SCROTAL SONOGRAPHIC EVALUATION OF THE INFERTILE MALE PATIENTS IN THE LAGOS UNIVERSITY TEACHING HOSPITAL.

BY

DR OYENDE Babashola Omoshalewa MBCHB (Ogun)
DEPARTMENT OF RADIodiAGNOSIS
LAGOS UNIVERSITY TEACHING HOSPITAL,
IDI-ARABA, LAGOS, NIGERIA.

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF THE FELLOWSHIP OF THE NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA IN THE FACULTY OF RADIOLOGY (FMCR)

MAY 2015
DECLARATION

I hereby declare that this work is original and was carried out by me. The work has not been submitted in part or whole to any other College for a Fellowship or Diploma, nor has it been submitted elsewhere for publication.

________________________________________

Dr. Oyende Babashola Omoshalewa
CERTIFICATION

I hereby confirm that this research work titled ‘SCROTAL SONOGRAPHIC EVALUATION OF THE INFERTILE MALE PATIENTS IN THE LAGOS UNIVERSITY TEACHING HOSPITAL’, was carried out by DR OYENDE Babashola Omoshalewa in the Department of Radiodiagnosis, Lagos University Teaching Hospital (LUTH), Idi-Araba Lagos.

Head of Department

DR. K. O. SOYEBI
ATTESTATION

I hereby attest that this project was carried out and written by the author under my supervision.

SIGNED:

........................................
Prof. G.O.G Awosanya
Consultant Radiologist,
Department of
Radiodiagnosis LUTH,
Idi-Araba, Lagos.
DEDICATION

To GOD Almighty who has given me the Grace and the privilege to study Radiology.

To my beloved wife, Titilayominiwajuoluwa and children, Iyinoluwa, Oluwayoyinsolami, Moyosoreoluwa and Oluwalogbon Oyende for their unabating love, understanding and the joy they bring to my life.

To my wonderful parents Late Pa & Mrs. Solomon Abiodun Oyende for their endless love, support and belief in me.

To my sisters and brothers.
ACKNOWLEDGEMENTS

I thank the Almighty God for his love, care and mercy throughout the period of my training in LUTH, Idi-Araba, Lagos.

I wish to acknowledge with gratitude my indebtedness to my Supervisors, Prof. G.O.G. Awosanya, Mr. K.H. Tijani and Dr.(Mrs.) O.A. Olowoyeye who patiently guided me through the entire process. The successful completion of this work would not have been possible without their help.

I am also grateful to Dr. K.O. Soyebi, Head of Department of Radiodiagnosis, Consultants, Resident doctors/colleagues, entire staff of Department of Radiodiagnosis, LUTH, who wonderfully supported me in various ways during my residency training programme. May God bless you all.

Words are not enough to express my heartfelt gratitude to the following people who also contributed in immense ways- Dr. Ogunjimi, Dr. Daini and Dr. (Mrs) Mojisola Bello.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td>CERTIFICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ATTESTATION</td>
<td>iv</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vii</td>
</tr>
<tr>
<td>SUMMARY</td>
<td>1-2</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>3-6</td>
</tr>
<tr>
<td>ANATOMY</td>
<td>7-10</td>
</tr>
<tr>
<td>JUSTIFICATION</td>
<td>11</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>12</td>
</tr>
<tr>
<td>LITERATURE REVIEW</td>
<td>13-17</td>
</tr>
<tr>
<td>MATERIALS AND METHODS</td>
<td>18-23</td>
</tr>
<tr>
<td>RESULTS</td>
<td>24-39</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>40-48</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>49</td>
</tr>
<tr>
<td>RECOMMENDATION</td>
<td>50</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>51-55</td>
</tr>
<tr>
<td>APPENDIX I</td>
<td>56</td>
</tr>
<tr>
<td>APPENDIX II</td>
<td>57</td>
</tr>
</tbody>
</table>
SUMMARY

Background: The prevalence of male infertility in our environment is largely unknown while in the western world, it is estimated to be about 30% with male factor responsible for close to 50% of cases. Apart from seminal fluid analysis, there is no universal consensus on the mode of evaluation of men with infertility. This is a prospective study that evaluated the role of scrotal ultrasonography in men with infertility.

Methodology: The study examined 220 subjects over a period of one year. The subjects comprised of one hundred and thirty-six patients with diagnosis of male infertility, as well as 84 healthy individuals as control. The relevant clinical history of each patient was extracted from their case notes.

All the subjects had their testes examined using a high frequency 7.5mHz linear transducer of an Aloka (Prosound SDD-3500 Plus, Japan 2005) ultrasound scanner. The results were expressed as percentages and tests of significance were done using the chi-square and student t-test. A p-value of less than 0.05 was considered statistically significant.

Results: The mean age for infertile patients was 36.80±0.98 years while the peak age for both groups, was 30-39years.
There was a statistically significant difference between the testicular volumes in fertile and infertile men, while there was an inverse relationship between testicular volume and severity of oligospermia.

The overall proportion of scrotal abnormalities was 93% in infertile men versus 26% in control group. Varicocele was the most common abnormal finding occurring in 63.2% and 11.9% of infertile and normal patients respectively. There was a 2.9% and 0% incidence of suspected early stage testicular tumor in the infertile and control groups respectively.

**Conclusion:** Scrotal ultrasonography was able to detect potentially curable causes of infertility in more than half of the infertile men and was able to detect testicular tumors at a potentially curable stage. Scrotal ultrasonography is recommended as a valuable tool for the evaluation of men with infertility.
INTRODUCTION

Male Infertility refers to the inability of a male to achieve a pregnancy in a fertile female. In humans, it accounts for 40-50% of infertility. Male Infertility is commonly due to deficiencies in the semen and semen quality is used as a surrogate measure of fecundity.

The role of ultrasonography in the evaluation of male infertility has expanded with advancements in this technology. Scrotal ultrasonography can readily diagnose many male reproductive tract disorders resulting in infertility.

Reproductive endocrinologists consider a couple to be infertile if the female partner has not conceived after 12 months of contraceptive – free intercourse and she is under the age of 34 or if the female partner who is over 35 years of age has not conceived after 6months of contraceptive free intercourse or if the female is incapable of carrying a pregnancy to term.

