UPPER ABDOMINAL ULTRASONOGRAPHY FINDINGS IN HIV PATIENTS AT KENYATTA NATIONAL HOSPITAL AND THE ARMED FORCES MEMORIAL HOSPITAL.

DISSERTATION SUBMITTED IN PART FULFILLMENT FOR THE DEGREE OF MASTERS OF MEDICINE IN DIAGNOSTIC RADIOLOGY OF THE UNIVERSITY OF NAIROBI

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DECLARATION

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This dissertation is my original work and has not been presented for a degree in any other university.

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ABBREVIATIONS

1) AIDS	Acquired Immunodeficiency Syndrome.
2) AJR	American Journal of Roentgenology.
3) AFMH	Armed Forces Memorial Hospital.
4) ARF	Acute Renal Failure
5) ARV	Anti Retrovirals
6) CRF	Chronic Renal Failure
7) CT	Computerized Tomography.
8) CDC	Centre for Disease Control.
9) CNS	Central nervous system.
10) CMV	Cytomegalovirus.
11) DDR-UoN	Department of Diagnostic Radiology-University of Nairobi.
12) ELISA	Enzyme – Linked Immunosorbent Assay.
13) GTI	Gastro Intestinal Tract.
14) HAART	Highly Active Anti Retroviral Therapy
15) HBV	Hepatitis B virus.
16) HDV	Hepatitis D virus.
17) HIV	Human Immunodeficiency Virus.
18) HIVAN	HIV Associated Nephropathy.
19) KNH	Kenyatta National Hospital.
20) KS	Kaposi's sarcoma.
21) PCP	Pneumocystis Carinii Pneumonia.
22) TB	Tuberculosis.
23) NHL	Non-Hodgkins Lymphoma.
24) HTLV III	Human T cell Lymphotrophic Virus- III.
25) US	Ultrasound/Ultrasonography
26) IV	Intravenous.
27) USA	United States of America.
28) STD	Sexually Transmitted Diseases.
29) MRI	Magnetic Resonance Imaging.
30) HIV-FGS	HIVassociated focal glomerulosclerosis.
31) HIV-ICD	HIV associated immunecomplex renal disease.
32) HIV-TTP/HVS	HIVassociated thrombotic thrombocytopenic purpura/haemolytic anaemic syndrome.

ABSTRACT

Background

In the majority of sub-Saharan African countries, the absence of accessible and affordable computerized tomography (CT) facilities makes abdominal ultrasound (US) an alternative imaging tool in the clinical investigation of infectious and noninfectious complications of HIV-infected patients. Abdominal ultrasound for diagnostic purposes in HIV-infected individuals is required by clinicians for a range of primary clinical indications.

Methods

This was a descriptive cross-sectional study carried out at the Kenyatta National Hospital (K.N.H), Department of Diagnostic Radiology –University of Nairobi (D.D.R-UoN) and the Armed Forces Memorial Hospital (A.F.M.H). The objective of this study was to determine the pattern of upper abdominal abnormalities as detected by sonography in HIV-infected individuals. A sample of 273 HIV-infected patients and clinical indications were recorded in pre-designed data collection forms. Systematic sampling procedure was used in selecting patients into the study.

Results

In this study right upper quadrant pain accounted for 31.9%, pyrexia of unknown origin 30.40% and general abdominal pain 27.68%. The main clinical indication for liver sonography was hepatitis (45.8%), whereas for the kidney was renal failure (66.67%). Ultrasonography revealed Para-aortic lymphadenopathy in 42.9%, ascites 25.6%, mesenteric adenopathy in 23.5% and porta hepatis nodes in 13.7%. Solid abdominal masses and abscesses were seen in 2.2% and 3.3% respectively. At sonography various liver pathologies were found in 36.3% of the cases. Different

pathological features were seen in the kidneys (44.30%), spleen (20.15%), gallbladder (22.34%) and pancreas (2.56%).CD4 counts were known in 35.2% of the cases and the mean CD4 count was 212 cells/μl (95%CI 177.05 -246.91)±172.40. The lowest CD4 count was 2.0 cells/μl while the highest was 755 cells/ μl. There were significant differences in the presence of ascites and CD4 levels ($P<0.05$), and in increased renal parenchymal change and CD4 levels ($P<0.05$). However there were no significant differences in ascites and gender of the patient ($P>0.05$), ascites and age ($P=0.05$), para-aortic lymphadenopathy and gender ($P>0.05$), para-aortic lymphadenopathy and age, ($P>0.05$), increased renal parenchymal echogenicity and gender ($P>0.05$), increased renal parenchymal echogenicity and age ($P>0.05$), CD4 count levels and gender ($P>0.05$).

Conclusions

This study reveals that renal parenchymal changes, fatty liver, intra-abdominal lymphadenopathy and gallbladder sludge are common intraabdominal findings in HIV infected individuals despite paucity of clinical suspicion. These findings may have implications for the radiologist especially in our set up, where accurate microbiological or pathologic diagnosis of infectious and noninfectious diseases afflicting the HIV-infected patient is usually not readily available and ultrasound is often relied upon as a "diagnostic" investigation by many clinicians.

