THE REALITIES IN SHADOWS AND IMAGES – SEEING IS BELIEVING AND MORE RELIABLE THAN FEELINGS.

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PROTOCOL

Mr. Vice Chancellor Sir, I want to thank you most sincerely for this unique opportunity which you have given me to present my academic stewardship in this great academic community, the Obafemi Awolowo University.

It is with great humility and glory to almighty God that I stand before this august assembly today to deliver this Inaugural lecture which by HIS grace is the first to be delivered in the department of Radiology in the history of this great University.

INTRODUCTION

Before the advent of radiology, the practice of clinical medicine, was totally dependent on clinical skills in arriving at the diagnoses of ailments before treatment is commenced. Often times, especially where the skill is lacking, the causes are missed or difficult to unravel.

However, since the discovery and over the years, medical imaging has played and continues to play vital roles in patient healthcare. It aids in disease prevention, early detection, diagnosis, and treatment.

It will be appropriate at this juncture for us to be on the same page as to what we mean by medical imaging for the benefit of some members in this audience.

Medical imaging is the term used to describe a range of non-invasive methods that enable radiologists and other specially trained medical personnel to visualize the inside of the human body and thereby uncover hidden abnormalities, without the need for surgery to view various organs and areas of the body before diagnoses are made.

Without medical imaging, many conditions would go unseen until they reach a much more severe and often life-threatening stage. Timely access to imaging enables doctors to identify and treat diseases more accurately, and care for their patients with greater insight into their condition.

Mr. Vice Chancellor, the 21st century has brought about incredible advances in the treatment of the world's illnesses. This is made possible by the constantly advancing field of medical imaging occasioned by the revolutionary changes in modern technology which has not only helped shortening morbidity, reduced mortality and improved quality of life but has also become the epicenter of diagnosis and treatment in modern medicine. Medical imaging has therefore, been one of the success stories of 21st century medicine. The ability to 'see' inside the body which represents one of the most potent diagnostic tools of modern medicine inspired the title of this inaugural lecture - THE REALITIES IN SHADOWS AND IMAGES – SEEING IS BELIEVING AND MORE RELIABLE THAN FEELINGS.

The inspiration for this topic was further strengthened by the experience I gathered from the interactions with people in our society. What we see in the images looks very much of miseries to laymen and untrained eyes in the medical profession. Jokingly, some think we are involved in the art of divination or worse still, abracadabra. No wonder, some call us the seers.

On many occasions, some have even doubted the realities of the shadows in the images. For example, the wife of a surgeon colleague came for routine antenatal obstetric scan when I was a senior registrar in training. Like any expectant couple expecting their first child, what will be on their mind will be the wellbeing and the sex of the baby. To their amazement and total disbelief, the result of the ultrasound turned out to be a large ovarian mass. It was a spontaneous rejection of the result only to believe when what I saw on the scan image turned out to be correct at surgery - SEEING IS BELIEVING AND MORE RELIABLE THAN FEELINGS.

Another case was that of a Professor in this University who complained of vague pain in the upper abdomen to his friend Prof. Roger Makanjuola who was the chief medical director at that time.

The Prof was referred to me for ultrasound which showed distorted liver architecture from cancer. It was an unbelievable diagnosis because he was apparently looking healthy except for slight loss of weight. Further investigations including liver biopsy confirmed the diagnosis. Unfortunately he succumbed to the ailment few weeks after the diagnosis. May his soul rest in perfect peace. Again, SEEING IS BELIEVING AND MORE RELIABLE THAN FEELINGS.

Some years ago, a gentleman on referral from a consultant ENT surgeon, came in for head CT on account of chronic sinusitis. A review of the CT images confirmed the sinusitis but a cursory look at the brain showed a very tiny blob of contrast raising an unusual appearance in a vascular anatomic zone. This raised a suspicion of Anterior communicating artery aneurysm, a more sinister condition. The patient had intracranial aneurysm in addition to sinusitis. Again, too good to be true to the patient and the referring consultant because the indication for the study (sinusitis) was not causally related to aneurysm. Further investigation i.e. angiography, confirmed the diagnosis. Similarly, unexpected aneurysm was picked on CT for unrelated indication barely a week after this case and again, SEEING IS BELIEVING AND MORE RELIABLE THAN FEELINGS.

Just to mention few cases of how people doubted the art of "seeing" and did not only believe but eventually agreed that the realities of shadows and images were real and dependable.
This art of seeing that has revolutionized healthcare delivery today was the product of accidental discovery of over a century years ago.

THE DISCOVERY OF X-RAY

Mr. Vice Chancellor, on November 8, 1895, while doing research work on the electric discharge process in diluted gas, Wilhelm Conrad Roentgen (1845–1923) **(Fig1)** discovered a 'new kind of ray' which was previously unknown to physicists.

Fig. 1. Wilhelm Conrad Roentgen (1845-1923)

Wilhelm Conrad Roentgen while working in his laboratory **(Fig2)** noticed a barium platinocyanide screen fluorescing in his laboratory as he generated cathode rays some distance away.

Fig. 2 Roentgen while working in his laboratory

Three days before Christmas he brought his wife into his laboratory, and exposed her hand to the rays. They emerged with a photograph (X-ray) of the bones in her hand and of the ring on her finger **(Fig3)**.

Fig. 3 X-ray Roentgen wife's hand

Roentgen's sensational discovery and case report of the first x-ray of his wife's hand, was a paradigm shift, in that it completely revolutionized the way medicine is practiced and had a profound effect on healthcare delivery. Six years later in 1901, the first Nobel Prize in physics was awarded to Roentgen for his discovery (Alexi 1995; ISHR 2013).

One big lesson we as academics must learn from this account of Wilhelm Conrad Roentgen's discovery is that a case report which we often looked down on and rated poorly during academic reviews for promotion may achieve a tremendous transformation on patient care and also make great academic impact.

With the discovery of x-rays, people freely offered their hands to be x-rayed just to see the bones inside the flesh. It was however soon realized that repeated and unguided exposure to these great wonder rays was injurious to the body, as it was discovered that the x-ray was an ionizing radiation with associated biological hazards **(Figs 4a, b)**, particularly on actively dividing cells in the body. But with judicious use for diagnostic purposes in the hands of the experts, you have nothing to fear.

Fig. 4 a: Dermatitis **Fig 4 b: Tumour**

There is virtually no part of the body that cannot be imaged and this has over the years been influenced by technological development since the discovery of x-ray; as many new techniques have been introduced into medical imaging especially in recent years.

The development of ultrasound (US), computed tomography (CT) and magnetic resonance imaging (MRI) over the past three and half decades, and the more recent emergence of molecular imaging, has created diagnostic capabilities that had dramatically changed the way medicine is practiced.

Ultrasound (US)

Ultrasound is an imaging technique that uses sound waves to see the inside of human body as well as pathological changes.

Its use started in the 1950s and gained popularity in the 1960s. “Real-time” ultrasound machines were introduced in the late 1970s and ultrasound is now the most commonly used examination modality after plain radiographs. The use in the last 10 years of Doppler technology has enabled blood flow **(Fig5a, b)** to be assessed as well as the anatomy.

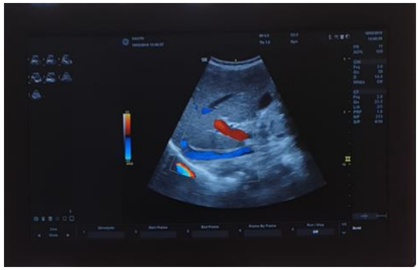


Fig 5a: Ultrasound machine **Fig 5b: Colour flow Doppler Image**

Computed Tomography (CT)

This modality uses X-rays to produce images. The first CT scanner was developed in 1972 by Sir Godfrey Hounsfield and independently by Allen Cormack. At the inception, each tomographic slice required hours of scan time and days of computation to construct images **(Figs 6a,b)**.

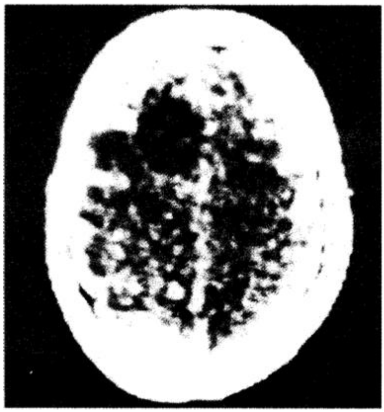


Fig 6a: First CT scanner and 1st image of the brain

Fig. 6b: Modern CT scanner and modern image of the brain

The early 1990s saw the introduction of continuous helical scanners, reducing scan times **(figs 7 animation)** and with this introduction, images were still not captured fast enough to view contrast in clinical applications especially that of Computed tomographic angiography (CTA).

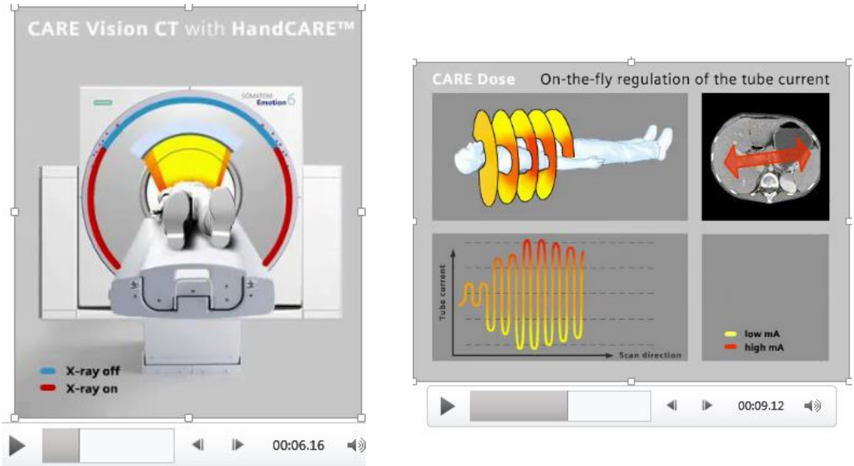


Fig. 7 continuous helical scanners

In this century, technology has improved, and commercial multirow detector CT scanners have become available that can take 320 slice volumes in a single second and now we have those that are capable of 630 slice volumes/sec. That’s fast enough to make 3D videos of a beating heart **(fig 8 animation)**.

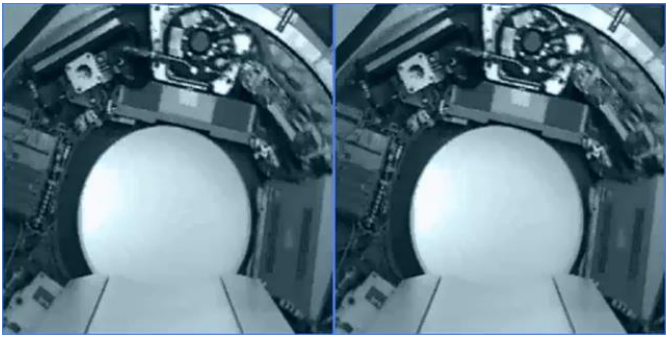


Fig. 8 multirow detector scanners fast enough to make 3D videos

Significant impact has also been made in Computed tomographic colonography (CTC), or "virtual colonoscopy" **(fig 9 animation)**, which uses a low-dose CT scan to spot polyps and tumors in the colon and faster to perform than conventional colonoscopy.

Fig. 9: CT colonography (CTC)

Magnetic Resonance Imaging (MRI)

This imaging technique uses powerful magnetic field to align the nuclear magnetization of hydrogen atoms in the body (i.e. Body's natural magnetism) to produce images.

The first MRI human scan was obtained at Aberdeen in 1977.
The major advantages of MRI over other imaging modalities such as CT is its excellent soft tissue contrast which can be widely manipulated and it does not use ionizing radiation **(Figs 10a, b)**.

Fig. 10a: MRI

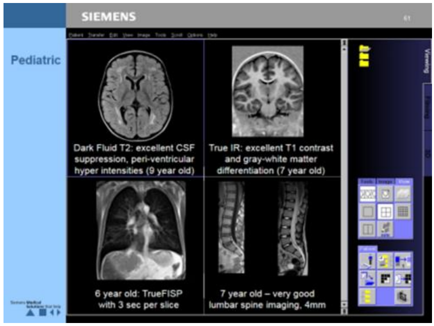


Fig. 10b: MRI Images

These and many more imaging modalities keep the specialty of radiology alive and busy.

WHAT IS RADIOLOGY?

Radiology is a branch of medicine that uses imaging technologies, such as radiography, MRI, nuclear medicine (NM), US, CT, and PET scan to see within the human body in order to diagnose disease and abnormalities and treat as the case may be.

Radiology may be sub-divided into three different areas namely, diagnostic radiology, interventional radiology and therapeutic radiation. The field of therapeutic radiation uses more powerful x-rays to treat cancer, and is now called radiation oncology.

Who is a Radiologist?

A radiologist is a physician/medical doctor who is also an imaging expert with specialized training in obtaining and interpreting medical images and treating diseases and injuries using medical imaging techniques.

A radiologist correlates medical image findings with other examinations and tests, recommends further examinations or treatments, and confers with referring physicians. Those who treat diseases by means of radiation (radiation oncology) are called Radiotherapists and those that engage in minimally invasive, image-guided surgery (interventional radiology) are called interventional Radiologists.

Radiologists work closely with Radiologic Technologists known as diagnostic medical Radiographer or Medical Imaging Scientist (depending on the country of practice) who are responsible for accurately positioning patients and ensuring that a quality diagnostic image is produced by way of adjusting controls of mobile and immobile equipment to obtain optimum views of specific body areas.

Subspecialties in Radiology

Subspecialisation has been a general trend in all areas of medicine and the desire to become subspecialized is increasing.

In the Western world, subspecialisation in radiology began to appear in major academic centers in the late 1920s (Scott 2007).

With the giant advances such as functional MRI, breast MRI, PET, and CT/PET fusion, these technologies have made the practice of radiology more complex. With this complexity comes an impetus toward specialization in radiology as it enhances improved accuracy and better diagnosis when subspecialists interpret exams.

This development has thus encouraged current division of radiology into three different major disciplines spanning 17 areas of subspecialty and the value of having this high level of expertise within these groups, are leading towards increasing super-specialization: **Diagnostic radiology**, with 12 subspecialties, **Interventional radiology/diagnostic radiology**, with 5 subspecialties, **Radiation oncology**, with 2 subspecialties.

Clearly it isn't possible for individual radiologists to develop expertise in all these areas. Since most radiology departments like ours in OAU/OAUTHC comprise few Radiologists relative to subspecialty disciplines, radiologists are increasingly required to interpret studies outside their areas of expertise or interest. Hence the choice of General Radiologists with bias for one or two areas of interest.

MY JOURNEY INTO RADIOLOGY

After the completion of my Housemanship and National Youth Service (NYSC), I was employed, posted to Adeoyo Hospital in

Ibadan as Medical Officer and unexpectedly posted to the department of radiology contrary to the usual practice.

With open mind, I joined the radiology department under the headship of Dr. Obisesan, with two other consultants, Dr. (Mrs.) Kemi Otolorin, Dr. (Mrs.) Osinaike and a senior registrar in transit in the department - Dr. Duro Ashebu. Five months into my unexpected posting to radiology, Dr. Obisesan left for the University of Jos to take up a new appointment as Professor of Radiology. He later invited me to join him to start the training in radiology in Unijos Teaching Hospital. The much expected letter of employment to start the residency never came. On one fateful morning, I got a message from Dr. Ashebu that a place for residency programme in Radiology was available in UNITH. I responded to the invitation and before long, I found myself in training as the first full fledge resident in radiology in UITH, Ilorin. By providence, I was under the tutelage of Prof. Funsho Komolafe who literally poured himself into my training programme which I finished in a record time of 4 years. He was the man God used through his guidance and counselling, to make me become who I am today in radiology. I am eternally grateful to him and other teachers I mentioned earlier that God placed along my path to becoming a radiologist and academic today.