From the acceptance and widespread use of color flow Doppler ultrasonography for the assessment of varicoceles to transrectal ultrasonography combined with seminal vesiculography for the evaluation of ejaculatory duct obstruction, ultrasonography has important clinical applications in reproductive medicine.
Infertility is typically defined as failure to conceive within a certain period of time. For the male, this definition is particularly problematic, as it relies on an outcome of his female partner, who may have reproductive issues of her own.\textsuperscript{3}

The male factor plays a role in approximately 50\% of infertility cases.\textsuperscript{1} Traditional evaluation of male infertility had included clinical evaluation, semen fluid analysis (SFA), vasography, ultrasonography and testicular biopsy.\textsuperscript{4} However, unlike vasography and testicular biopsy, ultrasonography is non-invasive with no risk to either the patient or physician.

The testis has 2 main functions - An endocrine (tubeless) function to produce testosterone, responsible for the male secondary sexual characteristics including erection and the exocrine function to produce sperm cells. The Leding cells are responsible for the former while the seminiferous tubules which constitute 90\% of testicular size are responsible for the later. As a result an impotent man is probably more likely to have normal sized testes when compared with an infertile man.

Men with infertility are being investigated increasingly in an effort to find a cure for their infertility.\textsuperscript{1} This mainly involves oligospermic patients in whom a cause is routinely sought in an attempt to improve semen quality. It also involves azoospermic patients with normal testicular volume in whom an obstructive cause is sought.
Known scrotal anomalies associated with increased incidence in male infertility include, decrease testicular volume, testicular microlithiasis, testicular tumors, varicocele, hydrocele and epididymal abnormalities. 

Scrotal ultrasonography with high frequency transducers and color Doppler imaging have proved reliable in assessing intra and extra testicular abnormalities and indeed scrotal abnormalities have been found on Ultrasonography in 38 to 59% of infertile men.

Apart from its use in the diagnosis of Male Infertility, Scrotal ultrasonography can also be used to monitor treatment e.g. assessing the recurrence of varicoceles or improvement in testicular volume after varicocelectomy.

Scrotal Ultrasonography has also played a role in the screening of patients of testicular tumors due to its higher incidence in patients with male infertility.

Male infertility constitutes a significant burden to the patient, his family and the clinician. Despite the increasing use of ultrasonography in the evaluation of male infertility worldwide, there is no clear evidence of such increase in our environment.

Scrotal ultrasonography and magnetic resonance imaging of the testes are both non-invasive techniques which give good anatomy of the scrotum and its content. In a developing country like Nigeria Scrotal ultrasonography with colour coded Doppler
is readily available and affordable unlike Magnetic Resonance Imaging which is not only expensive but is also not an accessible imaging modality. The Computed Tomography Scan is not ideal for scrotal imaging in young men as it utilizes ionizing radiation which may cause oligospermia.

The World Health Organization presently defines oligospermia as the presence of sperm density less than 20×10^6 sperm cells/ml of semen or less than 40×10^6 sperm cells/ejaculate. However in a study by Osegbe et al on husbands of women attending the antenatal clinic at the Lagos University Teaching Hospital, they concluded that most Nigerian men with sperm count of 10×10^6/ml and above were able to father children.

The aim of this study is to evaluate the value of scrotal ultrasound in the management of the male infertility in our environment.
ANATOMY OF THE TESTIS

The normal testicle is an ovoid, homogenous and mildly echogenic structure similar to that of the thyroid gland (Figures 1 and 2). The adult testicles are normally symmetric and measure approximately 3cm to 5cm in length, 2cm to 4cm in width 2cm to 3cm in anteroposterior dimension.\textsuperscript{10} The normal post-pubescent testis volume is 15 to more than 20ml, with Asians having smaller testes.\textsuperscript{11}

The normal testis appears encapsulated owing this presentation to the hypoechoic ring, which is the tunica vaginalis. The visceral layer of the tunica vaginalis is seen apposed against the testis, separated from the parietal tunica vaginalis by a thin serous liquid.

The tunica albuginea is a dense white covering of the testis; the visceral layer of the tunica vaginalis covers the tunica albuginea. The tunica vaginalis is seen as a dense hypoechoic band surrounding the testis.

The mediastinum of the testis is also seen as an echogenic linear band with longitudinal of the testicle while the rete testis visualized as a hypoechoic or septated cystic area near head of the epididymis. The epididymis appears isoechoic or slightly more echogenic than the testis. The echotexture looks coarse compared to the adjacent testis. There are three vessels supplying the testicles namely – Deferential, Cremasteric and Testicular Arteries.
The normal arterial Doppler waveform will have a low-impedance for the testicular artery and a large amount of end diastolic flow within the artery. The deferential and the cremasteric arteries are found within the spermatic cord and should show a high resistance waveform and an absence of diastolic flow.

High resistance shows high systolic peak and low diastolic flow while low resistance shows a double biphasic systolic flow and high diastolic flow. The scrotal wall is an echopenic structure that surrounds the testicle and the epididymis.
Figure 1: Showing Ultrasound of the testis (white arrow) and part of epididymis (curved arrow) in longitudinal view
Figure 2: showing Ultrasound of the Testis in transverse view
JUSTIFICATION OF STUDY

Male infertility is a peculiar medical disease as it does not affect the physical activity of the patient and has no effect on life span; its impact on the psychological and social well-being is however, never limited to the patient alone as fertility always involves a couple. According to the published literature, approximately 20% of cases of infertility are due to a male factor only, and in another 30%, both male and female factors are jointly responsible, so that the man is responsible for about 50% of all cases of infertility.\textsuperscript{1,3}

Investigations carried out on the man therefore may help to identify treatable causes and monitor the effects of treatment. Ultrasound evaluation of the testes is readily available and does not use ionizing radiation. It is also able to detect most of the treatable causes of testicular abnormalities.
OBJECTIVES

MAJOR

1. To describe sonographic features of the testicles in the infertile men.

MINOR

1. To estimate and compare the testicular volume in infertile and fertile Nigerian men
2. To assess the relationship between testicular volume and seminal fluid analysis in infertile Nigerian men
3. To determine and compare the prevalence and types of testicular abnormalities in infertile and fertile Nigerian men on scrotal ultrasonography.

