639 (27.5%) had secondary infertility and were generally older. Bilateral tubal blockage was identified in 701 (41.6%) women with primary infertility and in 365 (57.1%) of those with secondary infertility. Other findings included hydrosalpinx (10.2%), fimbrial adhesions (19.1%), Asherman’s syndrome (0.2%), and bilateral beaded tubes/tubercular salpingitis (0.2%). Notably, 513 women (22.1%) had no abnormalities detected on HSG despite clinical evidence of infertility. Overall, 64.6% of patients had tubal blockage, with 45.9% bilateral and 18.8% unilateral.

Kamal and Elzaki (2024) conducted a prospective study among 100 Sudanese women. Primary and secondary infertility were experienced by 46% and 54% of infertile women, respectively. The BMI for both types of infertility was 25.1 kg/cm2 and the average age was 31.1 years, respectively. The prevalence of abnormal results was 30/54 (56%) and 29/46 (63%). For primary and secondary infertility, the incidence of fallopian tube abnormalities was 52/100, 52% (25/46, 54.3%) and 27/56, 50%, respectively. The hysterosalpingograms of 41% of subjects were normal. For 24% of the individuals, pelvic surgery was the greatest risk factor. The kind of infertility was highly correlated with age and past medical conditions. Fallopian tube abnormalities, particularly tubal blockage, were the most frequent cause of infertility, highlighting the need for early diagnostic evaluation.

Kamphuis *et al*. (2024) assessed 1,160 infertile women, focusing on the cost-effectiveness of tubal patency tests. The study was nationwide, multicentre, open label, randomised controlled trial with a superiority design. Infertile women with an indication for tubal patency testing during their fertility work-up will be randomly assigned to HSG with oil-based contrast medium or hysterosalpingo-foam sonography (HyFoSy). The primary outcome is conception within 6 months after randomisation leading to live birth. To demonstrate or refute an 8% difference in conception leading to live birth in favour of HSG with oil-based contrast, 1102 women will be included in the trial. A cost effectiveness analysis from a societal perspective will be performed alongside the trial. Their analysis, which included incremental cost effectiveness ratios (ICERs), provided an economic justification for various diagnostic strategies based on outcomes like live birth rates.

Khalil *et al*. (2024), in a retrospective study, found tubal blockages in 21.4% of infertile women. Among these, unilateral and bilateral blockages occurred in 11.9%

and 9.5%, respectively. Hydrosalpinx was the most prevalent abnormality, accounting for 66.7% of the tubal pathologies.

Malik *et al*. (2024) conducted a one-year prospective study at Islamabad Diagnostic Center in Islamabad, Pakistan. The sample size was calculated using online software "Raosoft" which estimated it to 242. All the patients who gave informed consent and having primary and secondary infertility were enrolled. Demographic data, including age, duration of infertility, and the presence of tubal and uterine abnormalities, were collected by reviewing clinical notes and X-ray findings. The study reported fallopian tube blockages in 20% of patients with primary infertility and 30.6% with secondary infertility. In the primary infertility group, unilateral and bilateral tubal blockages were observed in 26.5% and 29.4%, respectively. Bilateral hydrosalpinx and unilateral loculated spill were also noted.

Mayrhofer *et al*. (2024) conducted a retrospective cohort study which included 373 women aged between 18 and 40 years, treated from 1 January 2017 to 31 December 2022. Fallopian tube patency was tested using either hysterosalpingography, hysterosalpingo-contrast sonography, or laparoscopic chromopertubation.analysed 373 women using HSG, hysterosalpingo-contrast sonography, and laparoscopic chromopertubation. About 25.5% had one occluded tube, with unilateral blockage more common than bilateral. Proximal tubal occlusion was predominant (86.2%).

Wu *et al*. (2024) compared 4D-hysterosalpingo-contrast sonography (4D-HyCoSy) and HSG using laparoscopy as the gold standard. Both modalities demonstrated high diagnostic efficacy; however, 4D-HyCoSy had the advantage of reduced pain and fewer adverse effects.

Albalushi *et al*. (2023) retrospectively evaluated infertile women in Muscat and reported a 22.3% prevalence of tubal blockage. The majority of the patients (552;

60.5%) were aged ≥ 30 years. All patients who underwent this investigational procedure in the five-year period from January 2013 to December 2018 were included in the study. The HSG radiographic reports were collected and analyzed for the presence and type of CUA and tubal blockage. Among those, 39.4% had primary infertility, and 60.6% had secondary infertility. Uterine anomalies such as arcuate and bicornuate uteri were observed in a few patients with tubal blockage.

Canday *et al*. (2023), in a prospective study, reported that 82% of HSGs appeared normal. However, 88.4% of women with secondary infertility had tubal pathologies, However, patients with primary infertility was more likely to have uterine abnormalities (62.5%).Heuser *et al*. (2023) conducted a prospective study among 26 women (age >18 years) searching for infertility causes and with virtual multislice CT hysterosalpingogram (VHSG) physician request. Tubal patency, uterine morphological, ovarian, and extrauterine abnormalities were evaluated through both examinations in all the women. There was no significant difference between diagnostic performance measurements between the methods. Thereafter, the assessment performance of both techniques was determined by two reader analyses found that MRI-hysterosalpingogram (HSG) outperformed VHSG in tubal evaluation, demonstrating 100% sensitivity and specificity, suggesting its promise as an alternative diagnostic modality.