MY MODEST CONTRIBUTION TO KNOWLEDGE

I joined the department of Radiology of this University in January 1992 with two of us (DR. Dele Hammed and myself) on ground. By mid-1994, I was the only one on ground providing the academic and clinical services until I was joined by Drs. Famurewa and Baralatei in 1999. Since 1992 to date I have trained more than 40 radiologists who are now consultants in many hospitals and lecturers of Professorial grades in many Universities. These include all the current academic staff and consultants in our department of radiology.

The specialty of radiology is very demanding and provides the central management point where virtually all the clinical problems are brought for consultations and solutions. Hence we Radiologists are referred to as **“Consultants of all consultants”.** Being the only one on ground for a long time providing service, teaching, and training, I had no choice but to be of service in all specialties to all specialists. As a result, my research work covered varieties of clinical problems. Mr. Vice Chancellor, Sir, in the milieu of the resulting numerous clinical research, occasioned by the need to solve clinical challenges that cut across all specialties, my contributions to Knowledge among many others, have focused majorly on the Radiological management of the problems in Maternal and Child health with emphasis on the role of ultrasound in modern medical practice.

Maternal and Child health

Maternal and child health (MCH) refers to the health of mothers, infants, children, and adolescents.

The objectives of the Maternal, Infant, and Child Health address a wide range of conditions, health behaviors, and health systems indicators that affect the health, wellness, and quality of life of women, children, and families *(Health People 2016)*.

Preconception Care for Women

This involves screening and diagnosis of couples following 6–12 months of attempting pregnancy, and management of underlying causes of infertility/sub-fertility, including past STIs *(WHO 2013)*.

In our experience with imaging, reproductive abnormalities such as structural problems in the uterus or cervix and pelvis have been identified as some of the problems during preconception care. Such structural abnormalities in addition to infertility/sub-fertility (miscarriage), can heighten the risk of difficulties like, an abnormally positioned fetus, difficult labour and cesarean delivery.

Infertility

Infertility is a major preconception health problem being investigated because of the importance attached to child bearing in this community. In our quest at unravelling the cause(s), of this emotive health issue, diagnostic imaging employs majorly hysterosalpingography (HSG), ultrasonography and more recently sonohysteroraphy (SHG). HSG is the contrast examination which involves the use of contrast medium and inonising radiation while the other 2 use high frequency sound waves to bring about seeing where feeling has failed or impossible.

At the twilight of my academic journey, before the advent and active utilization of ultrasound in our settings, we relied majorly on the technique of HSG which is still very much relevant till today. In the study of HSG in the investigation of infertility; my experience with 248 patients showed that 29 % had normal findings i.e. no structural abnormality **(fig 11)** which raised the probability of hormonal or psychological cause after male factor has been excluded, as no anatomical abnormalities were discovered *(Adetiloye, 1993)*.

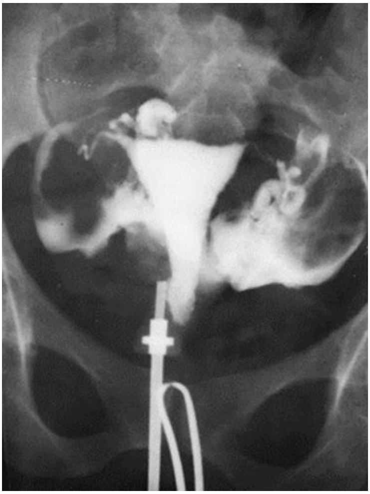


Fig 11. Normal HSG

A good number of patients (174) had abnormal HSGs producing 210 abnormalities from multiple pathologies **(Tab1)**.

Tab. 1 Abnormalities from multiple pathologies

Table 2 Tubal Abnormalities

	Rt. Tube	Lt. Tube	Bilateral	Total	%
Hydrosalpinx	12	8	15	35	34.3
Isthimic Occlusion	10	7	11	28	27.5
Cornual Occlusion	6	4	6	16	15.7
Perifimbrial Occlusion	5	2	5	12	11.8
Ampullary Occlusion	3	2	5	10	9.8
"Beading"	—	—	1	1	0.9
	36	23	43	102	100.0
%	35.3	22.5	42.2	100	

Uterine Abnormalities

	No.	%
Adhesions	40	50.0
Fibroids	36	45.0
Asherman's	3	3.8
Duplications	1	1.2
	80	100.0

Cervical Abnormalities

	No.	%
Adhesions	17	60.7
Fibroids	10	35.7
Duplications	1	3.6
	28	100.0

The most frequent abnormalities were tubal lesions with an incidence of 48.6%. This high incidence of tubal abnormalities which were mainly occlusive, ranged from Hydrosalpinx to ampulary occlusions with a special appearance of “Beading” in one of the patients **(Figs 12, 13)**. These occlusive abnormalities play a significant role in infertility but only revealed by seeing through imaging.

Fig. 12. HSG showing Hydrosalpinges

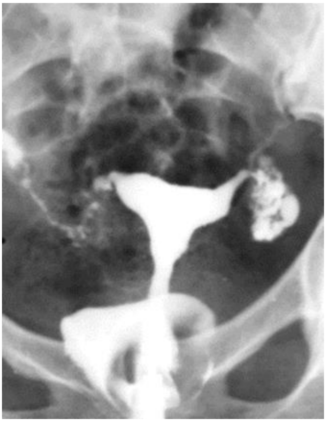


Fig. 13. HSG showing tubal “Beading

The occlusions are sequel to sepsis resulting from aseptic methods of deliveries, abortion or sexually transmitted diseases. Beading which is least encountered (0.9%) raised diagnostic differentials of Tuberculous salpingitis and salpingitis isthmica nodosa. The significant contribution to infertility by tubal occlusion stemming from sepsis was further confirmed by other studies from us (Asaleye and Adetiloye, *et al* 2004; Aremu and Adetiloye, *et al* 2012)**.**

Uterine abnormalities constituted 38.1% with adhesions and fibroids **(Fig14)** accounting for 95%.

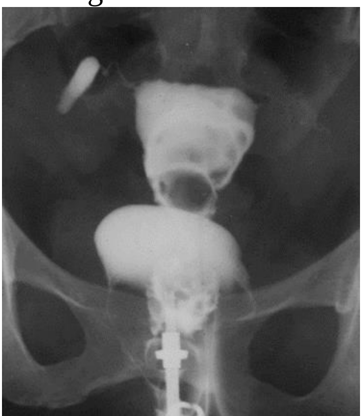


Fig. 14. HSG showing fibroids

The most severe of adhesions seen in Asherman’s syndrome constituted 3.8% **(fig.15)**.

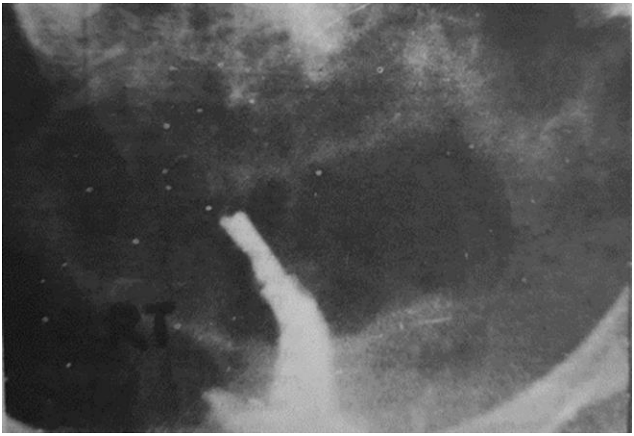
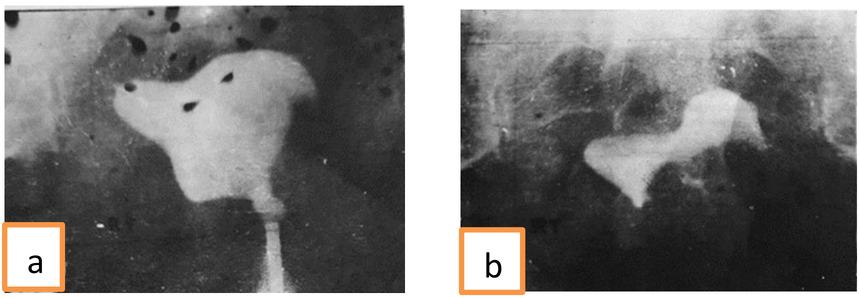


Fig. 15. HSG showing severe adhesions in Asherman's syndrome

These abnormalities caused various deformities and mechanical obstruction, impeding sperm migration, occlusion of tubal ostia and or implantation of fertilized ovum. One of the patients with secondary infertility had unusually severe lower abdominal colicky pain after the procedure. The delay image showed prolonged retention of the contrast medium within the uterine cavity **(Figs16a&b)**.



Figs16. HSG showing "Ball-valve-mechanism" (a) from large submucous fibroids and (b) retained contrast within uterine cavity on delay film

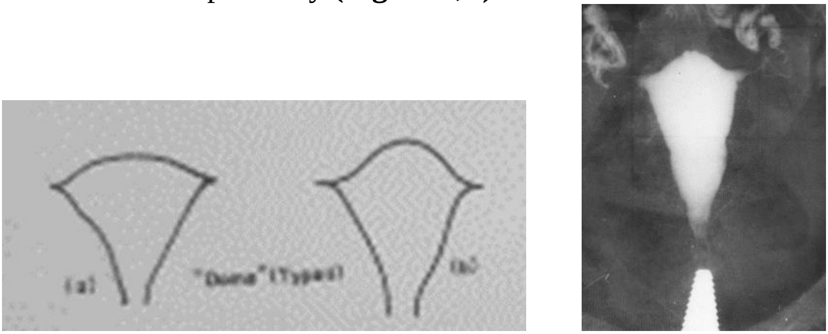
This was attributed to the ball-valve-mechanism which the large submucous isthmic fibroids had on the drainage of contrast. With each uterine contraction to expel the retained contrast medium was a corresponding severe colicky pain.

Of interest was a case of uterine duplication **(Fig17)**, a form of Mullerian anomaly. The patient presented with secondary infertility of 3years duration following Caesarian Section (CS).

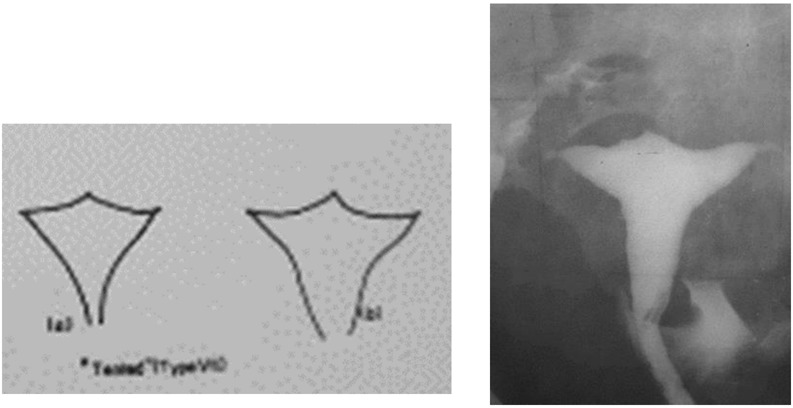
Fig17. HSG showing Uterine duplication

The cause of infertility was not apparent, but the occurrence of previous pregnancy was in consonance with similar lesions in literature.

Such outcome of Mullerian anomalies may be associated with premature labour, breech presentation, CS and abortion (Buttram, *et al* 1976). The existence of these Mullerian anomalies have been known for many years but controversy persists with regards to the clinical implication of each anomaly. Many authors have made attempts at categorizing different configuration of Mullerian anomalies. The interpretations are as varied as the numbers of authors especially in describing what the normal HSG appearance is. I added to this controversy or should I say added to knowledge in a pioneering research work in our locality where different uterine fundal contours as seen on HSG were described and “new” varieties of uterine contours which were not previously known in literature were described (Adetiloye 1995). These are “Dome and Tent Fundus respectively **(Figs 18a,b)**.



Figs HSG showing 18 a “Dome” Fundus



Figs 18 b HSG showing “Tent” Fundus

In extreme cases, and very rarely, Mullerian anomaly could present as agenesis (absence) of uterus and vagina a syndrome called Mayer-Rokistansky-Hauser syndrome (MRKH). We were able to present two cases of this very rare Mullerian disorder which is nonhereditary in siblings (Aremu and Adetiloye *et al* 2006). Both patients presented with primary amenorrhhoea and primary infertility. Ultrasonography revealed absent uterus and ovaries in both patients but showed a pelvic kidney. The findings were further confirmed with CT in both patients **(Fig.19a & b)**.

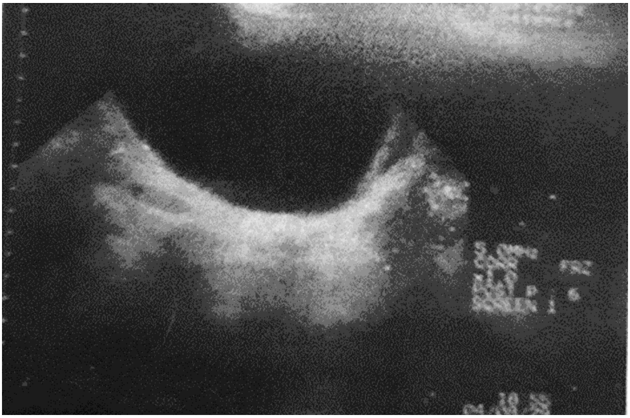


Fig. 19a: Sonogram showing full urinary bladder, absent uterus and ovaries

Fig. 19b. CT showing absent uterus and ovaries with a pelvic kidney

Associated congenital anomalies of the upper urinary tract are seen in about 30-40% of cases and these may vary from renal genesis to pelvic kidney (Strubbe *et al* 1993).

Disordered Menstrual flow

Other preconception area which ultimately aims to improve women care is normal menstrual flow. The average menstrual cycle is about 28 days with each menstrual flow lasting 4-5 days. However, there are variations in cycle, duration of days of flow and amount of blood loss with each individual. Deviation from normal cycle, duration or amount of blood flow for such individual constitute abnormality (Disordered menses). Such abnormalities are mere symptoms i.e. feelings, which in some cases do not represent specific pathological entities.

In order to bring these to imaging realities we embarked on a study to correlate these feelings with realties of imaging findings in the developing country like ours with limited facilities to detect internal genital tract abnormalities at the time this project was carried out (Adetiloye 1997).

The majority (76%) of the patients with disordered menstrual flow was investigated for menorrhagia and HSG was conclusive in the diagnosis of uterine fibroids in 43.9% constituting the highest cause.

Secondary amenorrhoea and hypomenorrhoea (oligomenorrhoea and Asherman's) constituted 38.7% of which intrauterine adhesion (IUA) were the main findings. Moderate adhesions were mainly associated with oligomenorrhoea while severe adhesions were seen in Asherman's syndrome and 2°amenorrhoea.

Normal HSG were seen in 23.3% of cases i.e. no structural abnormalities were seen thereby excluding lesions such as small submucous fibroids which cannot be felt clinically. The causes in these cases might be due to higher centers.

Apart from the diagnostic value in revealing what could not be felt, HSG was also of therapeutic advantage bringing about the end to the misery of infertility in 4 of the patients. These patients became pregnant after the procedure. Two of the patients had normal HSG and the remaining 2 had tubal lesions. The mechanisms for the therapeutic effect varied from bacteriostatic effect of the contrast medium to enhancement of cilliary activity of tubes and hydrotubation (Soul *et al* 1982).

HSG with its limitations, has been invaluable over the years and still considered as a valuable tool in preconception care as exemplified in these studies. However, the advent of modern imaging techniques such as ultrasound, CT and MRI have expanded the horizon of seeing what cannot be felt.

A pioneer work with sonography was done in this environment where the technique of abdominal sonohysterography (SHG) using normal saline as the contrast medium, was performed to assess its diagnostic value and acceptability in 100 infertility patients (Aremu and Adetiloye et al 2008). SHG was well accepted by greater proportion of the patients. With this acceptability, can (SHG) replace the old reliable HSG?