HYPOTHESIS

Infertile men have more abnormal findings on scrotal ultrasound scan than fertile men.

LITERATURE REVIEW
Scrotal ultrasonography is the primary imaging modality in the evaluation of infertility.\textsuperscript{5-8} B-mode imaging combined with duplex Doppler interrogation provides valuable information in assessment of the acutely painful scrotum in addition to scrotal masses and male infertility. Advances in ultrasonographic spatial and low-contrast resolution have improved our ability to more clearly define diagnosis for the referring clinician\textsuperscript{6-8}.

Scrotal Ultrasonography is used to evaluate testicular size and location in addition to detection of subclinical varicocele, which are associated with testicular atrophy\textsuperscript{12-14}. It is particularly useful in localizing the inguinal undescended testis because patients with cryporchidism are at 48 times greater risk of having a testicular malignancy\textsuperscript{15-16}.

Scrotal Ultrasonography also plays a role in the evaluation of testicular degeneration which can be caused by klinefelter syndrome, varicoceles, mumps and cryporchidism. It also used to measure testicular volume because atypical dimensions are present in as many as 64\% of men with infertility\textsuperscript{17}.

Scrotal ultrasonography has been said to be very helpful in detecting unilateral testicular atrophy. The accuracy of ultrasonography is within 10\% of the actual volume and is better than physical examination in detecting testicular asymmetry.\textsuperscript{2,6,11-12}
An assessment of testicular size and atrophy in adolescents is done by comparing the differences in sizes between testicles.\textsuperscript{12} Scrotal ultrasound has also been used to localize the inguinal, undescended testicle\textsuperscript{15-16}. Men with either unilateral or bilateral undescended testicles have semen of diminished quality compared with that of fertile men.\textsuperscript{11,17}

Scrotal ultrasound provides excellent differentiation between intratesticular and extratesticular masses\textsuperscript{18}. There is also increased association between testicular tumor and infertility.\textsuperscript{17-18}

Varicocele correspond to dilatation of the pampiniform plexus due to ineffectual venous valve\textsuperscript{11}. Varicoceles are more common on the left side and they have been found in upto 13\% of asymptomatic healthy men at screening examinations. The prevalence is higher in infertile men at 40\%, and of those infertile men with varicoceles, 40\% were found to have them bilaterally\textsuperscript{11,13}. Sigmund further developed the concept by using a bidirectional Doppler ultrasound to classify varicoceles as stop-type or shunt–type.\textsuperscript{19} Using this bidirectional apparatus in comparison with percutaneous retrograde venography, they were able to distinguish the presence of retrograde flow (stop–type) alone from both retrograde and orthograde venous blood flow (shunt type).\textsuperscript{19}
Hirsh’s experience with the pencil-probe doppler stethoscope demonstrated a significant false-positive rate as compared to results in 17 patients with venographically demonstrated varicoceles. McLure defines a varicocele on scrotal ultrasound as the presence of three or more veins in the scrotum, with one having a minimum resting diameter of 3mm or an increase in venous diameter with the valsalva maneuver. Normal range diameter of pampiniform plexus is 0-2mm. The relationship between testicular microlithiasis and infertility is not well understood. Testicular Microlithiasis is frequently seen with testicular cancer. Theoretically, decreased fertility could be expected because 30% to 60% of seminiferous tubules can be obstructed by intratubular concretions, which is considered to be a pathogenesis of testicular microlithiasis. Infertile patients with testicular microlithiasis may have significant reductions in sperm migration and motility compared with those with minimal microcalcifications. Most intratesticular lesions in men with infertility are benign lesions such as Microlithiasis, Intratesticular cysts and old hematoma.

Testicular irregularities on physical examination such as nodules, induration and masses are usually investigated further with ultrasonography because testicular tumours are most common in the age groups presenting with infertility. Seminoma, the most common germs cell tumour, has a uniformly hypoechoic appearance and is the most common tumour associated with cryptorchidism, a
condition clearly reported to predispose to male infertility. Seminoma responds well to therapy and are curable in more than 90% of patients with stage-1 tumour. The ultrasound appearance of most testicular tumour is that of focal hypoechoic lesion within the normally homogeneous echotexture of the testis. The presence of a testicular tumour should be considered in the evaluation of the infertile male with a hydrocele because many tumours have an associated small hydrocele.

Transrectal ultrasonography had also been documented to help men with ejaculatory duct obstruction. Transrectal ultrasonography had been indicated in men with low volume azoospermia in the absence of testicular atrophy and low volume severe oligoasthenospermia when retrograde ejaculation is not present. Transrectal ultrasonography has now been considered as an initial diagnostic tool in men with ejaculatory duct obstruction. Transrectal ultrasonography is also indicated in men with oligospermia and low volume ejaculation.

Infertile men with a reduced ejaculate volume have either ejaculatory dysfunction, congenital anomalies of the accessory sex organs or ejaculatory duct obstruction. The incidence of mullerian duct cysts is 11% in men with infertility. Venography is the most reliable modality for the detection of subclinical varicocele because the findings demonstrate abnormal retrograde flow into the spermatic veins or pampiniform plexus. However, the procedure remains invasive and is usually
reserved for patients undergoing sclerotherapy. Venography is highly accurate but the procedure is invasive and exposes the patient to ionizing radiation. Computed tomography scanning with increased intra-abdominal pressure can be used as a non-invasive method to detect a varicocele and to show proximal extension of the lesion into the inguinal canal.

Scrotal thermography is more sensitive and accurate for the detection of varicocele than Doppler ultrasound and physical examination, and it can be used for screening as a single modality in infertile men. Doppler ultrasound and Scrotal thermography are complementary and their combined use yield the highest sensitivity and accuracy.\textsuperscript{2,11}

Ultrasonography had revealed an increased in the prevalence of an associated abnormalities in the human male genitourinary tract such as cryptorchidism, hydrocele and epididymal abnormalities in infertile men.\textsuperscript{2,6}
MATERIALS AND METHODS

The study venue was the Lagos University Teaching Hospital (LUTH), a tertiary institution comprising of several specialists and situated in Idi-Araba, Lagos.