Igbodike *et al*. (2022) conducted a prospective cross-sectional study of 96 women who underwent hysterosalpingography and hysterolaparoscopy with dye test. Hysterosalpingography and hysterolaparoscopy with dye-test technique were performed on all women in the reproductive age group with utero-tubal infertility. The percentages of intrauterine disease and tubal obstruction were the outcome metrics. The gold standard for hysterosalpingography was hysterolaparoscopy with

dye test, which was used to calculate both individual and general mean accuracy. The patient underwent hysterosalpingography initially, and until analysis, the results of the hysterolaparoscopy with dye testing were concealed from both patients and laparoscopic surgeons. reported HSG diagnostic accuracy of 77.8%, 76.3%, and 78.3% for right, left, and bilateral tubal blockages, respectively. However, HSG was less accurate compared to hystero-laparoscopy, especially for hydrosalpinx detection.

Sharma *et al*. (2022) conducted a study in a tertiary referral centre of North India. The study was on 87 cases of female genital tuberculosis (FGTB) with infertility. Diagnosis of FGTB was made by composite reference standard using the presence of acid-fast bacilli on microscopy/culture or positive GeneXpert, positive polymerase chain reaction or epithelioid granuloma on endometrial biopsy or definitive or probable findings on laparoscopy or hysteroscopy. assessed the reliability of HSG using laparoscopy. Among 48 women with HSG-diagnosed tubal blockage, 40% of bilateral and 26.7% of unilateral blockages were confirmed laparoscopically. Laparoscopy had therapeutic potential and was recommended following HSG-detected blockages.

Gündüz *et al*. (2021) retrospectively evaluated hysterosalpingography and laparoscopy results of 208 patients who presented to the Obstetrics and Gynecology Clinic at Dicle University, Faculty of Medicine between January 2014-January 2018. 57.2% of patients had primary infertility, whereas 42.8% had secondary infertility. In determining tubal blockage, hysterosalpingography was found to have a specificity of 64.6%, a sensitivity of 81.3%, a positive likelihood ratio of 56.4%, and a negative predictive value of 86%. evaluated HSG's performance, reporting sensitivity of 81.3%, specificity of 64.6%, PPV of 56.4%, and NPV of 86%.

Jimah *et al*. (2021) performed repeated HSG workup under IV ketamine (20-40 mg/mL)27 infertile women at the Cape Coast Teaching Hospital were sedated. Unilateral tubular blockage, acute cervix or vaginal infection, severe vaginal bleeding, glaucoma, and high blood pressure at the period of the research were the exclusion criteria. Bilateral tubal blockage was seen in 44.4%, while 55.6% showed tubal patency. Ketamine reduced tubal spasm, improving diagnostic reliability.

Makwe *et al*. (2021) conducted a retrospective study of the pattern of HSG findings among female partners of infertile couples seeking fertility treatment, over a 2-year period, from January 2018 to December 2019. The age range was 24 to 50 years old, with a mean of 38.4 years. The majority of subjects (65.4%) were nulliparous, and the majority (80.5%) suffered secondary infertility. The most frequent anomaly found on HSG in 54.9% of women was tubal pathology. On HSG, about one-third (30.8%) of women had bilateral tubal blockage. In contrast to 41.7% for the left fallopian tube, 43.2% of those taking part had tubal occlusion in the right fallopian tube. Similarly, compared to 9% on the right tube, 10.2% of the women developed a hydrosalpinx on the left tube.Tubal pathology was the most common abnormality in at LUTH. Bilateral tubal blockage occurred in 30.8% with right-sided blockage being slightly more prevalent.

Tan *et al*. (2021) carried out a retrospective study in China, which consisted of 1,276 patients. As an initial test to assess the fallopian tube status, HSG was carried out. Women who showed signs of HSG abnormalities underwent a laparoscopic assessment. For the right and left tubes, the HSG's negative predictive value for identifying patency or occlusion was 92.08 and 95.44%, correspondingly. The accurate diagnosis in the left and right tubes had kappa values of 0.574 and 0.470, respectively. There was a larger than 40% likelihood that the right or left tube would

be patent in situations with low patency, with pelvic adhesion accounting for the remaining significant percentage. found high NPV for right (92.1%) and left tubes (95.4%) and a PPV of 87.2% for bilateral tubal blockage, affirming HSG as a reliable screening tool.

Adedigba *et al*. (2020) carried out a retrospective study at a private radiodiagnostic centre in Lagos, Nigeria. All recurrent patients who underwent HSG assessment between 2016 and 2018 had their radiologist findings examined. Indications for HSG examination and biodemographic data were recorded. A total of 450 patients was reviewed in this study, with ages ranging from 21 to 51 years and a mean age of 34.6 ± 5.56 years. The age group 31-35 years had the highest frequency of infertility. There were 299 patients referred for infertility. Secondary infertility was seen in 211 patients (46.9%), primary infertility was seen in 79 patients (17.6%), and subfertility was seen in nine patients (2%). There were 49 patients (10.9%) with cornual tubal blockage, while 57 patients (12.7%) had perifimbrial adhesion and/or blockage. There were 56 patients (12.4%) with hydrosalpinx and nine patients (2.0%) with tubal occlusion. Multivariate logistic regression analysis showed women with hydrosalpinx were 2.11 times more likely to be infertile than those without hydrosalpinxreviewed 450 patients, reporting secondary infertility in 46.9%, primary infertility in 17.6%, and various tubal abnormalities including hydrosalpinx (12.4%) and cornual blockage (10.9%).