To answer this question, a study comparing HSG with abdominal SHG in 100 patients was conducted (Aremu and Adetiloye *et al* 2012). SHG had 100% sensitivity, specificity and positive predictive value for uterine synechiae (adhesions) **(Fig. 20a,b)**, hydrosalpinges **(fig. 21a,b)** and bilateral tubal blockage but 13% sensitive for unilateral tubal blockage.

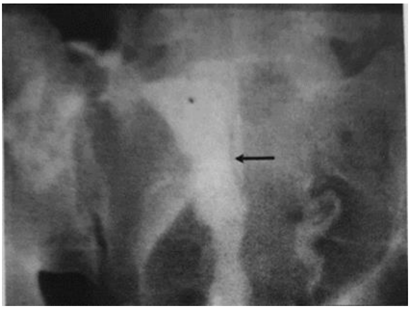


Fig. 20 a. HSG showing uterine synechiae (arrow)

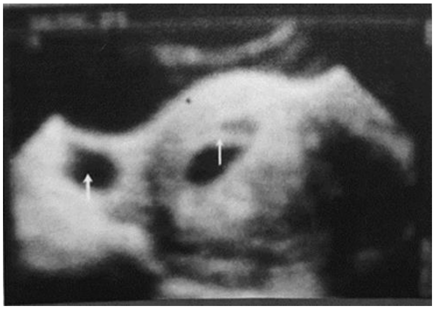


Fig. 20 b. SHG showing uterine synechiae (thinner arrow)

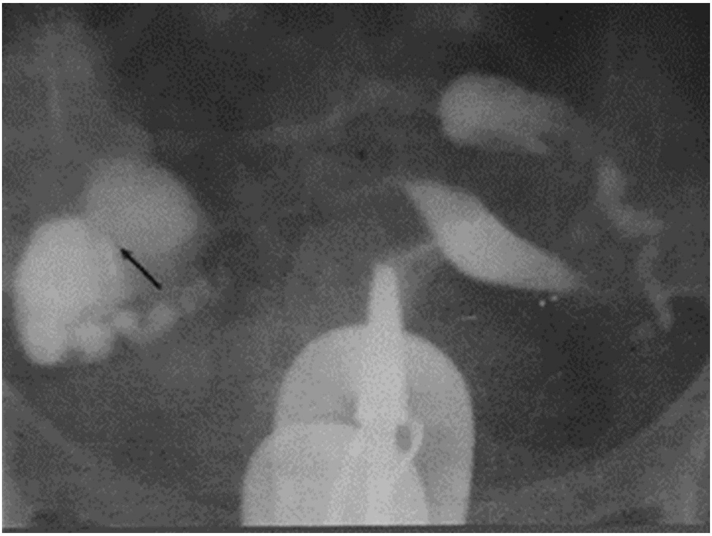


Fig. 21a. HSG showing linear filling defect within the right hydrosalpinx (black arrow)

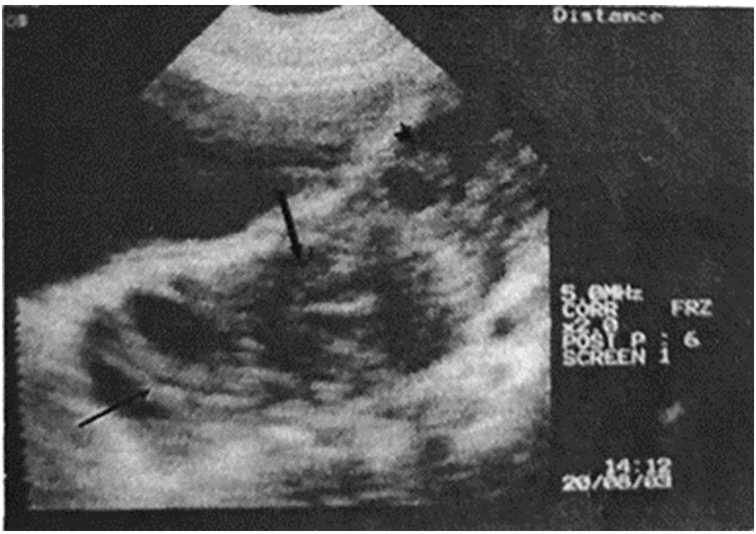


Fig. 21b. SHG showing the uterus (thick arrow), thick echogenic band (thin arrow) within the right hydrosalpinx

SHG had100% concordance with HSG in submucous masses (polyps & fibroids) **(fig. 22)** and found to be less painful by 80% of the patients.

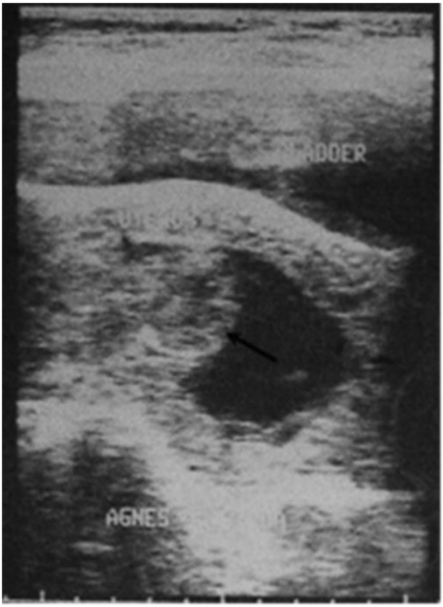


Fig. 22. SHG showing submucous masses

It was as accurate as HSG in evaluating the fallopian tubes and uterine cavity in infertile patients. We therefore advocated its use as a replacement for HSG in an environment where hysteroscopy, MRI, trans-vaginal probes and skill are not readily available.

Haemodynamic changes in uterine fibroids

The utilization of US in the assessment of uterine fibroids goes beyond the gray scale diagnosis but has an added advantage of haemodynamic information of not only the masses but the entire uterus. In a prospective study of 140 patents with fibroids and 140 controls (Idowu and Adetiloye *et al* 2017), we compared the changes within the main uterine artery of those with fibroids and that of the normal uterus, using several Doppler indices. We also explored the relationship between these changes in uterine volume and clinical symptoms and compared the main uterine artery Doppler changes in women with recurrent fibroid (after a previous myomectomy) and those with primary tumours (without previous surgical or medical intervention). We found that the women with uterine fibroids showed a significant increase in uterine perfusion/blood flow compared with controls, as evidenced by the elevation of uterine artery Doppler indices, reflecting increased blood flow velocity (PSV, EDV, TAMX, Tmean, DAR, AT and AI) with increase in uterine volume, while the indices reflective of the degree of resistance to blood flow or vascular impedance (PI, RI, SDR, Iml, inverse PI) diminished with increase in uterine volume **(Tab2)**.

No significant differences were detected between the main uterine artery Doppler indices of uteri with recurrent fibroid and those with primary tumours.

Table 2 Comparison of main uterine artery Doppler indices of the subjects and controls

Doppler indices	Subjects	Controls	$p^{\dagger}$
	n = 140	n = 140	
PSV (cm/s)	94.2 ± 39.3	54.2 ± 16.4	< 0.001
EDV (cm/s)	29.7 ± 19.1	7.7 ± 2.6	< 0.001
TAMX (cm/s)	49.1 ± 26.4	20.0 ± 7.2	< 0.001
Tmean (cm/s)	25.5 ± 16.4	10.0 ± 4.2	< 0.001
PI	1.5 ± 0.7	2.4 ± 0.4	< 0.001
RI	0.7 ± 0.1	0.9 ± 0.03	< 0.001
SDR	3.8 ± 1.6	7.2 ± 1.5	< 0.001
AT (ms)	117.9 ± 28.0	92.0 ± 22.8	< 0.001
AI	0.8 ± 0.3	0.6 ± 0.2	< 0.001
DSR	0.3 ± 0.1	0.1 ± 0.03	< 0.001
Iml	3.8 ± 1.6	7.2 ± 1.5	< 0.001
DAR	0.6 ± 0.2	0.4 ± 0.1	< 0.001
1/PI	0.8 ± 0.3	0.4 ± 0.1	< 0.001

Table 3 Comparison of main uterine artery Doppler indices by uterine volume in the subjects

Doppler indices	Uterine volume		$p^{\dagger}$
	≤ 200.0 cm^3	> 200.0 cm^3	
	n = 14	n = 126	
PSV (cm/s)	65.1 ± 14.6	97.4 ± 39.9	< 0.001
EDV (cm/s)	12.8 ± 5.7	31.6 ± 19.1	< 0.001
TAMX (cm/s)	23.8 ± 7.9	51.9 ± 26.2	< 0.001
Tmean (cm/s)	12.7 ± 4.7	26.9 ± 6.7	< 0.001
PI	2.4 ± 1.1	1.4 ± 0.6	< 0.001
RI	0.8 ± 0.1	0.7 ± 0.1	< 0.001
SDR	5.7 ± 1.7	3.6 ± 1.5	< 0.001
AT (ms)	98.5 ± 30.0	120.1 ± 27.1	0.01
AI	0.7 ± 0.3	0.8 ± 0.3	0.20
DSR	0.2 ± 0.1	0.3 ± 0.1	< 0.001
Iml	5.7 ± 1.7	3.6 ± 1.5	< 0.001
DAR	0.6 ± 0.3	0.6 ± 0.2	0.01
1/PI	0.5 ± 0.1	0.8 ± 0.3	< 0.001

Abbreviations: 1/PI, inverse pulsatility index; AI, acceleration index; AT, acceleration time; DAR, diastolic average ratio; DSR, diastolic/systolic ratio; EDV, end-diastolic velocity; Iml, impedance index; PI, pulsatility index; PSV, peak systolic velocity; RI, resistivity index; SDR, systolic/diastolic ratio; TAMX, time-averaged maximum velocity; Tmean, time-averaged mean velocity.
† Mann-Whitney U test applied.

Another study by Idowu BM *et al* 2018 further showed that the predominant pattern of fibroid vascularity is peripheral and the perifibroid artery indices (except EDV and DAR) are significantly higher than those of the intrafibroid artery. Recurrent fibroids in women with previous myomectomy had significantly higher intrafibroid PI, RI, SDR, and ImI than those without previous myomectomy **(Figs.23 a, b)**.

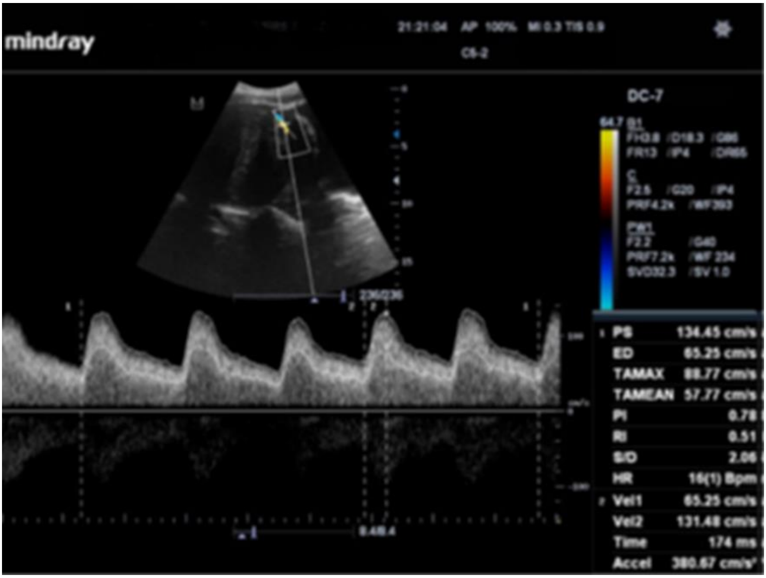


Fig. 23 a. Longitudinal triplex sonogram of a myomatous uterus showing the waveform pattern and Doppler indices of a perifibroid (peripheral) artery. (*Idowu BM et al 2018)*

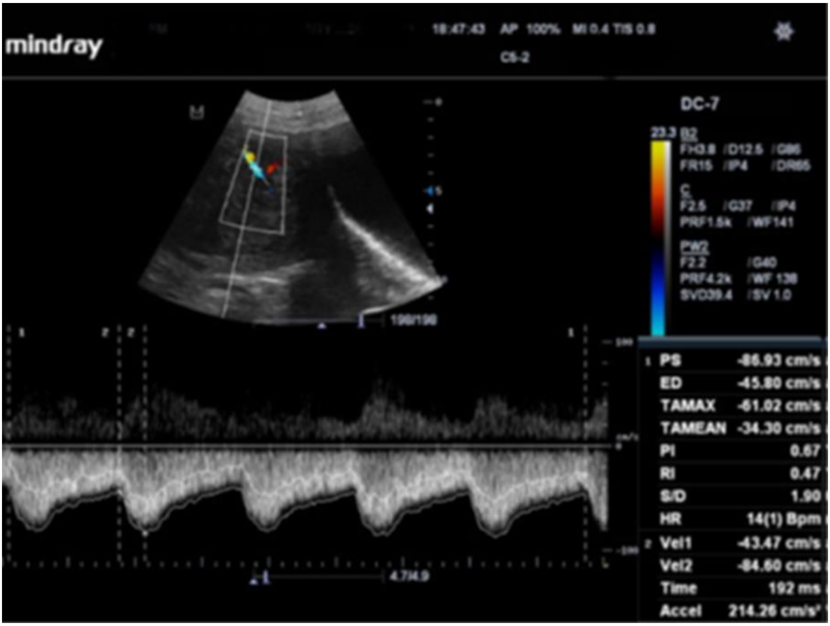


Fig. 23 b. Longitudinal triplex sonogram of a myomatous uterus showing the waveform pattern and Doppler indices of an intrafibroid (core) artery. *(Idowu BM et al 2018)*

Abortion

Contributing significantly to the causes of infertility has been the after effect of sepsis which majorly occurs as a result of induced abortion performed in unhygienic environments by untrained or poorly trained staff. The public health impact of unsafe abortion procedures is directly linked to its legal status (Finer *et al* 2013). However, women who wish to terminate their pregnancies will seek this service whether it is legal or not and this often result in various complications ranging from incomplete abortion, pelvic collection, perforation of the uterus to death.

We pioneered a sonographic research work in our locality where sonographic evaluation of the complications of induced abortion and correlation with surgical findings in 46 patients were carried out (Adetiloye *et al*). The various sonographic appearances following induced abortion were described. Based on the sonographic findings, the patients were categorized into three groups. There was no clear association between the severity of sonographic or pathologic findings and the time of presentation for ultrasound after the termination of pregnancy, but most of the patients presenting after 5 days belonged to those with uterine complications with or without abdominopelvic complications. The most common complication, which is sepsis was variably expressed sonographically and were similar to those seen in pelvic Inflammatory Disease (PID) but some features seen with post-abortal sepsis were peculiar **(Figs. 24. a-g)**.

Fig. 24 a. Sonograms (Trans. & Long.) showing thick echogenic structures with posterior pseudo-acoustic shadows from retained products of conception with gas from gas-forming organism

Fig. 24 b. Sonograms (Long.) showing a bulky, brightly echogenic Uterus with thick intrauterine echogenic structures from retained products of conception with gas from gas-forming organism. Note the presence of a pelvic kidney.

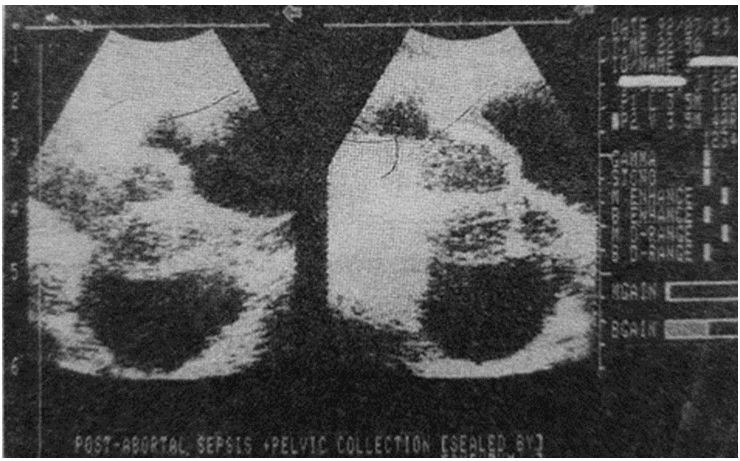


Fig. 24 c. Sonograms (Trans. & Long.) showing normal sized, slightly retroverted uterus. There is fluid in the pouch of Douglas and localized fluid over the anterior uterine wall.