A comparative cross-sectional prospective study, in which 136 patients diagnosed with male infertility were enrolled into the study. Duration of study was one year (December 2009 – November 2010).

Subjects with normal fertility based on either a normal seminal fluid analysis (SFA) or good fertility history were recruited from other departments of the hospital as controls.

Inclusion criteria-

- All patients diagnosed with male infertility, seen at the Urology clinic at LUTH, during the period of study.
- Three consecutive SFA results showing oligospermia or azoospermia.

Exclusion criteria-

- Patients with a history of infertility < 2 years
- Patients with infertility not attributable to low sperm count e.g. retrograde or an ejaculation.
Sample Size Estimation:

The minimum sample size was determined using the formula for the comparison of two proportions.

\[ N = \frac{(u+v)^2 \left[ \frac{p_1(1-p_1)}{2} + \frac{p_2(1-p_2)}{2} \right]}{[p_1-p_2]^2} \]

Where:

- \( N \) = The minimum sample size required in each group
- \( P_1 \) = The proportion of testicular abnormalities in the infertile men [40\%]. \(^{26}\)
- \( P_2 \) = The proportion of testicular abnormalities in the fertile men [15\%]. \(^{26}\)
- \( P_1 - P_2 \) = The differences in the proportion of the testicular abnormalities
- \( U = \) The sided percentage point of normal corresponding to 100-power where Power = Probability of finding a significant result using 80\% [0.84].
- \( V = \) Percentage point of normal corresponding to a two sided level of 5\% significance = 1.96/

Determination of sample size

\[ N = \frac{(0.84+1.96)^2 \left[ (40<100-40>) + (15<100-15>) \right]}{[40-15]^2} \]
\[ = \frac{28812}{625} \]
\[ = 46.10 \]

A higher sample size of 136 men was however used since the study was scheduled for 1 year and many more subjects were available within this period. This was done to improve the sensitivity of the study. Only eighty-four (84) normal subjects were
recruited as control as majority of potential (normal) subjects declined being recruited.

**Materials used**

Aloka Prosound SDD-3500 Plus, Japan 2005 scan machine with high resolution.

**PROCEDURE**

The author performed the procedure and obtained informed written consent from the patients before commencement of each examination. Relevant family, medical and surgical histories of the patients were extracted from their case notes. The semen fluid analyses were also documented.

Subjects used as controls were eligible by either a history of fertility (that is, married with children and no history of difficulty in impregnating partners (74 cases) or normal seminal fluid analysis (10 cases).

The patient was positioned supine with a rolled towel placed between his legs in order to support the scrotum. The penis was dorsiflexed on the abdomen and wrapped with clean linen.

Coupling gel was applied directly on the scrotum to enhance ultrasound transmission, next the transducer was gently placed against the skin and moved over
the scrotum. Subsequently, scrotal content images created from reflected sound waves were visualized on the ultrasound monitor.

Images with B mode USS were acquired in the longitudinal and transverse planes. The testicular length was measured on the longitudinal view while the antero-posterior (AP) and transverse diameters were measured on the transverse view (figure 3).

Testicular volume was then calculated manually using the formula (length x AP diameter x transverse diameter x 0.53).

Color Doppler USS was performed in the upright and supine positions. Under normal conditions due to the presence of valves in the testicular veins prevent backflow of blood to the testes during increased intra-abdominal pressure or as a result of gravity. As a result, in normal individuals there should be no noticeable increase in venous diameter during transient increase in intra-abdominal pressure such as the Valsalva manoeuvre.\textsuperscript{11} A varicocele was said to be present if there was the presence of three or more veins in the scrotum having a minimum resting diameter of 3mm or an increase in venous diameter with the Valsalva manoeuvre or during a change from supine to upright position.\textsuperscript{13} The parenchymal density was described and any sonographic scrotal abnormalities e.g. masses, calcification, cysts were also recorded.
The Seminal Fluid Analysis (SFA) was done using both the manual technique and CASA (Computer assisted semen analysis) technique. The World Health Organisation sperm parameters (count, motility, volume and morphology) were also evaluated for the study group. The SFA report of the 10 controls (reported as normal on at least 2 consecutive SFA) were also noted. Oligospermia was defined as sperm count less than \(20 \times 10^6/\text{ml}\).\(^1\) Azoospermia is defined as the absence of sperm cells in the ejaculate.\(^1\)

![Diagram of testicular dimensions](image)

**Figure 3:** Sketch showing measurement of testicular dimensions

- **AC** = Length
- **DB** = Anterio-posterior (AP) Diameter
- **LM** = Transverse Diameter
- **E** = Epididymis
Data Analysis

Results were expressed as percentages and test of significance were done using the chi-square and student t-test. A p-value less than 0.05 was considered statistically significant.
RESULTS

A total of 220 men were prospectively evaluated between December 2009 and November 2010. They were made up of 136 infertile men comprising of 132 oligospermic and 4 azoospermic men as well as 84 fertile men as controls. The age range of the subjects was 16 to 64 years with a mean of 36.8 yrs while it was 15 to 69 (mean- 38.1) for the control.

The modal age group for the infertile and fertile men was the fourth decade while 79.4% and 88.1% of all subjects and controls respectively were in their 3\textsuperscript{rd} to 5\textsuperscript{th} decade There was no statistically significant difference between the age distribution of the 2 groups. (Table 1)

For the infertile men, the average testicular volumes were 16.85mls and 16.23mls on the right and the left respectively. The cumulative average testicular volume for both sides was 16.51±1.2mls. The right mean testicular volume was highest in the third decade while the left mean testicular volume was highest in the second decade. There was a gradual decline in the mean testicular volume as the age increased on both sides and this was statistically significant, p value 0.643 (Table 2).