Njeze and Ezeofor (2020) This was a cross-sectional study included 160 female patients who presented at the gynecology clinic of a private hospital in Enugu, Nigeria with clinical impression of infertility. A total of 254 radiologic features were reported, some patients had more than one radiological findings. The age range of the participants was 20 - 46 years, and the most prevalent age group was 25 - 29 years

(31.1%). The most common type of infertility was secondary infertility. The most common abnormal cervical and uterine findings were synechia and fibroids respectively. Bilateral tubal blockage 29.4% was the most common finding in the fallopian tubes. Normal findings were seen in 5.44%. Synechiae(80%) and fibroids (65%) were the most frequent cervical and uterine findings, respectively.

Oriji *et al*. (2020) conducted a descriptive cross-sectional study, with a population of 220 infertile women referred for HSG for evaluation of infertility that met the inclusion criteria for this study. Bilateral normal tubes characterised by fre e intraperitoneal spillage with normal size tubes were present in 136 patients (61.8%). Tubal blockage, either bilateral or unilateral was the most common tubal abnormality, and it was observed in 48 patients (21.9%). Left tubal blockage alone was observed in 15 patients (6.8%). Right tubal blockage alone was observed in 6 patients (2.7%). Hydrosalpinx, either bilateral or unilateral was observed in 15 patients (6.8%). Bilateral hydrosalpinx was observed in 10 patients (4.5%). Left hydrosalpinx alone was observed in 1 patient (0.5%). Right hydrosalpinx alone was observed in 4 patients (1.8%). There was no patient with a combination of tubal blockage and hydrosalpinx. Tubal abnormalities, including blockage and hydrosalpinx, were found in 21.9% and 6.8% of women, respectively, with hydrosalpinx more common on the right.

Toufig *et al*. (2020) conducted another prospective descriptive study of 75 female patients referred, as cases of infertility, for HSG examination in Elrebat Hospital and Khartoum Advanced Diagnostic Center. During the very first half of the cycle, HSG was carried out. The investigation excluded patients with current uterine or vaginal bleeding and pelvic infections. Iodinated contrast was injected into the cervix under fluoroscopic observation using aseptic method and appropriate patient placement to show the uterine cavity, fallopian tubes, and free leakage into the peritoneal

cavity.documented abnormal HSG findings in 52.7% of infertile women, with tubal pathology being the most frequent (42.7%), followed by uterine and combined anomalies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research setting

The study was conducted at the Department of Radiology, University of Benin Teaching Hospital (UBTH), Benin City, Edo state. The University of Benin Teaching Hospital was taken over by the Federal Government on April 1st, 1975 as the fifth teaching hospital coming after Ibadan Teaching Hospital and Lagos Teaching Hospital.It had bed capacity of 360 when it was opened on May 12th, 1973, the UBTH has of a bed capacity of over 900 as at August 2019 and still increasing. It is located at Ugbowo Lagos Road,Benin City, Nigeria (Ubth, nd).The radiology department has 2 Computed Tomography scanners, Multiple ultrasound equipments, 3 mobile & 4 static x-ray machines, and one automatic processor The department receives a high number of referrals for HSG, making it an appropriate setting for assessing its efficacy in diagnosing tubal blockage. (Ubth, n.d).

3.2 Study design

The study used a retrospective design. It was conducted in the department of radiology, university of benin teaching hospital (UBTH) from July 2025- September 2025

3.3 Target population

The target population for this study consisted of women who underwent hysterosalpingography (HSG) for infertility evaluation at the Radiology Department of University of Benin Teaching Hospital Benin (UBTH). A total of 217 archived HSG reports were retrieved from the deparment records. Of these, (9 records had no attached reports, while 8 were excluded due to incomplete information. Afterwards, 200 HSG reports with complete data were included in the study.

3.4 Sampling technique/sampling size

A purposive sampling technique was employed to select available records of infertile women who underwent hysterosalpingography (HSG) between Jan 2024 and July 2025 at University of Benin Teaching Hospital Benin (UBTH). The sample size included all eligible patient records within the specified period that contain complete and readable HSG reports and relevant clinical information.

Inclusion criteria

i. HSG reports of women investigated for infertility within the specified study period.
ii. Reports that contained complete patient demographic details, radiological findings, and diagnostic impressions.
iii. Records that were legible and accessible from the departmental archives.

Exclusion criteria

i. HSG reports with missing or illegible information.
ii. Records of patients who underwent HSG for indications other than infertility (e.g., post-surgical evaluation).
iii. Duplicate entries or repeated HSGs for the same patient within the study period.

Sampling size determination

Since the study used a retrospective census method, all eligible and complete HSG reports meeting the inclusion criteria were included. Hence, the final sample size was 200 records.

3.5 Instrument for data collection

A structured data capture sheet was used to retrieve relevant data such as patient age, type of infertility, findings such as unilateral/bilateral blockage), and any associated uterine abnormalities and overall radiological impression. The instrument is attached as appendix I.

3.6 Validity of instrument

To ensure the content and face validity of the data collection instrument, the draft data collection sheet was reviewed by the project supervisor and a senior radiographer at UBTH. Feedback was obtained to verify that all important diagnostic parameters and variables were relevant and accurately reflected clinical reporting standards. The instrument was refined to include clearly defined variable categories, ensuring that data could be extracted consistently across different reports. Furthermore, pilot testing of the instrument was conducted on ten randomly selected HSG reports (not included in the main dataset). This step ensured that the instrument was practical and comprehensive, with all necessary variables represented.