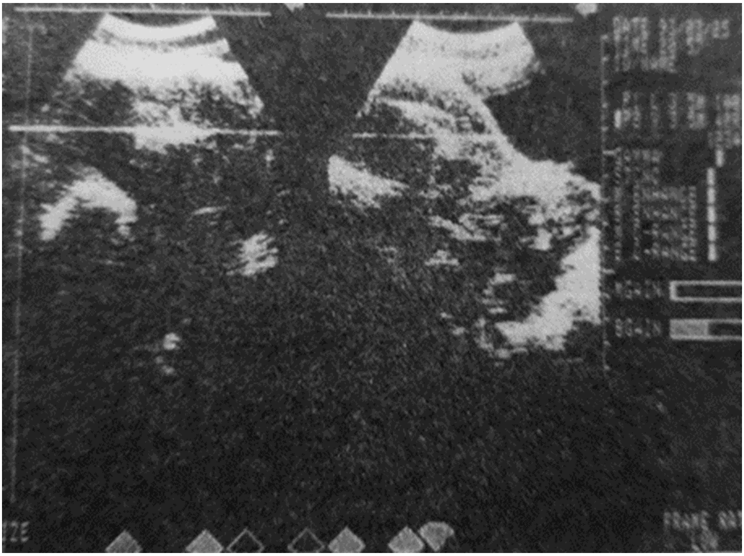


Fig. 24 d. Sonograms (Trans. & Long.) showing localized fluid with thick short echoes in POD. Note the presence of intrauterine retained product of conception.

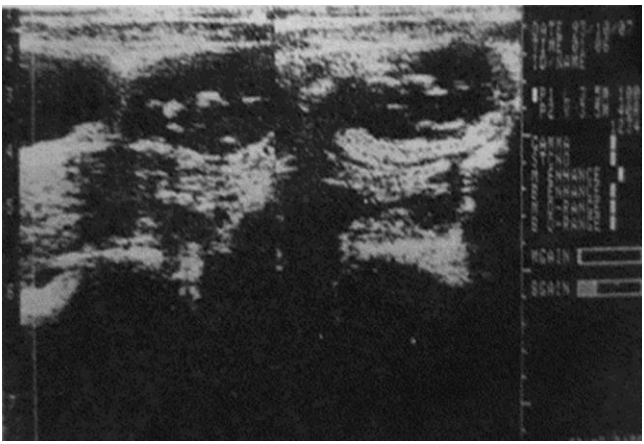


Fig. 24 e. Sonograms (Trans.) of adnexal mass showing an oval sonolucent appearance, containing short thick internal echoes. The wall posterior is in layers from omentum and collapsed bowel walls.

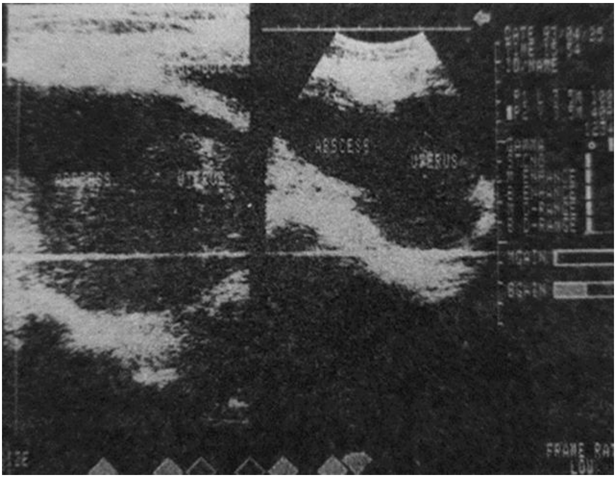


Fig. 24 f. Sonograms (Long. & paramedian) showing an extensive pelvic and abdominal abscess in which there is fluid/debris interface. The uterus is partially obscured.

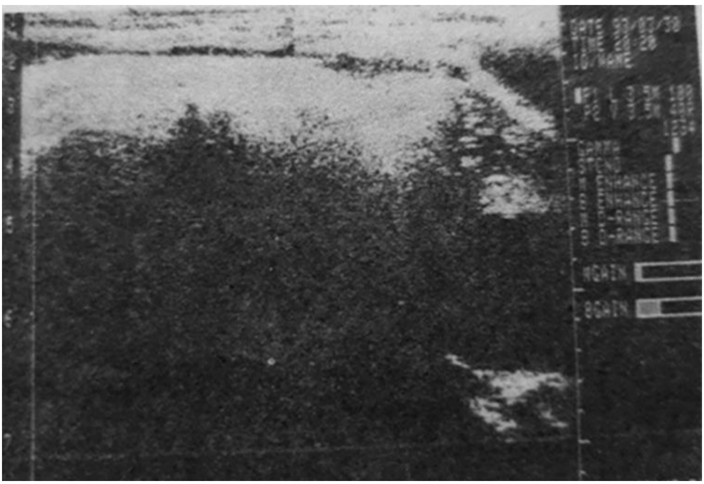


Fig. 24 g. Sonograms (Composite Long.) of the abd and pelvis in a patient with omental cake, showing anterior brightness with wide beam of posterior pseudo-acoustic shadows and clear fluid in POD. The uterus and central structures areobscured by the acoustic shadow.

A case of psuedouterus was demonstrated in a patient after hysterectomy **(Fig24.h)**.

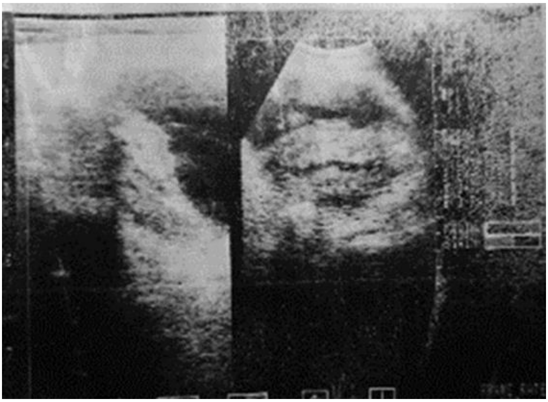


Fig. 24 h. Sonograms (Lon. & Trans.) of the pelvis after hystectomy showing "pseudo-uterus' appearance. Note the thickened posterior bladder wall.

Such sonographic descriptions in abortion were not previously available. This makes it the first in the literature. The likelihood of preoperative US diagnosis of uterine perforation is high when the presentation is early before the formation of complex echopatterns of sepsis or in the absence of free intraperitoneal gas from bowel perforation or gas-forming organism. A proposal that routine endometrial curetting of the uterus should be discouraged when ultrasound showed no evidence of intrauterine retained products of conception after induced abortion.

With pregnancy achieved with or without the preconceptional care, effective prenatal care, enhances opportunities to improve the outcomes of pregnancies.

Prenatal Care

Every pregnancy carries its risks, but good prenatal care and support given by imaging can help minimize those risks.

The effectiveness of such prenatal support in improving pregnancy outcomes, enhances healthy development of fetus through screening of fetal development, and early detection of co-existing conditions.

Early detection of co-existing conditions in pregnancy

Some conditions coexisting with pregnancy were antenatally diagnosed with imaging with resultant modification of the clinical management.

Liver cirrhosis

Pregnancy in women with liver cirrhosis is an uncommon occurrence and thus has been rarely reported in this region. Fetal wastage among pregnant women with liver cirrhosis is said to occur in 18% of cases and is related to the severity of maternal disease. The risk of spontaneous abortion is greatly increased even when there is no apparent deterioration in hepatic function (Cheng 1977). We reported three cases in OAUTHC; one of them was diagnosed before pregnancy and two became pregnant before the diagnosis of liver cirrhosis was made (Ndububa and Adetiloye *et al* 2001). All the three had hepatic decompensation as pregnancy progressed. One of the patients had an Intra-uterine death (IUD) at 30 weeks while in another, the baby died soon after delivery. The gestational age by ultrasound in this latter case consistently lagged behind the gestational age by dates. At the time of delivery, there was a difference of 5 weeks which was suggestive of intrauterine growth retardation. One major hazard to the pregnant woman with liver cirrhosis is post-partum haemorrhage (PPH) and the most common cause of maternal death is massive upper GIT bleeding due usually to oesophageal varices which was the cause in one of our patients as oesophageal sclerotherapy could not be done due to lack of the facility.

Hepatocellular carcinoma (HCC)

Risk factors for the development of HCC in pregnancy include hepatitis B virus, infection and high parity (Lau *et al* 1995). There is no report of HCC occurring during lactation and immediate postpartum period. This prompted our report of 6 patients with HCC in pregnancy and postpartum period (Ndububa and Adetiloye *et al*). The confirmation of HCC was done by ultrasound postpartum in 5 cases. This shows that all the women who presented during postpartum period may have had the tumour in pregnancy and that HCC may not be incompatible with normal pregnancy and delivery. The lesson here is that antenatal ultrasound should not be limited to the gravid uterus but other intra-abdominal organs should be screened at the same time to pick early liver or any other co-existing disease. However, maternal mortality has been found to be worse than fetal wastage in HCC in pregnancy. This was confirmed in this study where 4 out of 6 babies delivered were known to have survived while the case was fatal in 5 of the women, the 6th woman was discharged against medical advice. The major cause of death were hepatic failure and tumour haemorrhage.

Hydatidiform mole

This is a benign tumour of trophoblast. There are two types of hydatidiform mole (H. mole) – complete and partial.

In complete H. mole, no fetal part is present **(Fig. 25a)** while in partial H. mole, a fetal part is present **(Fig, 25b)**.

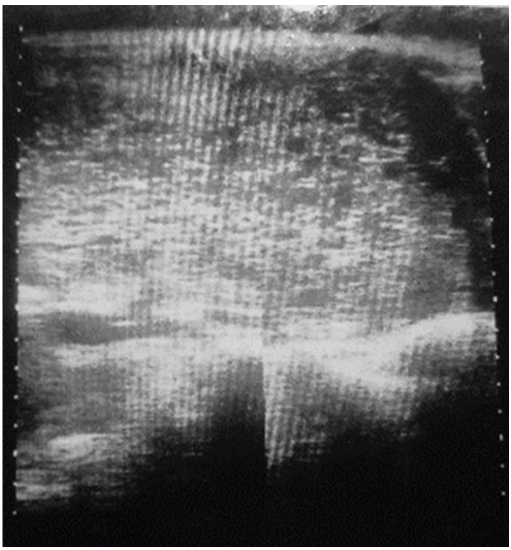


Fig. 25a Sonogram (composite long.) showing complete H. mole, no fetal part is present.

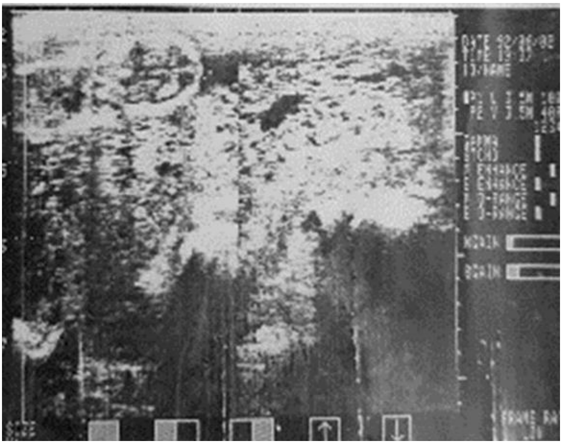


Fig. 25b. Sonogram (composite long.) showing Partial H. mole pregnancy coexisting with molar pregnancy

Normal intrauterine pregnancy coexisting with molar pregnancy is a rare condition and the diagnosis may be difficult. We made a diagnosis of normal pregnancy coexisting with molar pregnancy (Dare and Adetiloye *et al* 1999) where a normal fetus was seen with hydatidiform mole showing the typical "snow storm appearance" and further confirmed by elevation of serum BhCG. This case highlighted the value of detailed ultrasound evaluation of all pregnancies. This also reminded me of a case of complete H. mole that caused a diagnostic dilemma when I was on commonwealth scholarship programme in UK. It occurred in a 15-year old. While the discussion as to the possible diagnosis of this "bizarre" case was going on, I came in to offer the spot diagnosis with the description of the features of H. mole. The look on the faces of my colleagues spoke volume and they ignored my contribution, perhaps because it came from a young radiologist from Nigeria. They concluded their controversial argument with a decision for further evaluation with MRI. I did not hear anything about the patient again until after 3 days when one of my colleagues who happened to be a British citizen like others whispered to me and said "Victor, did you know you were correct with your diagnosis of H. mole in that patient. All of us were wrong". Again, seeing is believing. This experience gave me the confidence that my training in Nigeria and indeed our postgraduate training programmes both of National and West African colleges can stand shoulder to shoulder with other foreign programmes.

Inadequate pelvic capacity

One of the factors that affect the success of vaginal delivery is the adequacy of the "passageway" i.e. maternal birth canal. Inadequacy of the birth canal can be due to an underdeveloped pelvis among other causes. This can lead to difficulties during childbirth as a result of Cephalopelvic disproportion (CPD) or fetal-pelvic disproportion (FPD), when there is a mismatch between the fetus and the maternal birth canal. These are considered to cause protraction and even arrest of labor and as a consequence, they increase both maternal and fetal morbidity and even mortality.

When there is suspicion of reduced dimensions or when vaginal delivery is being contemplated in breech presentation, the evaluation of the passageway, to assess the pelvic dimensions and the pelvic shape is undertaken by a process called 'Pelvimetry'. Modern pelvimetry using CT or MRI is reliable, accurate and offers reduction of ionizing radiation in the former and absence in the latter.

It is difficult to discuss pelvic inadequacy unless one knows the normal pelvic dimensions for a giving population. There was little information in the existing literature describing the normal value of Nigerian female pelvic parameters. Therefore, to determine the baseline pelvic parameters of Nigerian female pelvis and to compare the parameters with those derived from other studies, a prospective study was undertaken by us to determine the baseline pelvic parameters using CT pelvimetry in Nigerian pregnant women at 36 weeks and above (Ma'aji and Adetiloye *et al* 2007).
A total of 100 pregnant women recruited for this study included women with breech presentation after 36 weeks gestation and women who either had previous lower segment caesarean section for reasons other than confirmed or suspected cephalopelvic disproportion (CPD).

We found that the mean anteroposterior and transverse inlet pelvic diameters were 11.6 cm +/-SD 0.9 and 12.0 +/-SD 0.8 cm respectively **(Figs 26a, & b)**.

Fig 26a. CT Pelvimetry showing antero-posterior inlet diameter measurements

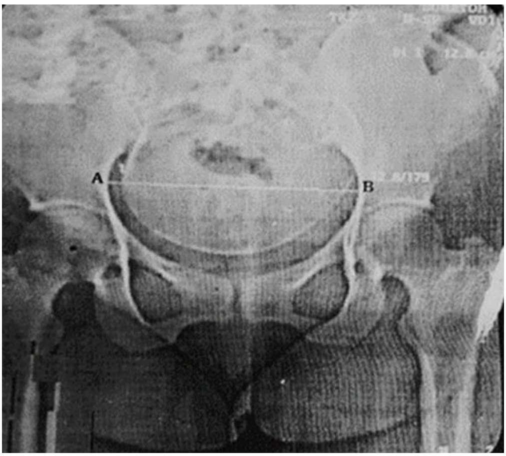


Fig26 b. CT Pelvimetry showing transverse inlet pelvic diameter measurement

The range of anteroposterior and transverse diameters of the inlet were 8.4 cm-14.0 cm and 10-13.8 cm respectively. The mean outlet diameter was 11.5 cm +/-SD 1.2 cm. The mean bispinous diameter of the pelvis was 10.6 cm +/-SD 0.9 cm. There was significant positive correlation between anteroposterior diameter of the inlet and outlet as well as the bispinous diameters (1st, 4th - 6th pairs) $p<0.001$.