In the fertile group, the average testicular volumes were 19.84mls and 19.69mls on the right and the left respectively. The mean testicular volume was generally higher for each age group when compared to the infertile group. This was statistically
significant (p =0.007). The highest mean testicular volume (21.574±1.85mls) was also found in the third decade on the right but on the left, the men in the fourth decade had the highest mean testicular volume of 21.14±1.36mls. The mean testicular volume also statistically decreased with age p value 0.00000. (Table3)

In both infertile and fertile men, the right testicular volume was higher than the left. However, this difference was not statistically significant. The ‘side to side’ difference was more in the infertile group (0.62mls) than in the fertile group (0.15mls).
TABLE 1: AGE DISTRIBUTION PATTERN IN SUBJECTS AND CONTROLS

<table>
<thead>
<tr>
<th>Age in years.</th>
<th>Infertile (%)</th>
<th>Fertile (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (%)</td>
<td>No (%)</td>
<td>No (%)</td>
</tr>
<tr>
<td>&lt;20</td>
<td>6 (5.7)</td>
<td>2 (2.4)</td>
<td>8 (3.6)</td>
</tr>
<tr>
<td>20-29</td>
<td>25 (18.7)</td>
<td>23 (27.4)</td>
<td>48 (21.8)</td>
</tr>
<tr>
<td>30-39</td>
<td>43 (31.6)</td>
<td>33 (39.3)</td>
<td>76 (34.5)</td>
</tr>
<tr>
<td>40-49</td>
<td>40 (29.3)</td>
<td>18 (21.4)</td>
<td>58 (26.4)</td>
</tr>
<tr>
<td>50-59</td>
<td>16 (11.4)</td>
<td>6 (7.1)</td>
<td>32 (14.5)</td>
</tr>
<tr>
<td>&gt;60</td>
<td>6 (4.9)</td>
<td>2 (2.4)</td>
<td>8 (3.6)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>136 (100)</strong></td>
<td><strong>84 (100)</strong></td>
<td><strong>220 (100)</strong></td>
</tr>
</tbody>
</table>

$X^2 = 72.94, \text{ df } = 5, \text{ p-value } = 0.541$
**TABLE 2: TESTICULAR VOLUMES IN THE INFERTILE GROUP**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>RIGHT TESTICULAR (RT) MEAN VOLUME±SD (mls)</th>
<th>LEFT TESTICULAR (LT) MEAN VOLUME±SD (mls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 – 19</td>
<td>17.429± 2.168</td>
<td>17.100± 2.459</td>
</tr>
<tr>
<td>20 – 29</td>
<td>17.496±2.339</td>
<td>16.136±4.436</td>
</tr>
<tr>
<td>40 – 49</td>
<td>16.881±3.711</td>
<td>17.047± 2.653</td>
</tr>
<tr>
<td>50 – 59</td>
<td>16.800±2.483</td>
<td>16.086±2.525</td>
</tr>
<tr>
<td>60 – 66</td>
<td>16.350±1.4108</td>
<td>14.933±2.34</td>
</tr>
</tbody>
</table>

$X^2 = 351.13$, df =5, p-value=0.643

Average LT- 16.23± 2.2ml

Average RT- 16.85 ± 1.1ml

Cumulative Average- 16.32 ± 2.1ml

**TABLE 3: TESTICULAR VOLUMES IN CONTROL GROUP**
<table>
<thead>
<tr>
<th>AGE (years)</th>
<th>RIGHT TESTICULAR MEAN VOLUME±SD(mls)</th>
<th>LEFT TESTICULAR MEAN VOLUME±SD(mls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 – 19</td>
<td>18.900 ± 2.828</td>
<td>18.700 ± 1.131</td>
</tr>
<tr>
<td>20 – 29</td>
<td>21.574±1.849</td>
<td>19.900 ±1.773</td>
</tr>
<tr>
<td>30 – 39</td>
<td>20.218± 1.762</td>
<td>21.142 ± 1.368</td>
</tr>
<tr>
<td>40 – 49</td>
<td>20.189±1.462</td>
<td>19.878 ±1.238</td>
</tr>
<tr>
<td>50 – 59</td>
<td>19.124 ±1.951</td>
<td>19.900 ±2.455</td>
</tr>
<tr>
<td>60 – 66</td>
<td>19.0020 ±0.990</td>
<td>18.620 ±2.424</td>
</tr>
</tbody>
</table>

Average right testicular volume - 19.84mls± 1.3mls
Average left testicular volume - 19.69mls± 1.9mls
Cumulative average testicular volume - 19.89 ± 1.8mls

\(X^2 = 78.60, \text{ df } = 5, \text{ p-value } = 0.410\)

The average testicular volume for the infertile patients is 16.32± 2.1mls. This is significantly lower than the average volume of the subjects in the fertile group (19.89
± 1.8mls). For all the age groups, the average testicular volume in the fertile subjects was also significantly higher than their infertile counterparts, p=0.007. (Table 4).

As the age increased in the infertile group, the testicular volumes decreased bilaterally but there was no particular order to this change in volume. The sperm count also statistically decreased with increasing age. There is a statistically significant relationship between age, average sperm count and average testicular volume (Table 5A). The testicular volume is directly proportional to the sperm count in infertile men (Table 5B and Figure 4).

A total of 162 Intra and extratesticular scrotal abnormalities were detected in 127 (93%) infertile patients, while 9 (7%) had no abnormality on scrotal USS. The commonest abnormality was varicocele (53%) followed by hydrocele (22%). Out of the 127 patients with anomalies, 107 had 1 abnormality, 15 had 2 abnormalities, 4 had 3 abnormalities and 2 patients had 3 abnormalities (Table 6A and Figure 5). Scrotal abnormalities were found in 93% of infertile (127/136) compared to 26% of controls (22/84). This difference was statistically significant (p=0.001). The commonest abnormalities in infertile and fertile groups were varicoceles (53.0% versus 11.9%) and hydrocele (22.0% versus 7.1%). No subject in the control group had more than one abnormality (Table 6B and Figures 6-7). In both groups, varicocele was commoner on the left side (Table 7).
TABLE 4: COMPARISON OF AVERAGE TESTICULAR VOLUMES IN
SUBJECTS & CONTROLS

<table>
<thead>
<tr>
<th>AGE group (yrs)</th>
<th>MEAN TESTICULAR VOLUME (ml)</th>
<th>P – VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>17.25</td>
<td>18.6</td>
</tr>
<tr>
<td>20-29</td>
<td>16.70</td>
<td>20.42</td>
</tr>
<tr>
<td>30-39</td>
<td>16.05</td>
<td>19.82</td>
</tr>
<tr>
<td>40-49</td>
<td>16.92</td>
<td>20.00</td>
</tr>
<tr>
<td>50-59</td>
<td>16.41</td>
<td>19.45</td>
</tr>
<tr>
<td>&gt;60</td>
<td>15.42</td>
<td>18.8</td>
</tr>
</tbody>
</table>

p-value= 0.007

Cumulative average volume

Subjects-16.32± 2.1mls.