3.7 Reliabilty of instrument

Reliability was assessed through inter-rater reliability testing. Two independent radiographers used the instrument to extract data from a randomly selected subset of 20 HSG reports. Their findings were compared for consistency in identifying variables such as type of infertility, pattern of tubal blockage, and uterine abnormalities. A Cohen's kappa coefficient (κ) was computed to measure agreement between the two raters, and a value above 0.80 was achieved, indicating strong reliability of the data collection sheet.

3.8 Method of data collection

The researcher accessed the physical archives of the radiology department and manually retrieved eligible HSG reports. Information was extracted and transcribed

into the data collection sheet. To ensure accuracy, each report was reviewed and cross checked before entry.

3.9 Method of data analysis

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) version 29.0. Descriptive statistics such as frequencies, means, percentages were used to summarize findings. Inferential statistics (Chi square test) was used to test associations between selected variables, and significance was set at $p < 0.05$. Incomplete variables were excluded from specific analyses on a case by case basis rather than listwise deletion, ensuring maximum data retention. To reduce potential confounding, only HSG reports for infertility evaluation were included, and cases with unrelated indications or unclear diagnoses were excluded during the sampling stage

3.10 Ethical consideration

Ethical approval was obtained from the Health Research Ethics Committee of University of Benin Teaching Hospital (UBTH). No patient consent was required due to the retrospective nature of the study. All data was anonymized, and confidentiality was strictly maintained. The ethical approval request and approval letters are attached as appendix II and III.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the results of this study. These results cover data obtained from descriptive (percentages and frequencies) and inferential statistics (Chi square test). The results are presented in narrative and tabular formats.

4.1 Presentation

This study comprised the findings of 200 infertile women who had hysterosalpingography (HSG) at the University of Benin Teaching Hospital's radiology department. The average age was 36.3 +/- 2.1 years. The vast majority of the patients were between the ages of 30 and 39. More over half of the 107 women (53.5%) were between the ages of 30 and 39, followed by those between the ages of 40 and 49 (26%), as seen in Figure 4.1. Just 8 (4%) of them were over 50.

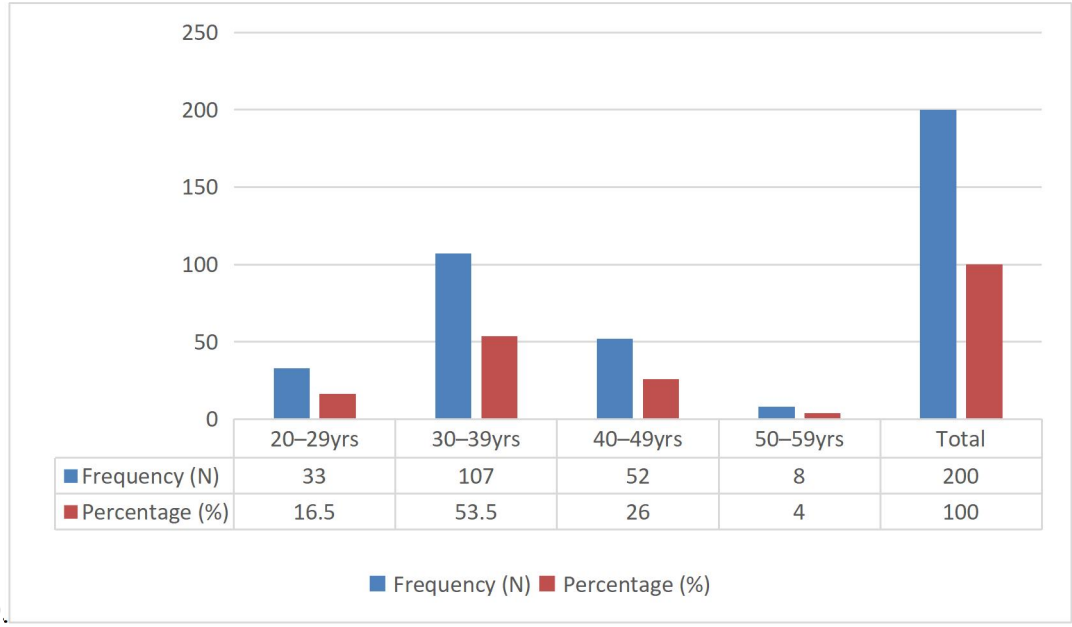

Figure 4 1: Age distribution of patients

Majority of the patients 152 (76%) presented with secondary infertility, while 38 (19%) had primary infertility. Subfertility was recorded in 3 (1.5%) of cases, and 7 (3.5%) were unspecified There was a significant difference between the types of infertility among the age groups (p value = 0.000) (Table 4.1)

Table 4 1: Types of infertility

	Types of infertility				
AGE	Primary infertility N=38 (%)	Secondary infertility N=152 (%)	Subfertility N =3 (%)	Unspecified N=7 (%)	p-value
20-29yrs	13 (34.2)	20 (13.2)	0 (0.0)	0 (0.0)	
30-39yrs	17 (44.7)	88 (57.9)	1 (33.3)	1 (14.3)	0.000
40-49yrs	7 (18.4)	38 (25%)	1 (33.3)	6 (85.7)	
50-59yrs	1(2.6)	6 (3.9)	1 (33.3)	0 (0.0)	

Almost half 90 (45%) of the women had normal uterine cavity outlines. Among abnormal findings, pelvic adhesions were the most common 45 (22.5%), followed by uterine fibroids 37 (18.5%). Uterine synechiae 13 (6.5%), arcuate uterus 3 (1.5%), septate uterus 1 (0.5%), and irregular outlines 11 (5.5%) were less common (Table 4.2)

Table 4 2: Pattern of HSG uterine findings.