INTRODUCTION

The acquired immunodeficiency syndrome (AIDS) was first reported in 1981 to the CDC in the United States of America. By the end of 2001, it was estimated that more than 40 million people were living with HIV globally and 95% of these were found in sub-Saharan Africa. To date, more than 2 million people are estimated to have been infected by the virus in Kenya as from 1984 when the first case of AIDS was diagnosed locally.

The gastro-intestinal tract is the second commonest site of opportunistic infection and AIDS related neoplasms after the respiratory systems the former accounting for upto 50% of deaths in children [25] Most of these opportunistic infections and neoplasms disseminate to involve abdominal viscera. Ultrasonography in good hands can give useful information about intra abdominal organs. It can be used to confirm or exclude a critical diagnosis [26, 27, 28]. It is capable of identifying and characterizing many an intra abdominal mass with high precision and is particularly useful in differentiating solid from cystic lesions [25, 26, 29].

Studies have been done locally on the pattern of upper abdominal disease seen at sonography but so far, none has been carried out to evaluate the pattern of abdominal disease in HIV/AIDS patients. This study seeks to determine the pattern of upper abdominal disease/abnormalities in HIV infected individuals at sonography and to compare these findings with the clinical presentations.

BACKGROUND AND LITERATURE REVIEW

The acquired immunodeficiency syndrome (AIDS) was first reported in 1981 to the CDC in the United States of America. The origin of HIV is not known. However, it is thought that the virus mutated from closely related African primate viruses, simian immunodeficiency viruses (SIVS). [1-4]

AIDS is a terminal multi-systemic complication of longstanding HIV infection. The first recognized cases presented mainly with Pneumocystis carinii pneumonia (PCP), Kaposi's sarcoma (KS) and a host of opportunistic infections. Together with PCP, Kaposi's sarcoma has become a hallmark of AIDS where it is particularly seen in homosexuals, bisexuals, and patients from sub-Saharan Africa [1-4]. Besides homosexuals and drug abusers, AIDS was soon reported in other groups of patients e.g. haemophiliacs, who had been transfused with pooled blood sourced from a large group of donors some of whom were infected with HIV [5]. In the 3rd world, especially sub-Saharan Africa, the major mode of HIV transmission remains heterosexual intercourse.

Since 1981, there has been a steady rise in the number of individuals infected with HIV and those dying of AIDS related illnesses [6] . The first case of AIDS was described in Kenya in 1984. Already more than 2 million people are estimated to have been infected in Kenya as from 1984. HIV prevalence rose steadily from a low of 6% in 1990 possibly reaching its peak in 2000 (13.4%). Currently, country wide statistics suggest prevalent rates in the range of 10-13% [6]. By the end of 2001, it was estimated that more than 40 million people were living with HIV globally and the cumulative death toll since the epidemic began was estimated at 20 million with 95% of cases occurring in sub-Saharan Africa. It was estimated that more than 13.2 million children had been orphaned and about 28.5 million African men, women and children were living

with HIV at the end of 2001. This was the equivalent of over 70% of the world HIV infected population [6].

The diagnosis of AIDS in older children (over 18 months of age) and adults is based on clinical criteria as well as the confirmation of the presence of HIV antigens or antibody by laboratory methods. In most centres, diagnosis of HIV infection is by ELISA antibody testing. This is based on the use of immuno dominant proteins that are recombinant synthetic or produced from infected cell lysates which then react with the antibodies in the patient's serum [7-9]. In the newborns and infants under 18 months of age, the diagnosis using this method is hampered by the presence of maternal antibodies to HIV, which may merely reflect maternal infection and transplacental passage of IgG antibodies into the fetal circulation. Isolation of the HIV itself is therefore required in this age group.

Confirmatory methods for HIV infection have since been developed and these include:

(1) Western Blot: this may be carried out according to standard and modified methods.

(2) Indirect fluorescence Assay (IFA): This is used for screening purposes as to compare with western Blot as confirmatory test.

(3) Rapid latex agglutination test: This cost effective method is easy to perform even in the hands of less skilled personnel.

Radio-Immunoprecipitation Assay (RIPA). Is a confirmatory immuno-assay though its use is restricted mainly to laboratories with facilities and expertise to propagate HIV in continuous cell culture.

P24 – antigen captive assays can also be used and mainly after the serological method has been used. It provides a quantitative measure of the level of viral P24 antigen present within serum or other body fluids and therefore can serve as a prognostic marker of disease activity over time [11-15].

Transmission of HIV occurs in conditions that facilitate exchange of blood or body fluids containing the virus infected cells. Thus the three major routes of transmission are:

(1) Sexual contact.

(2) Parenteral inoculation.

(3) Vertical transmission form mother to newborn.

Bi-directional venereal transmission is by far the predominant mode of infection [16-18], it is believed that the virus is carried in the lymphocytes present in the semen /vagina fluid and enters the recipient's body through abrasions in the rectal or vaginal mucosa in heterosexuals and homosexuals respectively. All forms of sexual transmission of HIV are aided and abetted by co-existing sexually transmitted diseases especially those associated with genital ulceration as is the case in herpes simplex and syphilis.

Parenteral transmission, though rare has occurred in three groups of individuals:

(1) IV – drug abusers.