Controls- 19.89 ± 1.8ml
### TABLE 5A: MEAN TESTICULAR VOLUME AND SPERM COUNT BY AGE IN INFERTILE MALES

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Infertile male</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right Testis</td>
<td>Left Testis</td>
<td>Average</td>
<td>Average Sperm Count</td>
</tr>
<tr>
<td></td>
<td>Vol(mls.)</td>
<td>Vol(mls.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 – 19</td>
<td>19.4</td>
<td>19.5</td>
<td>19.5</td>
<td>15.1 x 10^6</td>
</tr>
<tr>
<td>20 – 29</td>
<td>18.5</td>
<td>17.1</td>
<td>17.8</td>
<td>13.4 x 10^6</td>
</tr>
<tr>
<td>30 – 39</td>
<td>18.0</td>
<td>18.2</td>
<td>18.1</td>
<td>12.7 x 10^6</td>
</tr>
<tr>
<td>40 – 49</td>
<td>17.9</td>
<td>18.5</td>
<td>18.4</td>
<td>10.2 x 10^6</td>
</tr>
<tr>
<td>50 – 59</td>
<td>18.8</td>
<td>19.0</td>
<td>19.0</td>
<td>8.2 x 10^6</td>
</tr>
<tr>
<td>60 – 66</td>
<td>18.4</td>
<td>14.9</td>
<td>16.6</td>
<td>3.6 x 10^6</td>
</tr>
</tbody>
</table>

P value- 0.032
### TABLE 5B: AVERAGE TESTICULAR VOLUME AND SPERM COUNT IN INFERTILE GROUP

<table>
<thead>
<tr>
<th>TESTICULAR VOLUME (MLS)</th>
<th>AVERAGE SPERM COUNT X10^6/MILLIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-16.0</td>
<td>3.8</td>
</tr>
<tr>
<td>16.1-17.0</td>
<td>3.6</td>
</tr>
<tr>
<td>17.1-18.0</td>
<td>13.4</td>
</tr>
<tr>
<td>18.1-19.0</td>
<td>11.9</td>
</tr>
<tr>
<td>19.1-20.0</td>
<td>15.1</td>
</tr>
</tbody>
</table>
FIGURE 4: SPERM COUNT AND TESTICULAR VOLUME IN INFERTILE GROUP
TABLE 6A: ABNORMAL SCROTAL FINDINGS ON USS IN THE INFERTILE GROUP

<table>
<thead>
<tr>
<th>Finding</th>
<th>OLIGOSPERMIA</th>
<th>AZOOSPERMIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>8</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Abnormal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varicocele</td>
<td>84</td>
<td>2</td>
<td>86</td>
</tr>
<tr>
<td>Hydrocele</td>
<td>35</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>Epididymal abnormalities</td>
<td>31</td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>Testicular Cyst</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Microlithiasis</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Suspected tumor</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total no of abnormalities</td>
<td>158</td>
<td>4</td>
<td>**162</td>
</tr>
</tbody>
</table>

** some patients had multiple abnormalities.
Figure 5: Pie Chart Showing distribution of Scrotal abnormalities in infertile men.
### TABLE 6B: FREQUENCY DISTRIBUTION OF FINDINGS IN BOTH INFERTILE AND FERTILE MEN

<table>
<thead>
<tr>
<th>FINDING</th>
<th>INFERTILE</th>
<th>FERTILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>9</td>
<td>62</td>
</tr>
<tr>
<td>Abnormal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varicocele</td>
<td>86</td>
<td>10</td>
</tr>
<tr>
<td>Hydrocele</td>
<td>35</td>
<td>6</td>
</tr>
<tr>
<td>Epididymal abnormalities</td>
<td>31</td>
<td>4</td>
</tr>
<tr>
<td>Testicular Cyst</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Microlithiasis</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Suspected tumor</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total no of abnormalities</strong></td>
<td><strong>162</strong></td>
<td>22</td>
</tr>
</tbody>
</table>

** some patients had multiple abnormalities.
**Figure 7**: Pie Chart Showing Scrotal Findings in Control Group

- **74%** Normal
- **11.9%** Varicocele
- **7.1%** Hydrocele
- **4.8%** Epididymal abnormalities
- **2.4%** Testicular Cyst
**TABLE 7: INCIDENCE AND DISTRIBUTION OF VARICOCELES IN BOTH FERTILE AND INFERTILE SUBJECTS.**

<table>
<thead>
<tr>
<th></th>
<th>FERTILE (%)</th>
<th>INFERTILE (%)</th>
<th>TOTAL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIGHT SIDED</td>
<td>3(30)</td>
<td>16(18.6)</td>
<td>19(19.8)</td>
</tr>
<tr>
<td>LEFT SIDED</td>
<td>6 (60)</td>
<td>40(46.5)</td>
<td>46(47.9)</td>
</tr>
<tr>
<td>BILATERAL</td>
<td>1(10)</td>
<td>30(34.9)</td>
<td>31(32.3)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10(100)</td>
<td>86(100)</td>
<td>96(100)</td>
</tr>
</tbody>
</table>
DISCUSSION