Age	Normal N=90 (%)	Uterine Synachae N=13(%)	Pelvic adhesions N= 45(%)	Uterine fibroid N=37 (%)	Arcuate Uterus N=3(%)	Septate Uterus N=1 (%)	Iregular uterine outline 11 (%)
20-29yrs	18 (20.0))	2 (15.4)	6 (13.3)	5 (13.5)	0 (0.0)	0 (0.0)	2 (18.2)
30-39yrs	42 (46.7)	8 (61.5)	22 (48.9)	27 (73.0)	3 (100)	1 (100)	4 (36.4)
40-49yrs	28 (31.1)	3 (23.1)	13 (28.9)	4 (10.8)	0 (0.0)	0 (0.0)	4 36.4)
50-59yrs	2 (2.2)	0 (0.0)	4 (8.9)	1 (2.7%)	0 (0.0)	0 (0.0)	1(9.1)

Half of the women 100 (50%) demonstrated bilateral contrast spillage, indicating tubal patency. There was no contrast spillage in 48 (24%), while right and left spillage were 36 (18%) and 16 (8%) respectively. (Table 4.3).

Table 4 3: Frequency of tubal contrast spillage

Age	None N=48 (%)	Right tubal spillage N=36 (%)	Left tubal spillage N=16 (%)	Bilateral spillage N= 100 (%)
20-29yrs	6 (12.5)	5 (13.9)	1 (6.3%	21 (21.0)
30-39yrs	21 (43.8)	22 (61.1)	7 (43.8)	57 (57.0)
40-49yrs	21 (43.8)	4 (11.1)	8 (50.0)	19 (19.0)
50-59yrs	0 (0.0)	5 (13.1)	0 (0.0)	3 (3.0)

A total of 64 (32%) of the fallopian tubes were blocked while 136 (68%) were patent. Within the age groups, right fallopian tube blockage was highest in patients who were between 40-49yrs 29 (45.3%) followed by 30-39yrs age group 28 (48.8%) (Table 4.4).

Table 4 4: Patency of the right fallopian tube

Age	Right fallopian tube	
	Blocked N=64 (32%)	Patent N= 136 (68%)
20-29yrs	7 (10.9)	26 (19.1)
30-39yrs	28 (48.8)	79 (58.1)
40-49yrs	29 (45.3)	58.1 (16.9)
50-59yrs	0 (0.0)	8 (5.9)

From Table 4.5 below, regarding the left fallopian tube, 82 (41%) were blocked while 118 (59%) were patent. The age group with the highest number of left fallopian tube blockage and patency was 30-39yrs (blocked 41 (50%) and 66 (55.9%) were patent).

Table 4 5:Patency of the left fallopian tube

Age	Left fallopian tube	
	Blocked N=82 (%)	Patent N= 118 (%)
20-29yrs	11 (13.4)	22 (18.6)
30-39yrs	41 (50.0)	66 (55.9)
40-49yrs	25 (30.5)	27 (22.9)
50-59yrs	5 (6.1))	3 (2.5)

As shown in Table 4.6 below, bilateral non patent tubes were noted in 44 (22%) of all women. Left hydrosalpinx was concluded in 5 (2.5%) patients. Bilateral patent tubes were found in 104 (52%) women, indicating more than half of women had patent tubes on HSG.Right patent tubes alone were 23 cases (11.5%). Left patent tubes alone were 16 cases (8%). In total, 71.5% of women had at least one patent tube. Bilateral hydrosalpinx: 5 cases (2.5%). right hydrosalpinx only: 2 cases (1%). Based on age group, 20-29 years had bilateral patent tubes 21 (63.6%). While women between 30-39 years had highest proportion of both patent tubes 59 (56.7%). Women between 40-49 years had the most bilateral non-patent tubes 21 (47.7%).

Table 4 6: Overall HSG findings

Age	Bilateral non-patent tubes N = 44 (%)	Right Patent tube N= 23 (%)	Left Patent tube N= 16 (%)	Bilateral patent tubes N= 104 (%)	Bilateral Hydrosalpinx N= 5 (%)	Right Hydrosalpinx N= 2 (%)	Uterine synachae N = 1 (%)	Left hydrosalpinx N=5 (%)
20-29yrs	3 (6.8)	3 (13.0)	0 (0.0)	21 (20.2)	4 (80.0)	0 (0.0)	3 (6.8)	3 (13.0)
30-39yrs	20 (45.5)	14 (60.9)	9 (56.3)	59 (56.7)	1 (20.0)	1 (50.0)	20 (45.5)	14 (60.9)
40-49yrs	21 (47.7)	3 (13.0)	7 (43.8)	20 (19.2)	0 (0.0)	1 (50.0)	21 (47.7)	3 (13.0)
50-59yrs	0 (0.0%)	3 (13.0)	0 (0.0)	4 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)	3 (13.0)

4.2 Discussion

This study evaluated the efficacy of hysterosalpingography (HSG) in diagnosing tubal blockage among infertile women at the University of Benin Teaching Hospital (UBTH). A total of 200 infertile women were included, with a mean age of 36.3 ± 2.1 years.