(2) Hemophiliacs – who receive factor VIII concentrates

(3) Random recipient of blood transfusion.

Mother to infant transmission is the major cause of pediatric AIDS. Infected mothers can transmit the infection to their offspring's by three routes.

(1) In utero-transplacental spread.

(2) During delivery through an infected birth canal.

(3) After birth by the ingestion of breast milk.

There is so far no evidence for spread by casual personal contact as would occur in house hold or schools nor is there any scientifically documented proof of transmission of HIV through insect bites. [17-20].

HIV is a single stranded RNA retrovirus from the Lentivirus family. Two genetically different but related forms of HIV, called HIV-1 and HIV-2 have been isolated from patients with AIDS. HIV-1, commonly found in USA, Europe, Central and East Africa, whereas HIV-2 is

more prevalent in West Africa or countries with ties to this region. The virus differs from HIV-1 in that patients have lower viral loads, slower CD4 decline, lower rates of vertical transmission, and slower progression to AIDS [18-22].

There are two main targets of HIV in the human body, the immune system and the central nervous system (CNS). Profound immunodeficiency, primarily affecting cell mediated immunity is the hall mark of AIDS. This results from severe loss of CD4 T cells as well as an impairment of the function of surviving T- helper cells. The CD4 molecule is a high affinity receptor for HIV. This explains the selective tropism of the virus for CD4+ T cells e.g. macrophages [21-22]. Viral infection leads to cell death. With time, there is gradual attrition of the CD4 cell population and inversion of the CD4-CD8 ratio in the peripheral blood resulting in increasing impairment of cell mediated immunity with consequent susceptibility to opportunistic infections. This underlies the pathogenesis of the clinical disease.

Monocytes and macrophages present a veritable virus factory and reservoir whose output remains largely protected from host defenses. Macrophages in addition provide a safe vehicle for HIV to be transported to various parts of the body, particularly the nervous system. [21-22]

The CD4 cell count in normal healthy (individuals) adults ranges from 800-1200 cells/µl. Destruction of CD4 cells is central to immune impairment in HIV infected patients. AIDS defining illnesses are thus related to CD4 T- lymphocytes count (cells/µl). When the CD4 cells count drop below 200-cells/µl, these HIV infected individuals are classified to as having AIDS. Susceptibility to opportunistic infections and neoplasms increase markedly eventually resulting in death [21, 23,24].

The gastro-intestinal tract is the second commonest site of opportunistic infection and AIDS related neoplasms after the respiratory systems the former accounting for upto 50% of deaths in

children [25]. Most of these opportunistic infections and neoplasms disseminate to involve abdominal viscera. Several imaging modalities can be used to assess the involvement of these organs. Plain abdominal radiography is of limited value except in obstruction and/or ileus this regard owing to its limited soft tissue contrast. It however, can demonstrate calcifications and soft tissue masses deforming fatty planes. Double contrast barium studies can reliably identify lesions such as those involving the esophagus.

CT – scanning provides cross-sectional images of the abdomen in axial planes representing a major improvement on plain films. MRI study of the abdomen has developed much slowly than application in CNS and musculoskeletal due to motion artifacts as well as established imaging modalities such as CT –scan and ultrasound. However with new faster imaging techniques and judicious use of oral and intravenous contrast medium MRI offers unchallenged superior soft tissue contrast resolution. Its multiplanar imaging capability is an added advantage but the modality continues to be less widely available, accessible or affordable. Ultrasound is often the first investigation performed in a patient presenting with a variety of abdominal symptoms and there is a growing appreciation of its value in a wide range of gastrointestinal disorders including acute abdominal emergencies. Ultrasonography in good hands can give useful information about intra abdominal organs. It can be used to confirm or exclude a critical diagnosis [26, 27, 28,29,30]. Sonography is capable of identifying and characterizing many an intra abdominal mass with high precision. It is particularly useful in differentiating solid from cystic lesions.

Real time ultrasound scanning or rapid B mode scanning technique provides continuous data acquisition at a rate optimal for the provision of an impression on instantaneous depiction of moving structures. In most real time units it is possible to "freeze" the

displayed image holding it so that it can be studied and quantitative determinations made. [26-30].

For evaluation of deep structures in the abdomen or pelvis, more than 10-12 cm from the skin surface, frequencies as low as 2.5 - 3.5 MHz are employed to achieve adequate tissue penetration. A major pitfall in ultrasonography is that the quality of the information obtained exhibits high operator dependence. Many imaging artifacts can be induced by errors in scanning technique or improper use of the instrument and must be prevented.

Because the prevailing immunopathogenic conditions are usually multifocal, the abdominal manifestations of AIDS are often looked at by aetiology rather than location, the two major aetiologies being opportunistic infections and AIDS - related neoplasms. Opportunistic infections include those by viral, fungal, protozoan and bacterial pathogens. The commonest AIDS related neoplasms include Kaposi's sarcoma and non-Hodgkins lymphoma.

Ultrasound is of the greatest use for abdominal diseases as a screening procedure. The data obtained by sonography may not only answer the question of normal or abnormal, but also localizes and characterizes morphologically the abnormalities seen [31]. There are a large number of upper abdominal diseases in which ultrasound yields useful information and when supplemented with results of physical examination may precisely be diagnostic. Ultrasound is most beneficial when carried out with the operator fully aware of the clinical history and physical examination [31].