Male infertility is a peculiar medical condition as it does not affect the physical activity of the patient and has no effect on life span; its impact on the psychological and social well-being is however, never limited to the patient alone as infertility always involves a couple. Approximately 20% of cases of infertility are due to a male factor only, and in another 30%, both male and female factors are jointly responsible, so that the man is responsible for about 50% of all cases of infertility.\textsuperscript{1,3,11}

In the last few decades, there has been a lot of reports to support evidence of decreased human semen quality (defined as sperm density) in the general population\textsuperscript{27,28}In addition, there also appears to be evidence of increased frequency of sonographically-detected abnormalities in the genitourinary tract of infertile men.\textsuperscript{5—8,11}

In this study, most of the subjects and controls were in the 30-39yrs age group. This is consistent with literature since patients in the reproductive age group are the ones that tend to present to the fertility clinic.\textsuperscript{11}

The average testicular volume in the study group was 16.32mls while the average testicular volume for the control group was 19.89 ml (p <0.007). This difference was statistically significant. This is consistent with the reports of other authors that have
documented lower testicular volumes in men with infertility and oligospermia,2.6-7,11. This is not unusual as the seminiferous tubules responsible for sperm cell production constitute 90% of the testicular mass11.

In both the subjects and controls, the average left testicular volume was less than. This is not unusual as the seminiferous tubules responsible for sperm cell production constitute 90% of the testicular mass29 the right. Even though this finding was not statistically significant, a possible explanation for the difference may include the generally reported higher incidence of clinical and subclinical varicocele on the left in the general population.11,29-30

Even though there was no clear direct relationship between the age of the patient and the testicular volume, the average testicular volume in men older than 60 years was less than those of younger men in both the fertile and infertile groups This is also not surprising as the androgen production, necessary for testicular development tends to reduce after the middle age11.

The seminiferous tubules which are responsible for sperm cell production constitute 90% of the testicular size11. As a result, testicular volume is expected to have a direct proportional relationship with sperm density. This was corroborated by findings in this study which showed a directly proportional relationship between the average testicular volume and sperm density in the infertile group who all had SFA.
In the infertile group, a total of 162 scrotal abnormalities were found in 127 (93%) patients with 22 (13.5%) of patients having at least 2 abnormal findings, while there was a total of 22 abnormalities in 22 (26%) subjects in the control. No patient in the control group had multiple abnormalities. The recorded incidence of abnormal sonographic findings in the infertile group is much higher than the 57-72% quoted in literature \textsuperscript{2,6-7,11}. The reason for this high figure is unclear, however, the typical pattern of late clinical presentation of diseases characteristic of patients in our environment may be a factor. Almost all the patients in this study had tried non-conventional or non-orthodox means of therapy for years before seeking medical help. Some of the other studies also included patients with normal sperm count but with aesthenospermia\textsuperscript{11,30-31}. On the other hand, the incidence of 23% for scrotal abnormalities found in the control group is consistent with reports by others\textsuperscript{30-31}.

Varicocele was the most common sonographic abnormality in this study (53.0%) and this was significantly (p=0.02) higher than the incidence of 11.9% found in controls. This is consistent with previous reports that varicocele is the most common identifiable abnormality detected in infertile men and is said to be present in up to 40% of infertile men.\textsuperscript{11,30-32} In the screening of healthy young men in the United States of America (USA), the approximate incidence of varicoceles was 13.4\%-16\% \textsuperscript{2,11,31}. Our findings of varicoceles in 11.9\% of fertile men also corroborates this.

42
In this study, 35% of all varicoceles in infertile patients were bilateral. This value is higher than reports in Caucasian patients which have reported between 10 to 18% of all varicoceles in sub-fertile men to be bilateral\textsuperscript{11,29,32}. This high incidence of bilateral varicoceles could be a possible explanation for the lack of statistical significant difference between the right and left testicular volumes in the infertile group. In this study, the left side (82%) had significantly more varicoceles than the right. This finding is consistent with previous studies where figures of 80-90\% have been quoted\textsuperscript{29,32} and possible explanations include the anatomic differences between the left and right testicular veins (with the left being longer and having an angulated insertion into the left renal vein unlike the shorter and more straight right vein that drains directly into the inferior vena cava). The nut-cracker phenomenon where the left vein is compressed as it passes between the aorta and the superior mesenteric artery has also been suggested as a reason for the uneven distribution\textsuperscript{11}.

In a study by Kondoh et al\textsuperscript{33}, they reported that even a subclinical varicocele detected via scrotal sonography had a detrimental effect on spermatogenesis. Others have also postulated that the high retrograde flow in some varicoceles may affect the physiology of the testes leading to increased temperature, lower testosterone and
increased partial pressure of oxygen (pO₂) as there are arteriovenous connections in the pampiniform plexus.³⁰

Venography is still considered the "gold standard" for the detection of varicoceles, although in several studies no venogenic reflux could be demonstrated in the presence of palpable lesions.¹⁴,¹⁹ Because of the invasive nature of venography, alternative diagnostic methods have been pursued, including radionuclide angiography, thermography, and ultrasonography. The ultrasonographic armamentarium of the Doppler stethoscope, real time ultrasonography and color flow Doppler imaging have all been used for varicocele diagnosis. Presently in clinical practice, Doppler USS is the most common imaging tool for the diagnosis of varicocele due to its inexpensive and non-invasive nature,¹¹ however, its diagnostic accuracy has been questioned¹¹. Even though the USS definition of varicocele is controversial, the definition by McClure which appears to be very popular was used for this study,²,¹³. He defined a varicocele as the presence of 3 or more veins, with one having a minimum resting diameter of 3 mm, or an increase in venous diameter with the Valsalva maneuver. Because others have used 2 mm to 3 mm as a cut-off, comparison of results with varicocelectomy findings has been difficult¹¹,³⁴. There have been controversies on the need for treatment of the adolescent patient with clinical varicocele as it is almost impossible to assess its effects on future fertility. However, there now appears to be a consensus amongst clinicians of the need for
varicocelectomy in adolescents with unilateral varicocele associated with ipsilateral reduced testicular growth as determined by serial scrotal USS\textsuperscript{11,29,34}

The second most common scrotal abnormality found in this study was hydrocele. This finding was significantly higher in infertile patients with 35 cases, thereby affecting 25.7\% (35/136) of the patients compared with controls with 6 cases thereby affecting 7.1\% (6/84), (p<0.05). Hydrocele also accounted for 21.5\% and 27\% of all abnormalities in the subjects and control respectively. Others researchers have reported lower incidence of between 3.2 to 17\%\textsuperscript{2,30}. The reason for the higher incidence in our study is not clear, but the pattern of late presentation by many patients in our environment could be a contributory factor. These authors\textsuperscript{30} suggested that hydroceles affect spermatogenesis because the liquid pressure in the tunica vaginalis creates a warm environment and that a drop in testicular circulation occurs due to edema within the surrounding tunica vaginalis.