More than half of the women 107 (53.5%) were between 30-39 years, followed by 52 (26%) between 40-49 years. The smallest age group was 20- 29yrs and 50-59 years, having 33 (16.5%) and 8 (4.0%) respectively. This could be due to the fact that in this part of the country there is prevalence of late marriages compared to the North were early marriages are common. Hence, women begin to face fertility issues mostly after the second decade of life, since they are more forcused on business and education during their 20's. Sometimes in Nigeria women who have fertility issues resort to using traditional herbs for treatment and present late to the hospital after series of infections, miscarriages and tubal damges. The majority presented with secondary infertility 152 (76%), while 38 (19%) had primary infertility. This might be because, most ladies who have fertility issues might have conceived before but had complications leading to loss of the pregnancy or they had children before but want more due to the societal values placed on having more children. This predominance of secondary infertility is consistent with global reports that secondary infertility is more common than primary infertility, especially in low resource countries (Malik *et al*., 2024). Similarly, Edzie *et al*. (2024) reported a higher proportion of secondary infertility (57.1%) compared to primary infertility in Ghana, while Makwe *et al*. (2021) found over 80% of infertility cases in Lagos was reported to be secondary. These similarities shows the strong association between cultural and societal values, infections, poor gynaecological care, and acquired tubal damage in African countries

following previous conception. This pattern may be due to previous pregnancies complicated by miscarriages, infections, or unsafe abortions, which result in tubal damage. However, because this study relied on archived HSG reports without access to detailed clinical histories, some underlying causes of infertility such as hormonal imbalance or ovulatory disorders could not be evaluated, which may slightly limit interpretation of the infertility distribution.

Pattern of uterine findings

Almost half of the women 90 (45%) had normal uterine cavity outlines, while abnormal findings included pelvic adhesions 45 (22.5%), 37 fibroids (18.5%), synechiae 13 (6.5%), arcuate uterus 3 (1.5%), and septate uterus 1 (0.5%). Fibroids and adhesions were the most common abnormalities, consistent with Bobmanuel *et a*l. (2023), who reported fibroids and adhesions as common uterine abnormalities among infertile Nigerian women. The high occurrence of fibroids and adhesions may be due to high prevalence of fibroids among African women, pelvic infections, surgical complications, all of which can lead to uterine damge and cause infertility. Oriji *et al*. (2020) also found fibroids in 65% of women and synechiae in 80%, supporting this study's findings. However, Albalushi *et al*. (2023) in Oman found a lower prevalence of uterine anomalies (e.g., bicornuate and arcuate uteri), indicating geographical and genetic variations in the pattern of uterine abnormalities. Nevertheless, as this study was retrospective and based on written reports, the accuracy of uterine abnormality classification may have been affected by variations in radiologist descriptions or lack of image review. Minor anomalies such as endometrial polyps or subtle congenital malformations may have been underreported, which could slightly underestimate the true prevalence of uterine abnormalities in this population.

Tubal patency and blockage patterns

Half of the women had bilateral contrast spillage 100 (50%), indicating tubal patency, while 48 (24%) showed no spillage and 36 (18%) and 16 (8 %) had right and left tubal spillage respectively. Overall, the right fallopian tube was blocked in 64 (32%) of women, while the left was blocked in 82 (41%). Bilateral non-patency was observed in 44 (22%) of women. The reason for tubal blockage could be because of mistreated and untreated pelvic inflammatory infections. It is a common practice in our locality for women to take antibiotics (tablets or injections) without proper consultation and laboratory investigations. Previous ectopic pregnancies, post surgical adhesions could also be contributing factors. The higher prevalence of left sided blockage aligns with Oriji *et al*. (2020), who found left tubal blockage in 6.8% compared to right-sided blockage in 2.7% women. Similarly, Njeze & Ezeofor (2020) reported bilateral blockage in 29.4% of cases, which is slightly higher than the 44 (22%) reported in this study. These variations may be due to differences in sample size, diagnostic expertise or experience, or regional health factors.

Older women (≥40 years) were more likely to have blocked tubes and secondary infertility compared to younger women. This age related pattern could be due to both natural reproductive decline (Vander Borght & Wyns, 2018) and the cumulative effects of pelvic infections and surgeries. Younger women (20-29 years) showed the highest rate of bilateral patent tubes 127(63.6%), while older women (40-49 years) had the highest rate of bilateral non-patency 95 (47.7%). These findings agree with Jimah *et al*. (2021), who reported higher tubal patency in younger women and increased blockage with age. Similar report was made by Malik *et al*. (2024), who found higher tubal blockage prevalence among women with secondary infertility, often older in age. However, because laparoscopy (the gold standard for tubal assessment) was not available for comparison, the reported tubal blockage rates could

not be validated. As a result, false-positive occlusions due to tubal spasm or inadequate contrast filling during HSG may have occurred, potentially influencing the reported proportion of blocked tubes

Hydrosalpinx and other tubal pathologies

Hydrosalpinx was identified in 5 (2.5%) of patients, less frequent than reported by Makwe *et al*. (2021), who observed hydrosalpinx in 10.2% of infertile women, and Khalil *et al*. (2024), who found hydrosalpinx in 66.7% of tubal pathologies. The lower prevalence in this study may be due to differences in population size or under diagnosis in retrospective records. Regardless, its presence is clinically significant since hydrosalpinx reduces fertility potential and In-vitro fertilization success. Yet, because the study did not include detailed reproductive histories or prior infection data, the causal link between age and tubal pathology should be interpreted cautiously. The lack of such confounder control represents a minor limitation of this retrospective approach.