At the K.N.H and the D.D.R-UoN, the most common indication for upper abdominal ultrasound scanning in the general patients were clinically suspected intra-abdominal masses, metastases, abscesses, hepatomegally, pancreatic cyst, liver cirrhosis, renal tumors, hydronephrosis, right upper quadrant abdominal pains and ascites [32].

In 1989, Byarugaba conducted a study of 50 sonographs at K.N.H aimed at establishing the accuracy of ultrasound in the diagnosis of chronic hepatobilliary diseases such as liver cirrhosis, lymphoma and metastasis. The ultrasound findings were correlated with histopathology results and this showed the accuracy of ultrasound scanning in picking up these chronic conditions to be in the range between 89-98%. The commonest liver disease at K.N.H were shown to be liver cirrhosis (8%), hepatobilliary cholelithiasis (2%) [33].

Mjejwa in 1999 investigated the pattern of upper abdominal diseases demonstrated by ultrasound examination at Kenyatta National Hospital. Out of 410 patients 219 (53.2%) were found to have abnormal echogenic patterns or structural changes suggestive of past or on going pathology. The most common indication for upper abdominal sonography included metastasis (14.1%), abdominal masses (10%), jaundice (6.6%) and hepatosplenomegally (2.4%) [34].

A four year review of abdominal ultrasound in 900 central Africa adults with AIDS referred for diagnostic imaging revealed a diverse range of clinical indications. These were abdominal pain, fever of unknown origin, hepatosplenomegally, lymphadenopathy, and abnormal liver function tests. Abdominal ultrasound findings showed hepatomegally (35%), abdominal lymphadenopathy (31%), biliary tract abnormalities (25%), gut wall thickening (15%), ascites (22%) and gallstones (23%). [35]

For ease of description and given that most of those infections/neoplasms exhibit overlapping sonographic characteristics, this presentation will be carried out by systematic evaluation of organ systems.

Hepatobiliary system

The normal liver parenchyma at ultrasound is homogeneous, interrupted by portal vein and its branches, which are seen as linear tubular structures with echogenic walls. The hepatic veins exhibit thin and non-reflective walls. The normal echo texture of the liver parenchyma is slightly more reflective than that of the adjacent renal cortex but less reflective than that of the renal sinus. [27,28,29,30,]. The average liver span has been estimated to be in the range 14cm±1.7 by Kratzer et al in a study involving 2080 subjects.[36] Multivariate analysis of the same study showed that the factors body mass index, height, sex, age and (in male subjects) frequent alcohol consumption exert an influence over liver dimensions obtained at mid-clavicular line. [36]

The normal gall bladder appears as an echo free, pear shaped structure. It is very variable in position, size and shape. However, the normal gall bladder is seldom more than 4cm in transverse diameter. The thickness of the gall bladder wall is preferably measured in transverse scan. In a fasting patient, it should measure no more than 3mm across. [27-30]. Normal intrahepatic biliary ducts are hardly seen at ultrasonography while the common bile duct usually lies anterior to the portal vein and measures ≤6mm in diameter.

The hepatobilliary system is commonly involved by opportunistic infections and AIDS related neoplasms. Diverse but subtle sonographic appearances have been described, though most of these conditions tend to exhibit similar appearances. Amongst the viral opportunistic infections, cytomegalovirus (CMV) involvement of the hepatobilliary tract causes AIDS related cholangiopathy. Common radiological findings include gradual, regular narrowing of the distal common bile duct. Periductal fibrosis secondary to CMV is seen histologically. Associated ultrasonic findings include thickening of the

gall bladder wall. Similar abnormalities are caused by cryptosporidium infection in AIDS patients. Herpes simplex and HIV may also cause similar appearances as CMV but this is a rare occurrence [27,28,29, 37].

Fungal pathogens such as Candida albicans and Histoplasma capsulatum also involve the hepatobilliary system. Infection by Candida albicans causes multiple small abscesses in the liver and frequently in the spleen. These micro abscesses measure 3-10mm in diameter but may rarely be as large as 4cm in diameter. Sonographically, four patterns have been recognized:

(1) The target or bull's eye appearance, classic for this diagnosis and consists of hypoechoic mass containing a central small, hyperechoic solid area.

(2) The "wheel within wheel" appearance, seen early in the course of the disease.

(3) Uniformly hypoechoic lesion, this is the most common pattern.

(4) An echogenic or hyperechoic focus with variable acoustic shadowing.

The target lesions of candidiasis need to be differentiated from neoplastic lesions in the liver. In neoplastic lesions, the central hyperechoic area is usually larger and the peripheral rim is hypoechoic but it usually does not appear anechoic or cystic.

Histoplasmosis is the most common opportunistic infection in AIDS patients who live in endemic areas for the pathogen. Hepatosplenomegally with or without focal lesions is a common finding at sonography or CT – scanning, hepatic calcifications are usually 1-3mm in diameter. The gall bladder and biliary ducts are often spared by these fungal pathogens.