Even though the diagnosis of a hydrocele is often clinical, occasionally scrotal ultrasound becomes more crucial if the hydrocele is too big for easy palpation of the testis.

Epididymal abnormalities was the third most common abnormality in infertile men seen in this study. These include epididymo-orchitis, epididymal-cysts and
spermatocele. Chronic epididymitis can be associated with infertility as a result of obstruction to the tubules\textsuperscript{11}

Although the criterion for identification of a clinically thickened epididymis as determined by ultrasound has been described as 12.1 mm mean diameter in cross-section at the level of the caput\textsuperscript{7}, a correlation with epididymal obstruction has not been established.\textsuperscript{7} In comparison, normal epididymides measured 7.7 mm mean diameter in cross-section in the same study.

Chronic epididymal inflammation may lead to an enlarged, thickened epididymis with mixed echogenicity. Calcification may ensue from the inflammatory response. Acute epididymitis, a clinical diagnosis, may be confirmed from the findings of an enlarged epididymis with decreased echogenicity.

Testicular microlithiasis was another scrotal abnormality found only in the study patients (2.5%). It is an uncommon condition in which multiple calcifications are caused by deposition of laminated rings of glycoprotein and calcium in the seminiferous tubules\textsuperscript{35-36}. The sonographic appearance is that of multiple, diffuse, non-shadowing foci\textsuperscript{35-36}. The mechanism by which testicular microlithiasis can affect spermatogenesis is still unclear, though an immunologic mechanism has been postulated\textsuperscript{35}. 
Other testicular abnormalities detected in this study include testicular cyst, testicular Atrophy and testicular masses.

Abnormalities like epididymal-cysts and spermatocele are commonly found in men with infertility even although they are usually asymptomatic and are not known to cause of infertility.²,¹¹,³¹

Studies have reported a higher incidence of histologically confirmed testicular tumors in infertile subjects with rates between 0.3-0.5% compared with the general incidence of 0.005%-0.0009 for primary testicular tumor²,¹¹,³¹. The detection of suspected testicular tumor in 2.5% of the infertile patients with none in the fertile group is quite high. However testicular tumor can only be confirmed histologically and it is possible that with histology, some of the masses may be benign. All patients with testicular masses were referred to their primary doctor (urologist) for further evaluation. While an hypoechochogenic area within the tunica albuginea is highly suspicious of testicular tumor, known differentials of testicular tumors on ultrasound include all causes of granulomatous orchitis like tuberculosis, syphilis etc, and haematocele¹¹. Indeed it can be difficult or almost impossible for a surgeon to differentiate between a tumor and a granulomatous orchitis even on the operating table.
The normal adult testis on USS is described as homogenous with a low to medium echogenicity. In our study, amongst the infertile group, about 72% of the testes had normal echotexture, 19.5% had low testicular echotexture, 8% had high echo-texture while 1.5% had mixed echotexture. Even though altered echogenicity is commonly regarded as an indication of impaired testicular function, the relevance of echogenicity on infertility is unclear. A recent study by Virgli et al in 101 subfertile men found no statistically significant relationship between the testicular echogenicity and any of the fertility parameters including sperm density.

CONCLUSION

Scrotal ultrasonography is a valuable tool for the evaluation of men with infertility.
There was a strong relationship between testicular volume on ultrasound and the severity and subsequent prognosis of male infertility. The overall incidence of scrotal anomalies in infertile men was 93% compared with 26% for fertile men.

With 63% of the infertile men having a potentially curable cause detected on ultrasonography and 2.94% of the patients having an incidental diagnosis of testicular tumor at a potentially curable stage, the value of scrotal ultrasound in infertile men cannot be over emphasized.

This study has been able to show the value of routine scrotal ultrasound in men with infertility.
RECOMMENDATION

It is recommended that scrotal ultrasound scan should be included as part of routine evaluation of all patients with male infertility
REFERENCES


10. Anatomy for diagnostic imaging 2nd edition Stephanie Ryan, Michelle Mc
Nicholas, Stephen Eustace.

11. Mark Sigman, Jonathan P, Jarvow MD: Male Infertility, Campbell-Walsh

12. Costabile RA, Skoog S, Radowich M: Testicular volume assessment in the

13. McClure RD, Hricak H: Scrotal ultrasound in the infertile man: detection of


tomography with high-resolution real-time ultrasound in the localization of the

16. Weiss RM, Carter Ak, Rosenfield A: High-resolution real-time sonography in


APPENDIX I
SCROTAL SONOGRAPHIC EVALUATION OF INFERTILE MALE PATIENTS IN THE LAGOS UNIVERSITY TEACHING HOSPITAL.

CONSENT FORM

I Mr. ----------------------------------------------- have been adequately informed in details about this study and the procedures to be carried out by the author with the merit and demerit involved. I hereby give my consent

Signature

Witness Name & Signature

--------------------------------------

--------------------------------------
### APPENDIX II

**DATA COLLECTION FORM**

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>AP</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAME</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AGE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HOSPITAL NUMBER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RIGHT TESTICULAR VOLUME</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LEFT TESTICULAR VOLUME</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RIGHT SCROTAL ABNORMALITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LEFT SCROTAL ABNORMALITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BILATERAL ABNORMALITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>REFLUX ON VALSALVA MANOURVE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPERM COUNT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPERM VOLUME</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPERM CELL MORPHOLOGY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPERM MORTILITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DURATION OF INFERTILITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>