We concluded that there were significant variations in pelvic parameters of Nigerian women when compared with values from other countries of the world. These significant variations were considered anthropometric in origin.

Caesarian section is usually considered to avert untoward complications of CPD. Such complications include maternal and fetal morbidity, fetal demise and obstetric fistulae from unrelieved prolonged obstructed labour.

Obstetric Fistula

Vesicovaginal fistula (VVF) and rectovaginal fistula (RVF) are obstetric fistulae resulting from pressure necrosis and sloughing of tissue from prolonged obstructed labour. The clinical symptoms of continuous leakage of urine and or faeces per vaginum are one of the most calamitous clinical problems in developing countries.

In recent years, there has been a gradual decline in the incidence of VVF in some parts of developing countries probably because of the increasing awareness of the importance of antenatal care and supervised hospital delivery (Lawson 1993; Adewole 1994). Surprisingly, there has been in our practice encounter with cases of obstetric fistulae, hitherto considered as rare. Although the literature has several reports on surgical management of such fistulae, information about radiological findings in these conditions had been limited to plain film appearances of pelvic bone (Lagundoye *et al* 1975), urinary tract changes on IVU (Lagundoye *et al* 1976; Akamaguna *et al* 1983) and HSG (Dare and Adetiloye *et al* 1997).
Interestingly, the most common mode of evaluation of the female pelvis globally is by ultrasonography, but no report has analysed the sonographic appearance in these conditions. We therefore embarked on a novel prospective research using ultrasound to investigate obstetric fistulae and comparing the findings with those of IVU (Adetiloye, *et al* 2000). Various genital abnormalities not revealed by IVU were demonstrated by sonography preoperatively.

The site, size and course of the fistulae were identified in 29% of the cases. The likelihood of demonstrating the fistula sonographically is low in the presence of poor or lack of acoustic window from poor bladder distension resulting from large (>3cm) or multiple fistulae and from small fistula (0.9cm) even when the bladder was distended after instilling normal saline through an indwelling urinary catheter.

When fistulae were identified, they were represented either as linear hypoechoic or hyperechoic tracks. In combined RVF and VVF, the fistulae were recognized by linear hyperechoic bands with "ring-down" artifacts **(Fig.27a)** from the gas derived from the rectum that rose non-dependently through the fistula into the urinary bladder or as gas bubbles originating from the defect created by the fistula at the base of the urinary bladder giving rise to 'flat tyre sign' **(Fig. 27b)**.

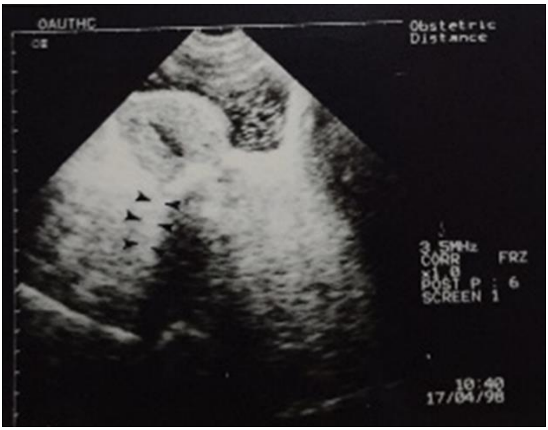


Fig 27 a. Sonogram (long.) showing linear hyperechoic bands with "ring-down" artifacts (arrow heads)

Fig 27 b. Sonogram (long.) showing gas bubbles originatingfrom the defect at the base of the urinary bladder giving rise to 'flat tyre sign' (arrow head)

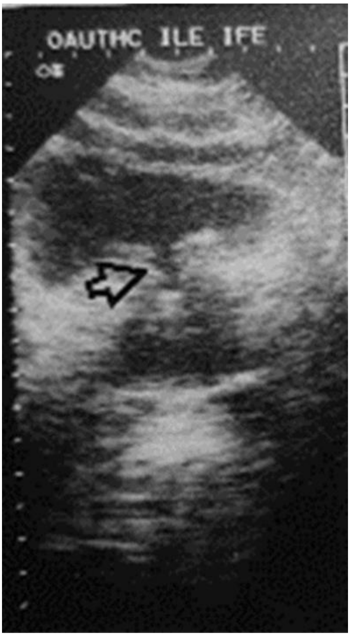
Air was preferentially identified in the fistulae in these cases because air is lighter than water and thus rose readily from the rectum to occupy the track at the expense of the urine. However, when the rectum was devoid of gas, the reverse would be the case **(Fig.28 a & b)**.

Fig.28 a. Sonogram (long.) showing Linear hypoechoic parmedian track from fluid-filled VVF (big arrow). Fluid in the vagina. (small arrow)

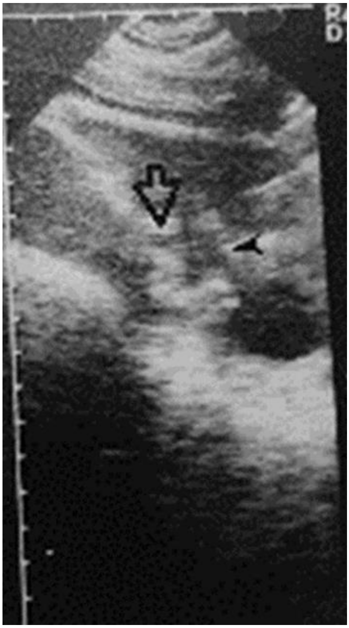
Fig.28 b. Sonogram (long.) showing linear hypoechoic parmedian track from fluid-filled VVF (arrow)

In VVF with RVF, in the absence of gas in the rectum, the fistulae were mainly hypoechoic from urine leakage because of their dependent position relative to the urinary bladder.

The pre-operative identification of cervical injuries in relation to VVF as we demonstrated in this study has not been reported in any of the previous radiologic studies especially the identification of "hour-glass" appearance of VVF in association with harelip defect of the cervix **(Figs. 29a & b)**. This study, makes these appearances and sign the first to be described in the literature, and the first time US would be used to diagnose obstetric fistula.



Figs. 29a. Sonogram (Trans.) showing "hour-glass" appearance of VVF. Arrow shows the fistula)



Figs. 29 b. Sonogram (Long.) showing "harelip defect" of the cervix (arrow)

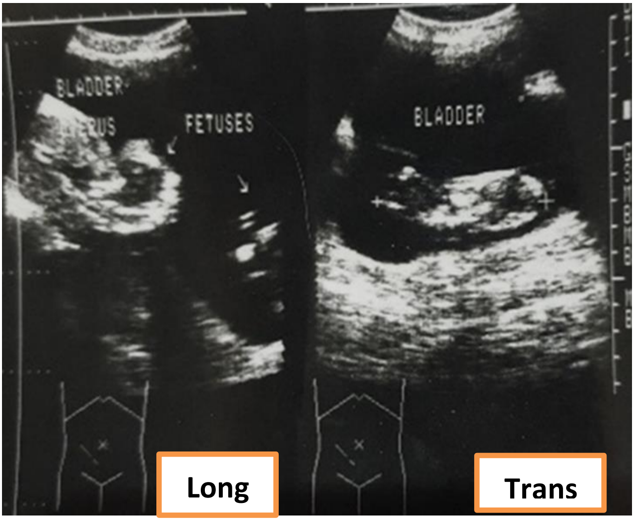
Sonography showed superiority over IVU or plain radiography in most aspects.

We concluded that sonography is complementary to EUA in preoperative evaluation of patients with VVF in general and in those with previous unsuccessful repairs in particular. This study was regarded as a novelty by assessors and widely acknowledged with very many requests for reprints all over the world.

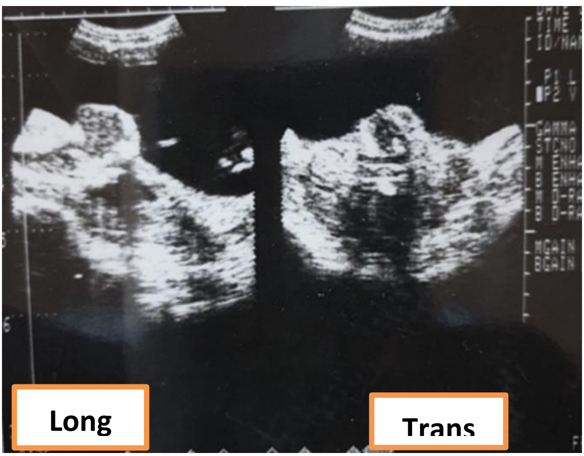
Good antenatal care, recognition of CPD and timely CS will prevent the occurrence of these complications.

As good as CS is in saving lives of high risk fetuses and mothers, it is not without complications like other surgical operations. Such complications include blood loss, damage to adjacent organs which may also lead to obstetric fistula, anaesthetic complications and on long term, infections and ruptured caesarian section scar to mention a few. We reported an unusual case of ruptured previous

CS scar with extrusion of twin fetuses into the urinary blabber (Fasubaa and Adetiloye *et al* 2001). This kind of case to the best of our knowledge had not been previously reported and thus became the first of its kind in literature **(figs. 30a & b)**.



Figs 30a. Sonograms (Long) showing 2nd twin being extruded through the anterior uterine wall into the urinary bladder. Fetal part of the 1st twin within the bladder, and (Trans) showing floating within the urine in the bladder.



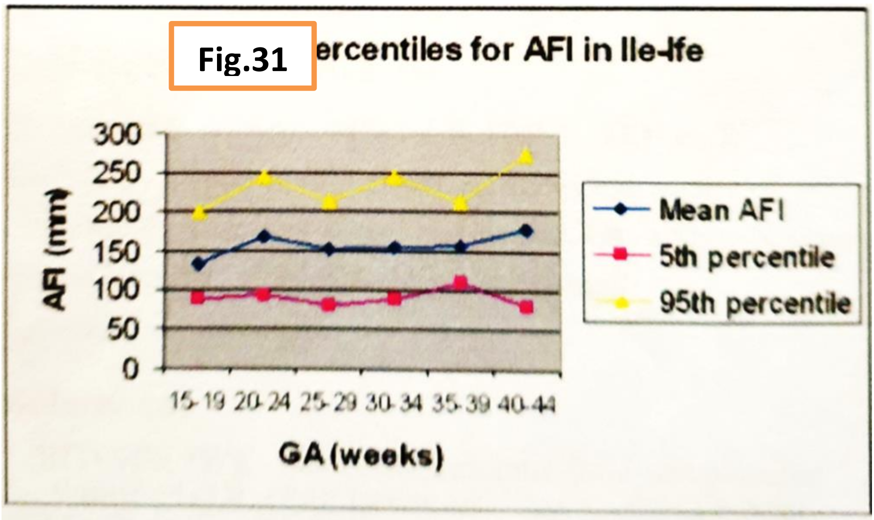
Figs 30b. Sonograms (Long) showing anterior uterine defect through which the skull of the 2nd twin is being extruded. Note part of the 1st twin in the bladder and (Trans) showing protruding fetal skull of the 2nd twin from uterine cavity into the bladder.

Screening of fetal development

Imaging plays important roles in the screening of the development of the fetus by the means of many sonographic parameters. We embarked on research to evaluate some of these parameters.

Amniotic Fluid evaluation

One of the parameters for the screening of fetal development is the evaluation of amniotic fluid. Amniotic fluid volume assessment is an integral part of the antenatal evaluation of pregnancy at risk for an adverse outcome as the volume of amniotic fluid is an important indicator of fetal condition. Amniotic fluid index (AFI) is a non-invasive technique of estimating amniotic fluid volume. To establish the normal range of AFI across gestation and gestational specific boundaries of normal AFI in our environment, we carried out a prospective study of 500 pregnant women with ultrasound from 15 weeks to 41 weeks gestation (Alao and Adetiloye *et al* 2007). The study showed AFI rising from 15 weeks to 22 weeks then dropped at 25 weeks before rising gradually again and reaching maximum value at 41 weeks **(Fig.31)** and the normal range of AFI of 7.9cm to 27.3cm was established.



The difference in mean AFI between the term and preterm pregnancy showed no significant difference {P>0.05(±=0.965)}. This reference range of AFI that we established from this study has been found useful in our environment.

Fetal weight estimation

The importance of fetal weight estimation cannot be over emphasized as both low birth weight and excessive fetal weight at delivery are associated with an increased risk of maternal and newborn complications during labour and peurperium (Shittu *et al* 2007). Decreasing the potential complications associated with birth of both small and excessively large fetus requires accurate estimation of fetal weight. Accurate estimation of fetal weight is therefore of paramount importance in the management of labour and delivery to optimize safe motherhood. A comparative study was carried out to find out the ultrasonographic formula with the greatest accuracy in predicting birth weight and the influence of scan delivery interval, placentation, and amniotic fluid index on the estimation of fetal weight. A prospective study of 100 pregnant women of gestational age between 37 and 42 weeks was carried out using ultrasonography (Ayoola and Adetiloye *et al* 2008). Measurements were taken and the estimated fetal weights were derived and analysed with formulae as listed in **Tab3** and actual birth weights were obtained after the babies were born.

Tab. 3 **Various formulae used for fetal weight estimation**

Authors	Formulae
Hadlock, *et al.* [11]	Log_{10} (Estimated fetal weight) = 1.3598 + 0.051AC + 0.1844FL − 0.0037(FL × AC)
Hadlock, *et al.* [12]	Log_{10} (Estimated fetal weight) = 1.335 − 0.0034(AC × FL + 0.0316BPD + 0.0457AC + 0.1623FL)
Shepard, *et al.* [15]	Log_{10} (Estimated fetal weight) = 1.7492 + 0.166BPD + 0.046AC − 0.00264(AC × BPD)
Nzeh, *et al.* [16] (formula 1)	Log_{10} Birth foetal weight = 0.470 + 0.488 Log_{10} BPD + 0.554 Log_{10} FL + 1.377 Log_{10} AC
Nzeh, *et al.* [16] (formula 2)	Log_{10} (Birth weight) = 0.326 + 0.00451(SDI) + 0.383 Log_{10} BPD + 0.614 Log_{10} FL 1.4885 Log_{10} AC

It was discovered that babies with assessed weight of less than 2kg were underestimated while babies weighing more than 4.2kg had their weights overestimated. Comparison of the formulae used revealed that the use of multiple fetal parameters and in particular the combination of the Biparietal Diameter (BPD), Femoral length (FL) and Abdominal Circumference (AC) is considered the best result as this gave the least biased results ($P<0.0001$). The fetal weights derived from the new formula were demonstrated to have a positive correlation with the actual birth weights, though with some overestimation **(fig.32)** thereby showing that the formula by Nzeh, *et al* 2000 will be most useful in predicting birth weights in this environment.