Cryptosporidium is an intracellular protozoan parasite that commonly infects the GIT of animals. It is one of the commonest causes of enteric disease in AIDS patients. Cryptosporidium has

been implicated in the pathogenesis of AIDS related cholangiopathy. Radiological findings of papillary stenosis, irregularity of common bile duct and intra hepatic duct strictures are similar to those seen in CMV infection. [23,27,28,29, 37].

Pneumocystis carinii is the most common cause of opportunistic infection in AIDS patients. The lung is the portal of entry and extra pulmonary infection is uncommon accounting for less than 1%. This is most often associated with the use of aerosolized pentamidine prophylaxis. Outside the lungs P.carinii has a predilection for the liver, spleen and lymph nodes. Ultrasonography reveals numerous tiny hyperechoic foci without acoustic shadowing in the liver. Calcification of these lesions eventually occurs as the disease progresses [23,27,28,29,30].Similar appearances may be seen in disseminated Mycobacterium avium complex and CMV infections.

Mycobacterium tuberculosis is the most common cause of AIDS related intra-abdominal opportunistic infection in developing countries. Common radiological findings are hepatomegally with or without small focal lesions. Cases of isolated tuberculous liver abscesses are rare. The diagnosis is often delayed or missed because of non-specific symptoms and the diseases rare occurrence. HIV infection has however led to an increase in the incidence of tuberculous liver abscesses. A case report with microbiological proof of tuberculous liver abscess showed three hypoechoic lesions with no evidence of liquefaction. [38-41] CT scanning of the abdomen revealed multiple heterogeneous masses within the liver. There was hepatosplenomegally but minimal ascites.

Mycobacterium avium complex tend to cause infections in patients whose CD4 cells are bellow 100cell/µl level. Common sonographic findings include hepatosplenomegally and non specific multiple tiny echogenic foci in the liver and spleen. Focal hypoechoic lesions may also be seen [40,41].

A case report of polymicrobial cholangitis and liver abscess revealed two hypoechoic lesions in the left hepatic lobe, intra hepatic and extra hepatic ducts were unremarkable, and there was no evidence of gallbladder wall thickening or pericholecystic fluid. Ultrasound guided FNAC was done and staphylococcus arreus, CMV and mycobacterium avium complex were cultured. ERCP revealed diffuse biliary strictures, focal dilatations, and mucosal irregularity *consistent with HIV associated cholangiopathy* [42].

AIDS related neoplasms do affect the hepatobilliary system. These include Kaposi's sarcoma and non-Hodgkin's lymphoma. Kaposi's sarcoma is a malignant proliferation of endothelial cells of lymphatic or blood vessels. Skin lesions are the most common manifestation. Sonography reveals large solitary or multiple hypoechoic lesions within the liver. Non Hodgkin lymphoma in HIV infected subjects is a multiclonal B cell lymphoma of high to intermediate grade. This is the most common AIDS related neoplasm after Kaposi's sarcoma. However, it is the most common AIDS related neoplasm in developing countries where heterosexual intercourse is the commonest route of HIV infection. The liver is a common site of extra modal involvement. Characteristic findings at ultrasound are hypoechoic or complex mass. [42]

Pancreas

The normal pancreas has about the same echogenicity as the adjacent liver and appears homogeneous. However, the pancreatic echogenicity increases with age. The outline of the normal pancreas is smooth. When scanning the pancreas, the superior mesenteric artery and splenic vein should be identified, thus acting as important landmarks.

In review of 17 cases with pancreatic tuberculosis by Deepak Ariga et al, four patients were found to be infected with HIV [43]. In

his literature review he concluded that extra pulmonary tuberculosis is common in persons with HIV disease, and pancreatic tuberculosis should be considered in the differential diagnosis of a person with HIV infection and a pancreatic mass. In contradistinction from those with bacterial infection, these patients had no history of acute pancreatitis. The common presentations were vague epigastric abdominal pains, weight loss and low grade fevers. Common findings at imaging were enlargement of the gland and focal hypodense

masses associated peri-pancreatic and periportal adenopathy. These findings are nonspecific, however, and cannot conclusively discriminate neoplasms [43]

Spleen

When the spleen is normal in size, it can be difficult to image it in totality due to the proximity of gas filled colon and the aerated left lower lung zone as well as the overlying lower ribs. When normal, it is a little larger than or about the same size as the left kidney. The normal spleen measures about 12.5cm in its long axis in adult patients. The splenic hilum is the reference point to ensure its correct identification. It is also important to delineate the left hemi-diaphragm and the upper edge of the spleen. The spleen shows a uniform homogeneous echotexture slightly less reflective than that of the liver.

Fungal pathogens that cause opportunistic infections especially Candida albicans does involve the spleen. Fungal splenic disease has a characteristic sonographic pattern. Candida abscesses produce small (1.0 – 1.5cm), round hypoechoic lesions with small hyperechoic central foci. This target pattern is characteristic of candida disease and when coupled with appropriate serologic correlation is usually sufficient to warrant specific treatment [23,37,44].

Histoplasmosis causes hepatosplenomegally with or without focal lesions. Splenic calcifications are usually 1.3mm in diameter. Peri splenic abscesses due to histoplasmosis with superimposed bacterial infection may occur, but are rare.