Diagnostic efficacy of hysterosalpingography

While HSG detected abnormalities in 88 (44%) of women, in this study there was no laparoscopic confirmation, limiting accuracy assessment. However, HSG has a sensitivity of 65-94% and specificity of 83-92% (Khalil *et al*., 2024; Van Welie *et al*., 2022). Igbodike *et al*. (2022) also reported that HSG, though less accurate than laparoscopy, remains reliable as a first line screening tool. Tan *et al.* (2021) found high negative predictive values (92-95%) for HSG, supporting its usefulness in ruling out tubal blockage when spillage is visualized. The findings of this study therefore support the clinical value of HSG as a first-line, accessible, and cost-effective method in infertility evaluation. However, its limitations including radiation exposure, patient discomfort, and inability to visualize peritoneal factors must be recognized. In

addition, the absence of standardized reporting protocols and lack of inter observer comparison among radiologists may have introduced variability in result interpretation, subtly affecting the precision of diagnostic efficacy reported here.

Summary of findings

- The mean age of participants was 36.3 years, with the majority aged 30–39 years.
- Secondary infertility was predominant (76%).
- Fibroids and adhesions were the most common uterine abnormalities.
- Bilateral tubal patency was observed in 50% of women, while bilateral blockage occurred in 22%.
- Left-sided tubal blockage was more frequent (41%) than right (32%).
- Hydrosalpinx was identified in 2.5% of women.
- HSG remains effective and accessible for diagnosing tubal pathologies, especially in resource limited environments.

CHAPTER FIVE

5.1 CONCLUSION

This study evaluated the diagnostic efficacy of hysterosalpingography (HSG) in detecting tubal blockage among infertile women at the University of Benin Teaching Hospital. Among 200 women assessed, tubal blockage was detected in 88 (44%), and secondary infertility predominated (152; 76%). Left-sided and bilateral blockages were the most frequent findings, while adhesions (22.5%) and fibroids (18.5%) were the leading uterine abnormalities.

Younger women showed higher rates of tubal patency, whereas older women exhibited more blockages, highlighting the effects of age and acquired pelvic pathology on fertility. The findings align with regional studies and reaffirm the relevance of HSG as a reliable, affordable first-line investigation for infertility assessment.

However, the absence of laparoscopic confirmation and the retrospective nature of data limit the accuracy of reported prevalence. Despite these constraints, the study shows the continued diagnostic value of HSG and the need for early fertility screening and improved infection prevention to reduce tubal factor infertility.

5.2 RECOMMENDATIONS

The following recommendations will be useful;

- Radiology departments should adopt uniform HSG reporting templates to ensure consistency, improve diagnostic accuracy, and facilitate communication between radiologists, radiographers, and referring gynaecologists.
- Where feasible, HSG findings should be corroborated with laparoscopy, HyCoSy, or ultrasound to enhance diagnostic reliability and guide appropriate management.

- Radiographers and clinicians should educate patients on infection prevention, safe reproductive practices, and early hospital visits, particularly after miscarriages or pelvic infections.
- Continuous medical education and hands on HSG training workshops should be organized to improve radiographers' and radiologists' competence in patient handling, positioning, and accurate interpretation.
- Implementation of community based fertility awareness programs to encourage early medical consultation and reduce reliance on unregulated herbal or self-prescribed treatments.
- Federal and state health authorities should upgrade radiology departments with modern HSG equipment, digital fluoroscopy, and contrast media supplies to improve service quality and reduce patient waiting times.
- The Ministry of Health and professional bodies (e.g., Association of Radiographers of Nigeria, Society of Gynaecology and Obstetrics of Nigeria) should collaborate to establish national guidelines for infertility imaging and reporting.
- To improve access, the government should include basic infertility investigations such as HSG in the National Health Insurance Scheme (NHIS) to support low-income families seeking reproductive healthcare.

5.3 LIMITATIONS

- The retrospective design used in this study led to limited control over completeness of clinical data.
- There was also absence of laparoscopy (gold standard) prevented calculation of sensitivity and specificity.

- Possible underreporting or misclassification of some HSG findings is also possible due to differences in radiologist interpretation abilities.

5.4 SUGGESTION FOR FURTHER STUDIES

1. Multicenter studies across Nigeria and other African countries are encouraged to provide regional prevalence data and improve the generalizability of findings.
2. Future work should assess the psychological impact of infertility and the role of imaging services in patient counseling and support.

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APPENDIX I: Data capture sheet

S/N	Patient ID	Age	Duration of Infertility (yrs)	Type of Infertility (Primary/Secondary)	Uterine Cavity Appearance	Rt Fallopian Tube	Lt Fallopian Tube	Contrast Spill (R/L/Bilateral/None)	Overall Impression

APPENDIX II: Ethical approval request

Department of Medical Radiography,

School of Basic Medical Sciences,

University of Benin,

Edo State.

June 2025.

The Chairman,

Health Research and Ethics Committee

University of Benin Teaching Hospital,

Edo State.