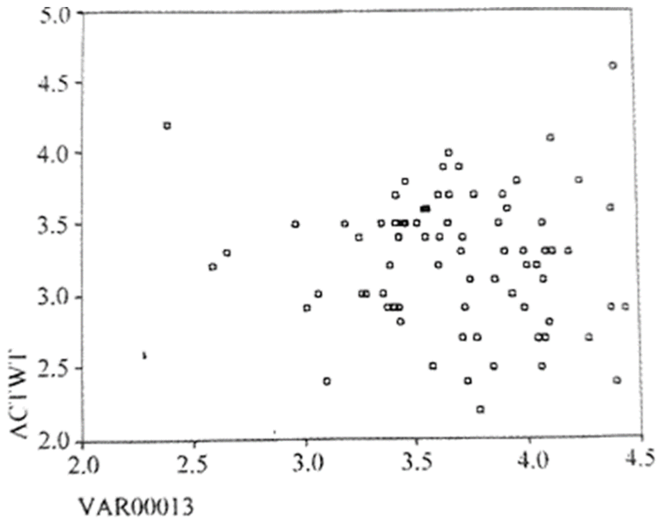


Figure 1 Scatt actual weight with that of the new formula

Note: ACTWT = Actual birth weight; VAR00013 = Predicted birth weight

Fig.32. Scattergram showing fetal weights derived from the new formula were to have a positive correlation with the actual birth weights

In another cross-sectional study in OAUTHC (Osho and Adetiloye *et al* 2019), we determined the strength of association between fetal kidney measurements and gestational age (GA) in third-trimester pregnancies in women with singleton pregnancy. Standard biometric measurements were taken, along with fetal kidney length (FKL), anteroposterior diameter (FKAPD), and transverse diameter (FKTD). Fetal kidney volume (FKV) was calculated via the ellipsoid formula. In total, 470 women were recruited. Compared with standard biometric parameters, renal parameters showed better correlation with GA. Among the standard parameters, FKL and FKV showed stronger positive correlation with GA when compared with FKTD and FKAPD. In multivariate linear regression modeling, FKL alone predicted GA with accuracy of ±10.1 days, whereas a combination of standard and kidney parameters predicted GA with better accuracy of ±8.0 days. Compared with standard biometric parameters, fetal renal parameters correlated better with GA in the third trimester. Among the renal parameters, FKL correlated most strongly with GA.

Fetal problems and Birth defects

The joy of an expectant mother is to know that she is carrying a normal and healthy baby after undergoing routine antenatal ultrasound. This has always been the prayers of the expecting parents. It is a traumatic experience for a pregnant mother to receive an ultrasound report indicating she is carrying a baby with anomaly or worse still to discover at birth a defective child.

Because many birth defects occur in the first three months of pregnancy, they are best prevented by quality preconceptional and early prenatal care. The causes of most birth defects are still unknown and require further research. Sometimes there may be a family history of fetal problems which may be a strong indication for antenatal ultrasound screening, but other times these problems are completely unexpected hence routine antenatal ultrasound plays a vital role in the detection of these anomalies.

Some of these anomalies were encountered in our practice and a few will be presented.

Fetal ascites

Fetal ascites is a relatively rare condition in the new born. A common cause in the past was rhesus incompatibility but this is less common today because of advances in obstetric management. The majority of other causes are those associated with developmental anomalies within fetal abdomen and pelvis, usually retroperitoneal. A rare case of fetal ascites not associated with Rh-incompatibility was diagnosed by antenatal ultrasonography **(Figs.33 a & b)** (Adetiloye 1990).

Fig. 33 a Composite sonogram showing grossly distended fetal abdomen

Fig 33 b. Photograph of the fetus showing grossly distended abdomen from ascites, generalized skin oedema and short neck

Systematic search for the cause of ascites was done but no definite cause was seen prenatally by ultrasound in spite of the good acoustic window provided by the ascites and post-natally at autopsy in the presence of impressive body oedema. The risk of prolonged obstructed labour with attendant fetal distress which occurred in this case is usually high.

Encephalocele

Encephaloceles are cephalic protrusions through a defect in the skull. The protrusions may contain meninges and cerebrospinal fluid (meningocele) or may contain a portion of the brain as well (encephalomeningocele). It may occur as an isolated lesion or as a component of various syndrome. We conducted a 10-year review of incidence, clinical presentations, sonographic diagnoses and obstetric management of this congenital anomaly in OAUTHC (Adetiloye *et al* 1993). Of the 23,438 infants seen within the period, only 12 cases of encephalocele were seen, giving a hospital incidence of 0.5/1000 births. Nine (75%) of the patients had occipital encephalocele, 16.7% occipito-parietal and 8.3% fronto-nasal.

Before the advent of ultrasound, the diagnosis of encephalocele was often made at birth. Of the 12 cases, 11 were referred from peripheral hospitals and thus had no ultrasound record. Antenatal sonographic diagnosis was made in one of the cases. The patient had occipital lesion with mild hydrocephalus at birth. Sonographic diagnosis was made when a sac-like protrusion from the skull was seen and more definitely when a bony defect in the skull was detected. We described two salient sonographic appearances from this study that could aid antenatal diagnosis – “Protruding tongue” sign when a “tongue-like” echogenic structure (herniating brain tissue) is seen within the sac at the site of the skull defect when viewed in profile **(Fig.34)** or a “target” sign when seen enface **(Fig.35)**. Again, these descriptions or signs in this birth defect were the first in literature.

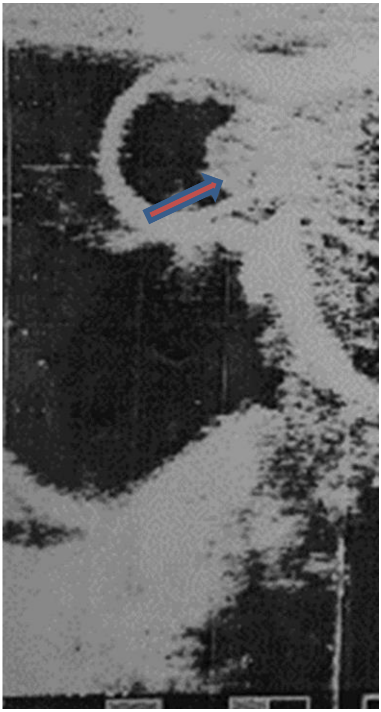


Fig 34. Sonogram showing "tongue-like" echogenic structure (herniating brain tissue) (brown arrow)

Fig. 35. Sonogram showing "target" sign

Three neonatal death were seen, the cause of death in two was sepsis and intracranial haemorrhage in one. Autopsy confirmed herniation of the brain tissue into the encephalocele in all as well as haemorrhage in the patient diagnosed antenatally **(Fig.36a & b)**

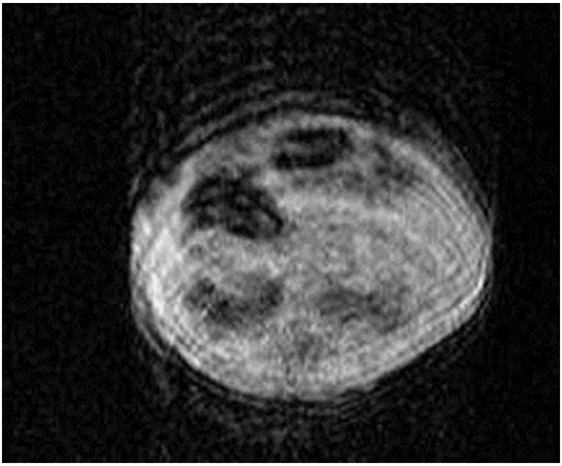
Fig. 36 a Photograph of the baby post delivery. Note the occipital protrusion (Yellow arrow)

Fig. 36 b. Post-mortem photograph of the baby showing herniated brain tissue and intracranial hemorrhage occipital protrusion (brown arrow)

Childhood Care

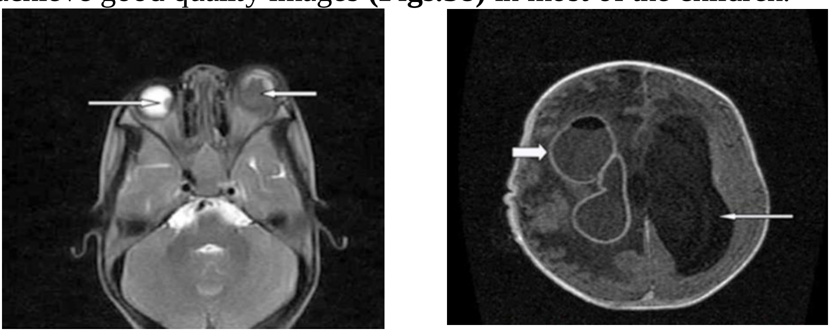
In the investigation of children, we usually consider their safety hence, MRI and US are given priority over x-ray. The application of MRI as the choice of imaging modality in children has been well established for neurological disorders and its application to paediatric body imaging has now started gaining acceptance.

Generally, imaging in paediatric patients requires them to be calm during the procedure especially in MRI, to avoid motion artefacts in the acquired images **(Figs. 37)**.



Figs. 37. Motion artefact in MRI

Sedation and/or anaesthesia is a way to achieve this. We retrospectively evaluated 69 paediatric MRI requiring sedations over a 5-year period since installation of an MRI device in our hospital (Owojuyigbe and Adetiloye *et al* 2017). Our audit shows that on the average, 13.8 sedated paediatric scans were done yearly in our facility over the 5-year period of this audit. This amounts to a monthly average of 1.2 paediatric MRI scans done under sedation. Midazolam via the IV route with or without oral route is the drug of choice for MRI sedation in children in our institution with a success rate of about 99%. This success rate enabled us to achieve good quality images **(Figs.38)** in most of the children.



Figs. 38. Sharp head MRI Images

Due to non-availability of MRI until very recently in our hospital, ultrasound (US) had been used extensively as investigation modality in children. It was usually and still the first line of imaging choice in many instances because of lack of ionising radiation, non-invasiveness and its much cheaper and readily available than MRI. The followings are some out of many studies we embarked upon using US to bring about important interventions in children.

Chronic hepatomegaly in children with sickle cell anaemia

Hepatomegaly is one of the commonly observed stigmata of sickle cell anaemia (HbS) both is steady-state and crises. HbS children with chronic hepatomegaly (CH) may constitute a distinct group of sufferers, even in the steady-state as CH is an index of severe disease in children with sickle cell anaemia. We decided to test a research hypothesis that hepatic perfusion may be poorer in HbS children with CH compared to matched controls without CH and to determine what other ancillary clinical and abdominal duplex ultrasonographic features may be characteristic of HbS patients with CH. We studied 14 HbS children with CH and 2 groups of controls made up of age and sex matched HbA and HbS children without CH (Adeodu and Adetiloye *et al* 2001). Hepatic perfusion was assessed using abdominal duplex ultrasonography which made possible the measurement of portal vein diameter (PVD) and velocity of portal flow **(Fig.39)**.

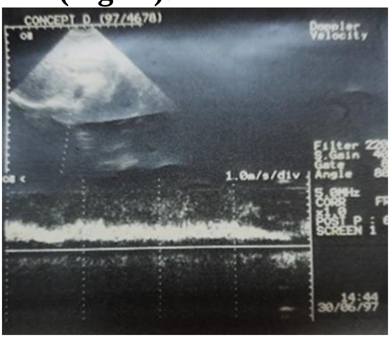


Fig.39 Duplex sonogram of liver of an HbS child showing normal Doppler flow in the portal vein.

We found that the mean weights, blood pressure profiles, ultrasonographic splenic span and common bile duct diameters did not differ significantly among the three groups. Similarly, the mean PVDs of the three groups were not significantly different despite the large livers of CH group **(Tab. 4)**.

Tab 4 Comparison of ultrasonographic data (means ± SD) among the groups.

		Controls			
	CH	HbS	HbA	F*	P
Liver span	11.8 ± 2.6	8.8 ± 1.3	8.3 ± 0.4	17.6	< 0.01
PVD	9.1 ± 1.9	8.6 ± 1.0	9.3 ± 1.7	0.8	> 0.05
Portal view velocity	0.38 ± 0.01	0.40 ± 0.02	0.44 ± 0.02	68.8	< 0.01
Bile duct diameter	1.6 ± 1.4	1.6 ± 1.2	1.4 ± 1.1	0.16	> 0.05
Splenic span	9.7 ± 4.6	9.0 ± 3.3	9.6 ± 1.1	0.18	> 0.05

$F^* = F_{2,39}$ i.e 2 degrees of freedom greater mean square and 39 degrees of freedom lesser mean square.

The CH groups, however showed linear growth faltering, a significantly lower mean haematocrit, faster pulse rate but paradoxically reduced hepatic portal blood flow velocity than HbA controls. Because of the disproportion of PVD relative to liver size in HBS patients with CH and reduced portal blood flow velocity, hepatic perfusion is poorer in these patients. HbS children with CH therefore need careful management of hepatic and anaemic crises to prevent hypoxic liver damage.

Liver transplantation

Irreversible hepatic disease with resultant liver damage from various causes is usually treated with liver transplantation. Following liver transplantation, small pleural effusions and minor amounts of ascites are common. Larger post-operative pleural and peritoneal fluid collections occur occasionally and may require intervention. Consequently, post-operative recovery can be prolonged. My colleague and I embarked on a retrospective study of 184 consecutive liver grafts in 164 children (Adetiloye *et al* 1998) in Birmingham U.K. to assess the incidence of moderate and large pleural and peritoneal fluid collections following paediatric liver transplantation. The need for intervention and the outcome following radiological and non-radiological treatment, with ultimate objective of recommending a treatment protocol for such post-operative fluid collections was also assessed. Out of the 184 grafts, 16.8% developed excessive fluid requiring intervention **(Fig.40)**.

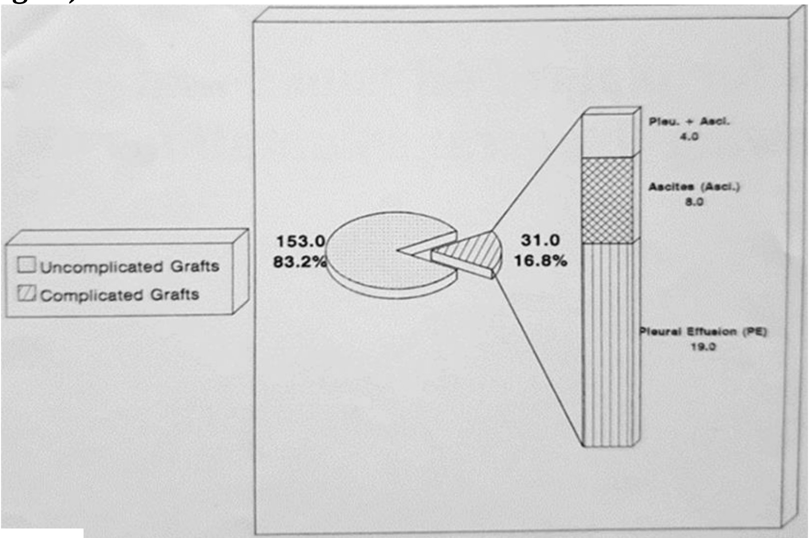


Fig Fluid/graft relationship

The pleural effusions were first diagnosed between days 1 and 44 after transplant procedure and ascites between days 1 and 14 **(Fig.41)**.

Fig.41. Chest radiograph showing pleural effusion and ascites

The initial diagnosis was made radiologically in 91 %(n=21/23) of pleural effusions and 83% (n= 10/12) of ascites. No identifiable cause or association was seen in 58% (n=18/31). The mean duration of the pleural effusions and ascites, from onset of treatment to resolution, ranged from 33±42 days (SD) to 35±48 days and from 36±47 days to 39±46 days respectively. Mode of intervention (unguided, radiological and surgical) showed no statistically significant difference in outcome of management **(Fig.42)**.

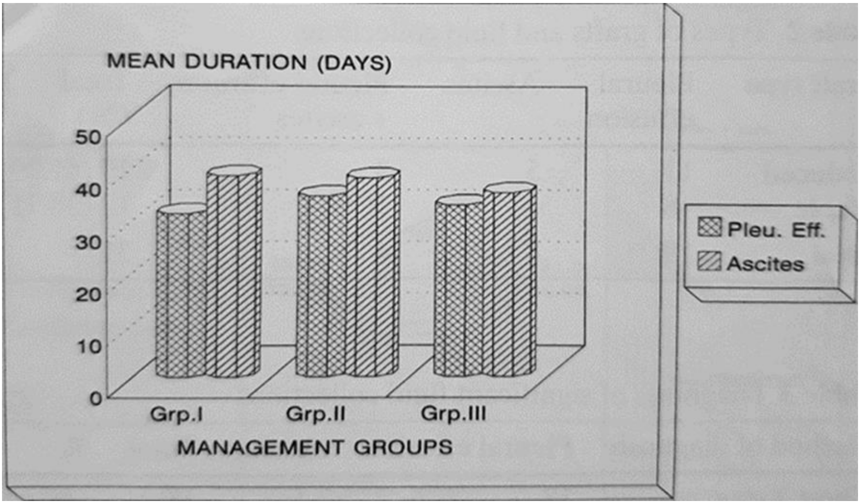


Fig.42. Mode of intervention (unguided, radiological and surgical) showed no significant difference in outcome of management

We concluded that post-transplantation pleural effusions and ascites requiring intervention are often without definite cause. They are more commonly seen with reduced grafts, but this cannot completely explain the occurrence or the protracted duration of accumulation in spite of combined interventional management. The outcome of treatment is not significantly influenced by the mode of intervention except in cases where surgical intervention was indicated. US contributed significantly in the initial and follow-up evaluation of these patients, and we recommended greater use of US in place of radiographs to reduce the radiation burden when fluid collections are protracted.