Amongst the protozoan pathogens, Pneumocystis carinii has a predilection for the liver, splenic and lymph node involvement. Multiple low attenuation lesions are found in the spleen. Calcification of these lesions usually occurs as the disease progresses. Ultrasonography reveals numerous tiny hyperechoic foci without acoustic shadowing in disseminated mycobacterium avium complex and CMV infections.

Mycobacterium tuberculosis causes hepatosplenomegally with or without focal lesions. Focal hypoechoic lesion may be seen within the spleen, similar lesions may be seen with mycobacterium avium complex infection. Kaposi's sarcoma may show solitary or multiple lesions within the liver and spleen though these are infrequent. Sonography shows a hypoechoic lesion with a central area of echogenicity. In most cases, predominantly hypoechoic masses are seen. The liver and spleen are common sites of intra abdominal solid organ involvement by non-Hodgkin's lymphoma. Solitary or multiple lesions of various sizes are detectable by ultrasonography or CT scanning. Characteristic findings on ultrasonography are a hypoechoic or complex mass. [45,46,47]

Adrenal glands

The normal adrenal glands are not easily visualized in adult subjects using ultrasound due to their small size, anatomical situation and surrounding fatty tissue. If they are easily seen, then they are likely to be pathologically enlarged except in infants.

Cytomegalovirus (CMV) causes focal diffuse damage of the gland in 70% of the affected cases. Ultrasonography shows hypoechoic masses that may be heterogeneous and gas containing if abscess formation has occurred. Adrenal insufficiency occurs if 90% of the gland is destroyed by infection or tumor. Similar changes may be seen with herpes simplex infection.

Diffuse focal damage with calcification of the adrenal gland is caused by Histoplasmosis and Pneumocystis carinii infection. Adrenal Kaposi's sarcoma is seen more commonly in AIDS patients than in the general population. Adrenal insufficiency follows when 90% of the gland has been destroyed by the tumor. A non -specific solid mass with or without necrosis may be seen in the adrenal bed. Biopsy and histology results confirm the diagnosis. [45,46,47]

Tuberculous peritonitis

Peritoneal tuberculosis is a growing problem in developing countries and in most developed countries where immigrants and AIDS patients are two population groups of particular risk. Though 50% of patients with tuberculous peritonitis (TBP) may present with accompanying pulmonary tuberculosis, most patients are diagnosed with non-specific symptoms. The diagnosis can be missed or delayed, resulting in increased morbidity and mortality, unless a high index of suspicion is maintained. It is difficult to detect Mycobacterium tuberculosis in ascitic fluid by microbiologic methods and clinical and radiological findings may have an important role for disease diagnosis. In a study of 11 children with tuberculous peritonitis ultrasonography demonstrated loculated ascites with fine septations in all the 11 patients, as well as thickening of either the peritoneum in eight cases or the mesentery and omentum in four cases and changes in the diameters of para-aortic and paracaval

lymph nodes in three cases [48]. The CT scans of these patients revealed high density ascites in 10 of 11 cases, increased density peritoneum in 10 cases, a thickening of mesentery and omentum in six cases and diffuse density lymph nodes in four cases after intra venous contrast medium injection.

Co-infection (TB and AIDS) should be considered when abdominal pain, anaemia, weight loss and abdominal lymphnode enlargement are present. Mycobacterium avium complex also presents with peritoneal thickening, large volume lymphadenopathy with mesentery and retroperitoneal being the commonest site. These nodes are characteristically echo-poor on ultrasound and low attenuation on CT, demonstrating marked peripheral enhancement following intra venous contrast medium. Identical appearances may be seen with infection such as Cryptococcus, Histoplasmosis, P.carinii, but are much less frequent than M.tuberculosis. Culture of the organisms from blood, tissue, faeces or bone marrow is therefore required for confirmation of diagnosis. [48]

Kidneys

When scanning, it is important to recognize the following sonographic features of the kidney:

The renal capsule appears as a bright, smooth, echogenic line around the kidney while the cortex is less echogenic than the surrounding capsule but more reflective than the adjacent renal pyramids. The renal medulla contains the hypoechogenic pyramids which should not be mistaken for renal cysts. The sinus (the fat, the collecting system and the blood vessels at the hilum) is the innermost part of the kidney and has the greatest echogenicity. The renal arteries and veins are best seen at the hilum; however they may be multiple and enter the kidney at different levels.

The kidney size measurements made with ultrasound are generally less than those made by radiography but are more accurate. The adult kidney length varies between 9cm-12cm, width 4-6cm, while the thickness is approximately 3.5cm. Studies have shown that bipolar kidney length is an accurate indicator of kidney weight, volume as well as its functional states. That is why longitudinal axis of kidney is used as parameter during clinical examinations. . [45,46, 47,49].

Thinwa in 1995 carried out a study on the diagnostic value of ultrasound in renal disease in adult patients at the Kenyatta National Hospital's, department of radiology [50]. In this study of 105 sonograms, the correlation between clinical diagnosis and ultrasound findings was 91% in structural renal disease such as renal stone and masses (cystic or solid). For medical renal diseases such as chronic pyelonephritis, acute or chronic inflammatory renal disease and end stage kidney failure and Para renal disorders, the correlation was down to 80% [50].