Dear Sir/ma,

APPLICATION FOR ETHICAL APPROVAL TO CONDUCT A RESEARCH STUDY

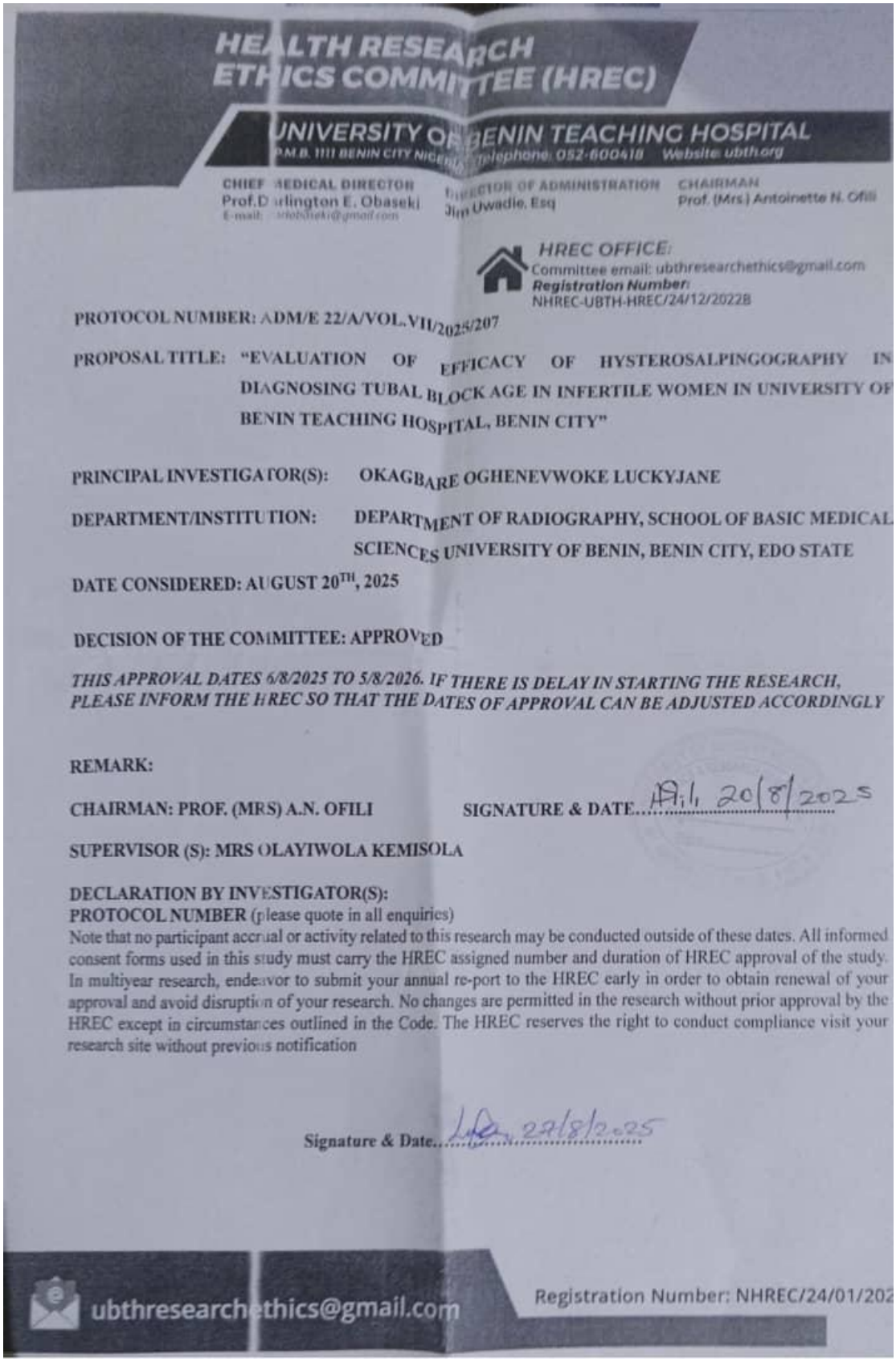
I Okagbare Ogenevwoke Luckyjane with registration number BMS2005203 , hereby apply for the above subject. I am an undergraduate student from the Department of Radiography, School of Basic Medical Science, University of Benin. I kindly request for ethics approval to conduct a research project on the topic titled "Evaluation of efficacy of hysterosalpingography in diagnosing tubal blockage in infertile women " in partial fulfillment of the requirements for the award of a Bachelor of Science degree in Radiography. Attached is a copy of my research project proposal. I hope my request will be considered.

Yours Faithfully,

Okagbare Ogenevwoke Luckyjane

Phone number: 07085267075

APPENDIX III: Ethical approval letter



HEALTH RESEARCH ETHICS COMMITTEE (HREC)

UNIVERSITY OF BENIN TEACHING HOSPITAL

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Committee email: ubthresearchethics@gmail.com
Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL.VII/2025/207

PROPOSAL TITLE: "EVALUATION OF EFFICACY OF HYSTEROSALPINGOGRAPHY IN DIAGNOSING TUBAL BLOCKAGE IN INFERTILE WOMEN IN UNIVERSITY OF BENIN TEACHING HOSPITAL, BENIN CITY"

PRINCIPAL INVESTIGATOR(S): OKAGBARE OGHENEVWOKE LUCKYJANE

DEPARTMENT/INSTITUTION: DEPARTMENT OF RADIOGRAPHY, SCHOOL OF BASIC MEDICAL SCIENCES UNIVERSITY OF BENIN, BENIN CITY, EDO STATE

DATE CONSIDERED: AUGUST 20TH, 2025

DECISION OF THE COMMITTEE: APPROVED

THIS APPROVAL DATES 6/8/2025 TO 5/8/2026. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY

REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI SIGNATURE & DATE..... 20/8/2025

SUPERVISOR (S): MRS OLAYIWOLA KEMISOLA

DECLARATION BY INVESTIGATOR(S):
PROTOCOL NUMBER (please quote in all enquiries)
Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. In multiyear research, endeavor to submit your annual re-port to the HREC early in order to obtain renewal of your approval and avoid disruption of your research. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification

Signature & Date..... 22/8/2025

ubthresearchethics@gmail.com

Registration Number: NHREC/24/01/202