Acute abdomen - Appendicitis

Acute abdominal pain is one of the most common complaints in children, and it poses a diagnostic challenge owing to the variety of underlying causes. Acute abdominal pain is usually self-limiting in benign conditions, such as in gastroenteritis, constipation, or viral illness (D'Agostino 2002). However, the challenge for the physician is to identify children who have uncommon and potentially life-threatening conditions that require urgent evaluation and treatment, such as appendicitis, intussusception, volvulus, or adhesion. The one that the cause is not always straight forward is appendicitis because of atypical presentation in about 20-33% of cases and often referred for ultrasound (Wong *et al* 1994). My colleague and I therefore looked into the outcome of ultrasound in equivocal cases of appendicitis in children with the aim of evaluating the potential causes of mis-diagnoses (Adetiloye *et al* 2002) in Riyadh Saudi Arabia. Eighty eight consecutive patients who had surgery following clinical suspicion of acute appendicitis following US interrogation were analysed. In all, appendix was not seen in 27.3% (n=24/88) of cases. The true positive rate (sensitivity) for US was 90%, true negative rate (specificity) 72.2%, overall accuracy of 86.4%, predictive value for a positive sonogram (PPV) 92.6% and negative (NPV) 65%. When appendices were seen, the cases of appendicitis had a maximum mural thickness (MMT) ranging between 3.2 and 6.1 mm (mean 3.8 mm±1.0) and maximum outer diameter (MOD) between 6.5 to 12.5 mm (mean = 8.0 ± 1.5). The inflammation involved the distal ½ of the appendix in 25.4% (n= 16/63) of cases, whole appendix in 54% (n=34/63) **(Fig.43a & b)**, and perforation in 20.6% (n= 13/63) **(Fig. 44)**.

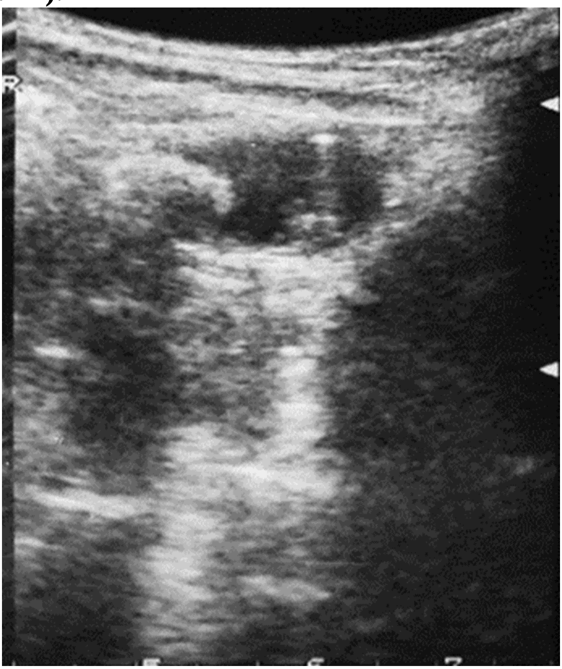


Fig 43a. Sonogram (long) showing an appendicolith within the mid portion of inflamed appendix. Tiny gas bubble with ring-down shadows noted within the distended end.

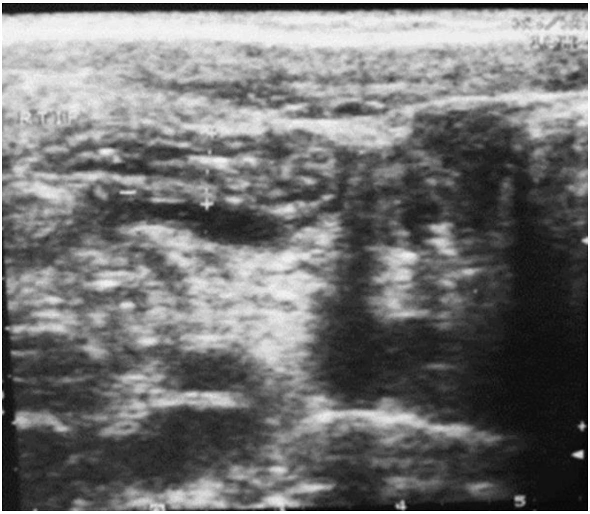


Fig.43 b. Sonogram (long) showing acute appendicitis involving the whole length with surrounding inflammatory fluid.

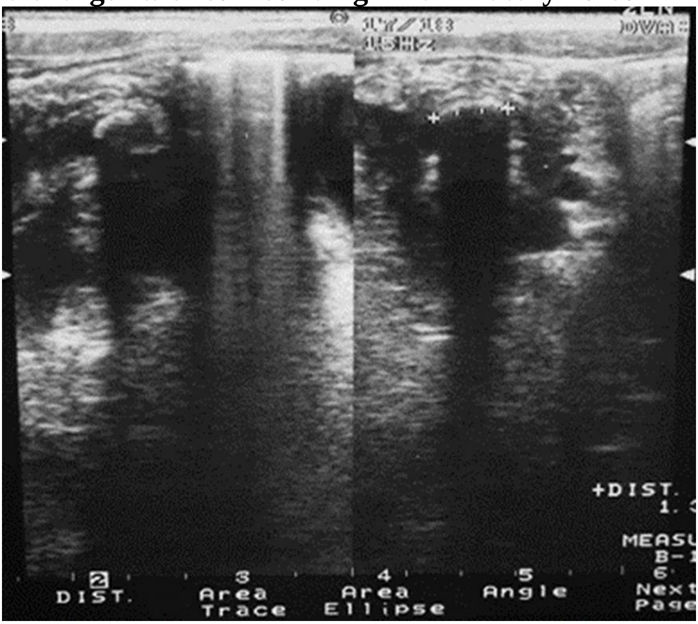


Fig. 44. Sonogram (long & trans) showing an appendicolith with posterior acoustic shadow, within the distal end of a perforated appendix. Note moderately large peritoneal fluid posterior the Fluid distended appendix.

Seven cases of false negatives were due to focal inflammation of the appendix coexisting with ovarian cyst and multiple adenitis while true negatives yielded specific reactive adenitis **(Fig.45)** in the right iliac fossa in 5 cases.

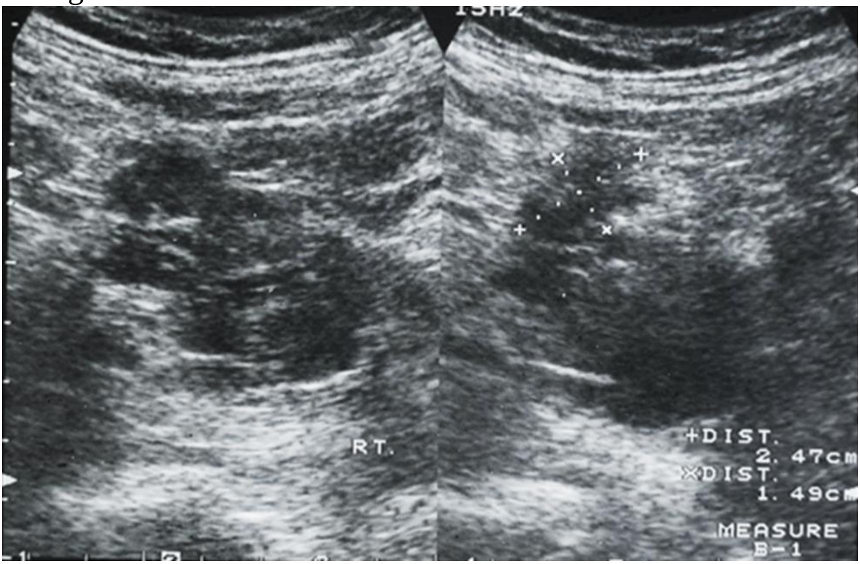


Fig.45. Sonogram (long & trans) showing multiple hypoechoic lymph nodes

We concluded that the diagnosis of appendicitis can be missed when it involves a focal portion especially the tip or when the occurrence of other pathological conditions coexist with appendicitis. It is therefore important to specifically look for the appendix, examine the whole length and also bear in mind the possibility of appendicitis coexisting with other conditions which may or may not be symptomatic.

We further emphasized the value of ultrasound by comparing the outcome of appendectomy result in patients who had pre-op ultrasound performed and those without having pre-op ultrasound

(Adetiloye *et al* 2004). The study further stressed the fact that US is very sensitive for the diagnosis of appendicitis and has significant association with positive appendectomy **(Tab.5)**.

Tab.5: Results of Appendectomy Following Pre-Op Ultrasound Decisions

Pre-op Ultrasound	Appendectomy		Negative appendectomy	Total
	Positive	Negative (*Misdiagnosis*)	True Neg.	
Performed	50	2	8	60
Not Performed	24	12	-	36
Total	74	14	8	96

Although no statistical difference in the negative appendectomy and perforation rates between patients that had pre-op ultrasound and those without, but there is a higher negative appendectomy in patients without, which showed that pre-op US can lower the negative appendectomy rate. Further reduction in the negative appendectomy rate can be achieved if US is performed by highly trained and experienced sonologists with a close rapport between the surgeons and sonologists. Unnecessary delay in surgery should be prevented by prompt preparation and performance of pre-op US so as to further reduce the perforation.

Diagnostic nightmare in childhood

Sometimes in clinical setting, diagnosis is straightforward. But at times, diagnosis is much more difficult. All too often, we may have no idea of what was causing a patient's symptoms.

There are a wide variety of lesions with clinical presentations that may occur in the pediatrics, posing such difficult clinical diagnosis. Solving such diagnostic clinical problems has always been the headache not only that of the clinicians but also that of the radiologists. Pressures are always on radiologists to solve the diagnostic dilemma. We encountered such cases in our practice but

I will highlight just a few that had and still have great impact to medical practice and also added to the body of knowledge.

A case of 1½-year old boy who presented with urinary retention, poor urine stream and constipation posed diagnostic dilemma as the differential clinical diagnoses were excluded by imaging (Adetiloye *et al* 1996). Abdominal ultrasound however **(Fig46)** showed a retro-vesical mass mimicking an "enlarged prostate"; hence, a pseudo-prostate enlargement description (sign) was made for the first time in a child and indeed in literature.

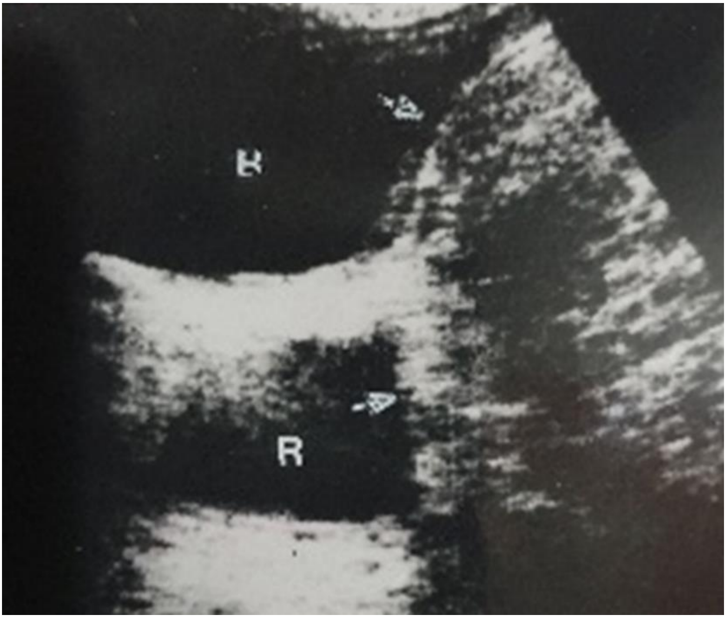


Fig. 46. Ultrasound showing a retro-vesical mass mimicking an "enlarged prostate".

The lesion was completely excised and the lesion turned out to be presacral myelolipoma on histology. Myelolipoma is a benign tumour composed of fat and myeloid cells **(Fig.47a)**, giving the heterogeneous sonographic appearance with a preponderance of whorls of high echogenicity and few hypoechoic areas **(Fig.47b)**.

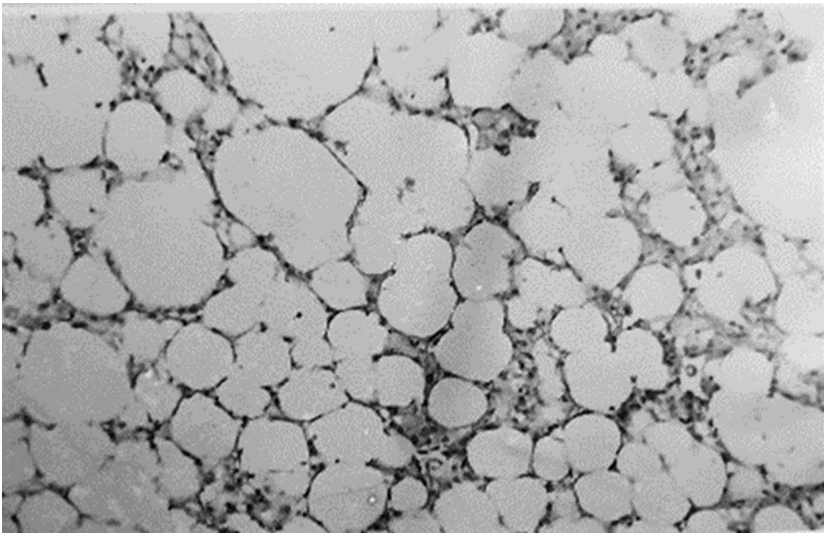


Fig.47a. Tumour composed of fat and myeloid cells

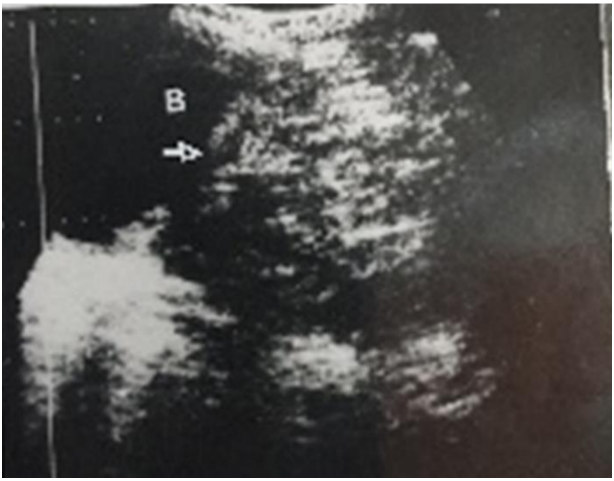


Fig.47b. whorls of high echogenicity and few hypoechoic areas

They usually occur in adrenal glands. Extra-adrenal myelolipomas are very rare with most occurring in presacral region as in our patient. The age range of presentation normally is between 41 – 81 years but our patient presented at the tender age of 1½-years, which turned out to be the first and the earliest age presentation in the literature, hence the diagnostic nightmare and a significant addition to knowledge.