The spectrum of kidney disease among patients infected with HIV is extensive. Acute renal failure (ARF) in patients infected with HIV occurs primarily for similar reasons as for patients without HIV infection. Pre-renal causes include hypovolaemia due to diarrhea, vomiting, and infections, hypotension from sepsis, bleeding and fluid loss, and hypoalbuminaemia due to third space fluid loss and cachexia. Acute tubular necrosis, due to hypovolaemea, shock, sepsis, anoxia or nephrotoxins is the most common cause of intensive ARF in patients with HIV infection. Post renal causes of renal failure due to urinary tract obstruction include bladder and urethral obstruction, extrinsic compression from tumor, lymphnodes or retroperitoneal fibrosis, intrinsic obstruction from blood clots, fungus balls, or crystalluria.

Chronic HIV nephropathies

Among causes of chronic nephropathy, three syndromes have been associated with HIV infections. Classic HIV – associated nephropathy with focal glomerulosclerosis (HIV-FGS), HIV associated immune complex renal disease (HIV-ICD), and thrombotic microangiopathies, HIV associated thrombotic thrombocytopenic purpura/haemolytic uremic syndrome (HIV-TTP/HUS). HIV associated FGS is the most common of the three HIV associated nephropathies found in biopsy series [51,52,53,54] . This syndrome has been reported in all stages of HIV infection, including during acute Sero-conversion. HIV-FGS typically presents with nephrotic syndrome (often with massive proteinuria) hypoalbuminaemia, large echogenic kidneys by renal ultrasound, and focal and segmented glomerulosclerosis on renal biopsy. If left untreated, patients with HIV-FGS may rapidly progress to end stage renal disease in a matter of weeks to months.

Recurrent urinary tract infections may affect as many as 50% of children with AIDS, with an increased frequency of unusual opportunistic infections such as Cryptococcus neoformans, Mycobacterium tuberculosis, Pneumocystis carinii and rarely Candida albicans and Aspergillus. Ultrasound is the imaging modality of choice, although appearances are usually normal or non-specific despite documented infection. Ultrasonic features of candida infections are characteristic and include focal echo poor or echogenic masses within the renal collecting system or parenchyma, with associated hydronephrosis due to urinary tract obstruction. P, carinii infection, however, appears as punctate renal calcification confined to the cortex.

OBJECTIVES

General

To determine the pattern of upper abdominal abnormalities as detected by sonography in HIV infected individuals at the Kenyatta National Hospital (K.N.H) and the Armed Forces Memorial Hospital (A.F.M.H) Nairobi.

Specific

(1) To determine the pattern of abdominal disease/abnormalities in HIV infected patients at sonography.

(1) To compare clinical presentation with ultrasonic findings.

STUDY JUSTIFICATION

The gastrointestinal tract is a major target organ in acquired immunodeficiency syndrome (AIDS), second only in frequency to the respiratory system. Opportunistic infections, Kaposi's sarcoma, and AIDS related lymphomas are a common finding in these patients [25].

Disseminated opportunistic infections, Kaposi's sarcoma and AIDS related lymphomas tend to commonly involve intra-abdominal visceral organs and lymphnodes leading to lymphadenopathy, intra - splenic, renal, hepatic and peritoneal masses all of which can be assessed by ultrasound which is a safe, affordable and easily accessible imaging tool.

In the majority of sub-Saharan African countries, the absence of computed tomography facilities makes abdominal ultrasound (US) an alternative imaging tool in the clinical investigation of infections and non-infectious complications of human immunodeficiency virus (HIV) infected individuals.

Studies have been done locally on the pattern of upper abdominal disease seen at ultrasonography [34] but So far, none has been carried out to evaluate the pattern of abdominal disease as seen in HIV/AIDS patients

While many of the sonographic findings may not be specific for a particular infection or neoplasm, the differential diagnostic possibilities for an abnormality can be narrowed down significantly with appropriate clinical correlation. A tissue diagnosis is often desirable and sonography guided biopsy/FNAC is particularly useful in this regard.

RESEARCH QUESTION.

(1) What is the sonographic pattern of upper abdominal Pathology in HIV infected patients?

(2) What is the correlation between clinical features and ultrasound findings in HIV patients with upper abdominal pathology?

MATERIALS AND METHODS

Study design

This was a descriptive cross sectional study carried out over a period of eight months (May 2004 to January 2005). The study population was patients who had tested positive for HIV-antibodies and had been referred for abdominal ultrasound scans, from the wards, clinics of Kenyatta National Hospital and Armed Forces Memorial Hospital.

Abdominal ultrasonography, for the purposes of this study refers to upper abdomen excluding the pelvic region which is regarded as a specific region of gynaecological interest.

Study setting

This study was carried out at Kenyatta National Hospital (K.N.H): Department of Diagnostic Radiology University of Nairobi (D.D.R-UoN) and Armed Forces Memorial Hospital (A.F.M.H) Nairobi.