In a similar vein, solving a diagnostic clinical problem also occurred in a 5-year old child with poor urinary stream thought to be posterior urethral valve clinically (Adetiloye *et al* 1992). Micturating cystogram excluded such well known lesions as urethral stricture and posterior urethral valve but revealed an unusual multiple filling defects in the posterior urethra and bladder base **(Fig.48)**.

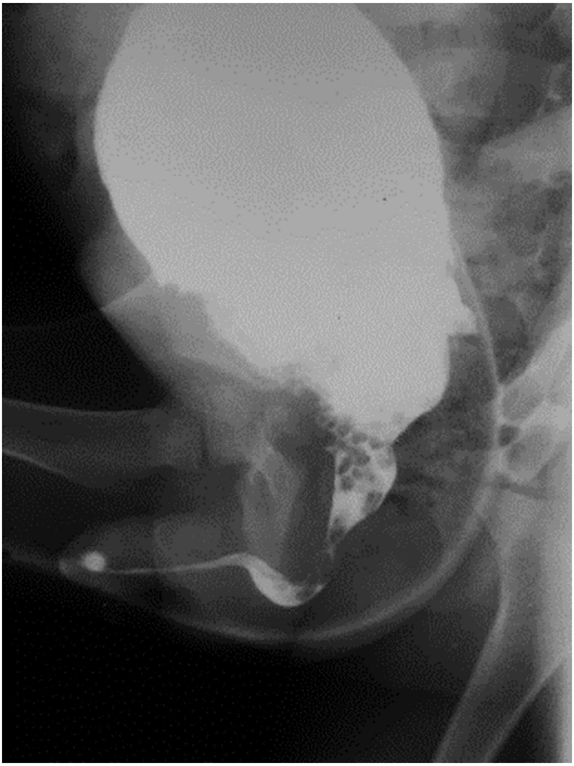


Fig.48 a. Micturating Cystogram showing multiple filling defects in the posterior urethra and bladder base

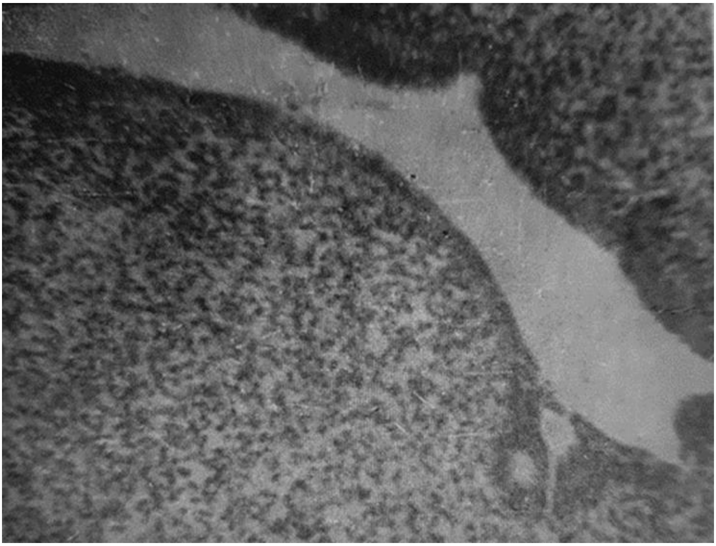
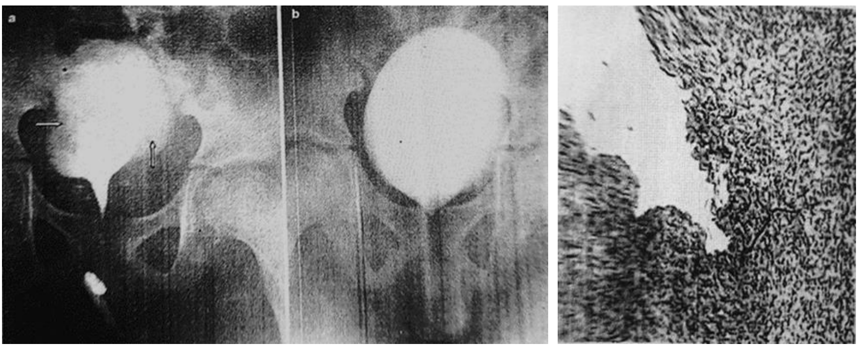


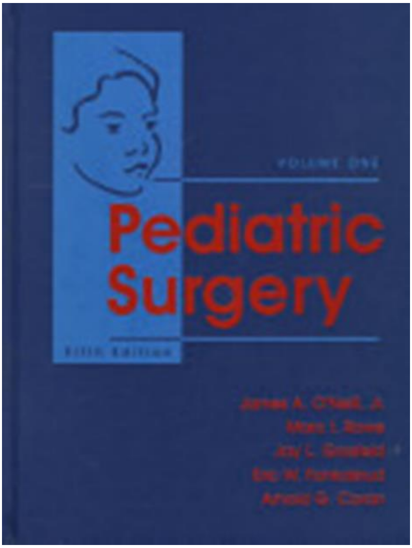
Fig.48. b. Photomicrograph of the histology confirming rhabdomyosarcoma

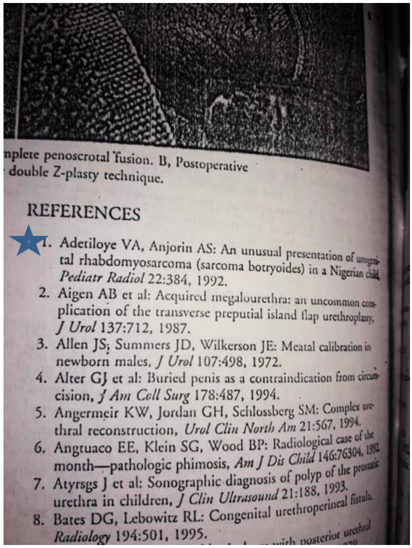
These turned out to be urogenital rhabdomyosarcoma. This was amazing. Amazing because urinary bladder rhabdomyosarcoma does not present as multiple filling defects but as an irregular, circumferential urinary bladder mass as seen in another case **(Figs. 49a, b & c)** (Olowu and Adetiloye *et al* 2008) we encountered.



Figs. 49 a. An irregular, echogenic, circumferential urinary bladder base mass b. Total remission after treatment. c. photomicrograph of the histology confirming rhabdomyosarcoma.

With this unusual presentation and being the first in the literature, urogenital rhabdomyosarcoma is now regarded as a cause and an important differential diagnosis of multiple filling defects in the posterior urethra and bladder-base. This work has been cited in a text book of surgery **(Fig.50) – "Paediatric Surgery" 5th edition, edited by Ed James, A O'Nell jnr; published by Mosby, Abnormalities of the urethra, penis and scrotum, pgs 1783 – 1795(Ref 1)**.





nplete penoscrotal fusion. B, Postoperative
double Z-plasty technique.

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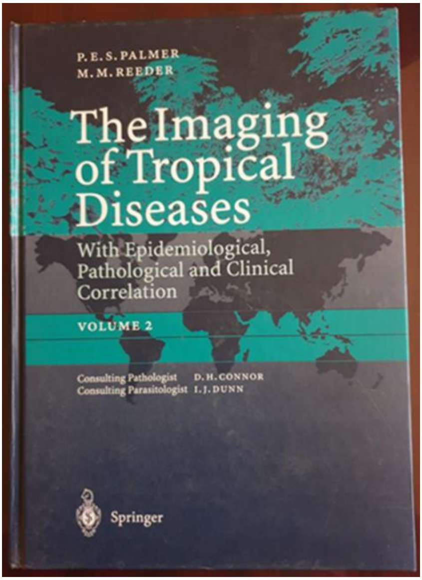
Fig 50

Mr. VC, I'm pleased to inform you that this is not my only problem solving work that has been cited in text books. Another is the diagnostic dilemma where gastrointestinal strongyloidiasis masquerading as gastric outlet obstruction from malignancy was successfully diagnosed with barium meal and follow through examination **(Fig. 51)** (Adetiloye 1991).

Fig. 51: Barium meal and follow through showing thickened small bowel mucosal pattern in strongyloidasis

Though this was not in the area of maternal and child health, but in an adult male who was a bread winner much needed to sustain family wellbeing (which makes this case indirectly related to MCH). This study gave vivid radiologic features that would help in making prompt diagnosis in similar cases. This work has been cited in 2 standard text books. One is in a text book of radiology **(Fig 52)** – **The Imaging of Tropical Diseases – by PES Palmer and MM Reeder 2nd Edition (revised). Published by Springer, Vol. 2 Pg 92**



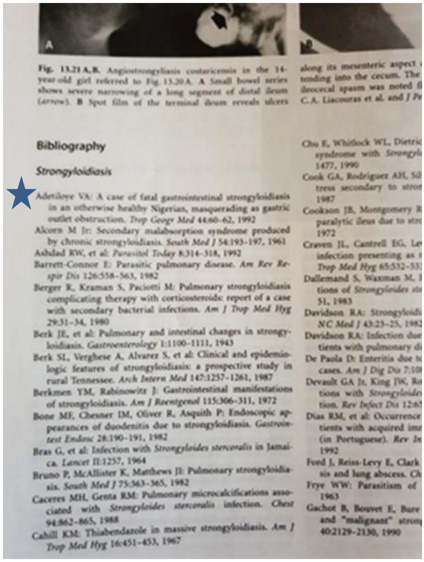


Fig. 13.21 A,B. Angiostrongyliasis costaricensis in the 14-year-old girl referred to Fig. 13.20 A. A Small bowel series shows severe narrowing of a long segment of distal ileum (*arrow*). B Spot film of the terminal ileum reveals ulcers

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(Fig 52)

and the other is the textbook of Medicine - **Medicine in Diaspora by AL Ajayi, Vol. 2.**

Current achievements under my watch that are making OAUTHC great again.

In the 4½ years that I have been at the helm of affairs in OAUTHC, our policy has enabled these achievements which we have recorded and still counting. These have been made possible under a peaceful atmosphere devoid of strike actions all these years and to the commitment of our members of staff and various unions.

Services

- ***Open heart surgery Dr. Uvie Onakpoya and his team***
  - Over 70 cases successfully performed in 2 years
  - The leading hospital to have achieved this record
  - Carried out the 1st double switch procedure in West Africa
- ***Laparoscopic (pin-hole) surgery Dr. 'Wale Adisa and his team***
  - Performed over 600 pin-hole surgeries
  - The leading hospital attained this feat

- High point is the successful laparascopic gastrectomy and colorectal surgeries pioneered in OAUTHC

- ***Endoscopy by Dr. Segun Alatise/Prof. Ndububa and their team***
  - Over a thousand procedures have been carried out under 1 year of the acquisition of this modern and equipped Endoscopy suite
- ***ERCP procedure by Dr. Segun Alatise and his team***
  - The only center in West Africa performing this procedure
  - 75 procedures have been performed within the last 1 yr. when we started
- ***Total knee and hip replacement by Prof. I. Ikem and his team of Orthopaedic surgeons***
  - Performed about 100 within the last 4 years.

Infrastructure and Equipping

- ***Dental unit in IHU OAUTHC***
  - Today, we have 30 (9 VAMED inclusive) new dental chairs and additional 17, courtesy of the alumni assoc., bringing the gross total to 47 in the last 1½ years
- ***Repair of the 4-Slice CT scanner (now functioning)***
  - making SEEING more BELIEVING AND MORE RELIABLE THAN FEELINGS
- ***Acquisition of new 16-Slice CT scanner (under installation)***
  - making SEEING more BELIEVING AND MORE RELIABLE THAN FEELINGS
- ***Befitting gates for IHU OAUTHC***
  - PHASE I GATE - Donated by Chief (Dr.) R. Adedoyin (Maye)
  - PHASE II GATE - Donated by Chief. A Odeyemi (Obasewa)
- ***Modern and Equipped Medical ward, WGH, Ilesa***
  - Donated by the Sarumi family
- ***Obstetric Fistula Ward WGH, Ilesa***
  - Donated by the Family of `Yinka Obaleye

Recommendation

As I end this lecture Mr. Vice Chancellor Sir, I wish to make some recommendations for the advancement of the Specialty of Radiology.

Acquisition of appropriate Imaging equipment

For the purposes of service, training and research, quality equipment are required. Radiology being particularly technology driven and capital intensive, lack of modern imaging equipment has gradually constituted a challenge to these mandates as a result of poor funding. I believe the time has come for the University to complement the effort of the teaching hospital by investing in the acquisition of radiology equipment since the teaching hospital is generally regarded as the laboratory of the college of health sciences and to some extent department of medical physics in the faculty of science. This will go a long way in improving research output in the college and Faculty of sciences.

Funds can be sourced through TETFUND to meet these needs. In the alternative, equipment investment through the Public-Private-Partnership (PPP) which is what is in vogue is advised in the spirit of international best practices as this eliminates large up-front investments of scarce public funds and enhances greater efficiency.

Residency training program

The establishment of residency programme was borne out of the need to provide the much-needed medical specialists, who are competent and capable of independent practice but this has faced many challenges especially funding. This issue of funding among other things can be addressed through the establishment of Tertiary Hospitals Commission similar to NUC and/or through a form of Education Task Fund (ETF). This will take care of the ever recurring issue of suspended one-year-abroad training. The University could complement this programme by appointing assistant lecturers in the department of radiology that will pursue the residency programme with special focus on subspecialisation in radiology.

Conclusion

Mr. VC sir, from this synopsis, it’s clear that the realities in shadows and images have made it possible for early detection of ailments through seeing and not just by feelings from signs and symptoms. This has enabled the necessary change in the line of thinking and course of clinical management. It’s also clear that good MCH outcomes are related to well-planned and image-driven preconception, prenatal, perinatal, postnatal and children services. I have reiterated that access to appropriate and timely utilization of imaging technologies especially ultrasound services will make marked difference in the improvement of healthcare of mothers and children in our community. The information thereof, can assist in identifying potential life threatening conditions and appropriate management carried out with the use of ultrasound screening and other imaging techniques.

Mr. VC Sir, ladies and gentlemen, you will agree with me that today, medical imaging technology once only imagined and viewed as those seen in science fiction movies (The man with the X-ray Eyes), is now the standard of care due to ever expanding frontiers in knowledge, enabling more targeted disease detection, diagnosis and treatment, and eliminating the need for invasive or exploratory surgeries in some cases.

On a positive note, the future will bring new capabilities that have even greater medical value. We will see radiation dose continue to drop and utilization of imaging services become more efficient, with fewer healthcare resources wasted.

As good as this may be, if the geo-economic barriers are not bridged, the modern imaging facilities currently available in the developed countries may turn out to be what we may be celebrating in the future in the 3rd world countries by the time such equipment might have become obsolete in the developed world.

Mr. VC, I have given a summary as it were, of my scholarship. I want to thank this great University for providing the conducive environment to realize my academic potentials which were very latent before I joined the system.

I want to thank all the staff members of OAUTHC, especially those of the department of radiology - my colleagues, radiographers, and my research partners, for their support over the years. My special gratitude goes to the management staff of the teaching hospital and the committee of friends for their encouragement and drive that invigorated me prepare for this lecture.

My thanks also go to my parents especially my late mother for seeing me through the early days of my education in spite of all the tough times that threatened my education. People say tough times don't last but the tough people do. This is what has played out today. I also want to thank my siblings and my in-laws for their encouragement and love.

My immense thanks go to my darling wife, the wife of my youth, Mrs. Adekemi Adetiloye, and my lovely children, one of which is a consultant physician of OAUTHC, (Dr. Adebola Adetiloye) and also an academic member of staff of this great University. These are the pillars God almighty provided to give me the much needed support and encouragement to navigate this treacherous journey.

Finally I want to appreciate God almighty for seeing me through it all. I want to thank Him for giving we Radiologists the opportunity to share the praise of "Arinu'rode" (He that sees both inside and outside) which rightly belongs to HIM but no man will share with HIM the glory of the other half of the praise i.e. "Olumoran okan" (He that knows the intent of human heart).

Mr. VC sir, distinguished ladies and gentlemen, I thank you all for your attendance and rapt attention.

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