Sampling method

All HIV positive patients at the study hospitals formed the sampling frame. The HIV positive patients sent for abdominal ultrasonography were included into the study. Systematic sampling procedure was used in selecting patients into the study, whereby all patients with odd numbers and eligible were included. Those patients with stigmata of AIDS but no laboratory serological confirmation were not included in this study. Enzyme linked immunosorbent assay (ELISA) was the immunological test predominantly used in the study hospitals. Patient data was obtained from radiological request form already filled by the referring clinician. Any necessary information that was not available from the form was obtained from the patients

whenever it was possible. This data was then filled in pre-designed data collection forms.

The ultrasound machines used were Philips (Model – SD 800) at K.N.H, while Hewlett Packard -Image Point was used at D.D.R-UoN and A.F.M.H. A 3.5 MHz sector transducer was routinely used while 5 MHz was used in selected cases especially in children and superficial lesions in adults.

Sample size determination.

The sample was determined using Fisher et al formula (1998)

$n=Z^2\ 1\text{-}\alpha\ P\ (1\text{-}P)/d^2$ (1-tailed)

Whereby: n= desired sample size

z= standard deviation corresponding to 95% confidence level one tailed (1.645)

d= absolute precision (5%)

α= level of significance (5%)

p= expected sensitivity for ultrasonography = 50%

Therefore desired calculated sample size is 271; to increase precision 273 patients were included into the study.

Patient assessment procedure

(1) At sonography, no prior preparation of the patient was indicated except in those cases where hepatobilliary system was of primary interest. The adult patients were advised to starve for at least six hours prior to the examination. In children and infants whose clinical conditions permitted, three hours fast was deemed adequate [23].

(2) Renal ultrasound, patients were requested to completely

empty their urinary bladder just before the examination in order to avoid the "full urinary bladder phenomenon" which could lead to false notion of hydronephrosis. The kidneys were scanned in all planes using the liver and spleen as acoustic windows for the right and the left kidney respectively while the patient was comfortably in supine position.

(3) Prone and oblique positions were used when better visualization of the kidneys were required.

(4) All the upper abdominal visceral organs were shown in longitudinal as well as transverse planes so as to visualize all parts of the organ under study. Para-aortic, mesenteric, porta hepatic regions and major blood vessels were studied as well.

(5) Sonographic findings/diagnosis of each patient's conditions was made on the basis of the following criteria:

i. Size of the organ/lesion.
ii. Echo-pattern.
iii. Presence of associated abnormalities such as ascites
iv. Multiplicity of lesions.

These imaging features were correlated with clinical diagnosis to reach a conclusive ultrasonic diagnosis. Selected images were recorded on the sono ultrasonic-thermoprinting paper by multiformat camera inherent within the machine.

Data analysis and presentation

Data was entered into the computer software SPSS (Statistical Package for Social sciences). Data cleaning was done and all errors were corrected. Descriptive statistics was done whereby all categorical variables were calculated in terms of proportions and

presented in tables, texts and bar charts. Continuous variables were analysed using measures of central tendency and confidence intervals were calculated using the 95% confidence levels. Correlations of clinical presentations and ultrasound findings were done using proportions. Chi-Square Test was used to determine associations between CD4 levels and parenchymal renal changes and ascites. Statistical significance was assessed at alpha level $\alpha = 0.05$

ETHICAL CONSIDERATIONS

(1) A request to conduct the study was submitted to and approved by the Kenyatta National Hospital Ethical and Research Committee before the study was commenced.

(2) Patient's written consent for the examination was sought for before scanning. Prior to giving/signing the written consent, they were explained to and made to understand the following facts:

i. Ultrasonography is a harmless examination. Sonography as a diagnostic imaging modality has been in use for over three decades and so far no serious adverse effects have been documented. Thermal energy absorbed by the body tissues in diagnostic sonography is quite small and risks due to mechanical effect have not been quantified but are considered insignificant at diagnostic exposure levels. It has been noted that known diagnostic ultrasound equipments as used today for imaging operates at acoustic outputs that are incapable of inducing harmful temperature rises. Data on human beings are sparse, but it has been concluded that use of ultrasound should apply the ALARA (As Low As Reasonably Achievable) principle to the exposures to which patients are subjected. [55,56,]

ii. Sonography is done as a part of diagnostic work up of a patient. The combination of sonography report, clinical and laboratory data allows for diagnosis that can be confirmed. This enables a decision for effective and focused therapy to be made thus reducing the period of morbidity.

iii. The results of the examination were to be used for research purposes by the researcher and that his/her name was not to appear in the research documents.

(3) No procedure other than that consented for was carried out on the patient.

(4) Confidentiality of the patient was maintained in that only patient's hospital number, and not name, was used for purposes of identification.

(5) Patient's name, religion, or ethnicity was not requirement in this study.

RESULTS

A total of 273 patients underwent abdominal ultrasonography. The results are arranged in sections whereby section A: has sociodemographic characteristics of the patients, section B; clinical indications for ultrasonography, section C; findings at ultrasound and section D; associations and CD4 levels.

SECTION A: Sociodemographic characteristics of the patients

Slightly above half 151 (55.3%) of the patients were referred from the wards. The clinics and casualties contributed 115(42.2%) and 7 (2.6%) respectively. There were nearly equal proportion of males (51.6%) and females (48.4%) among all the patients studied. The mean of age of the patients was 32 years (95%CI 30.33 – 33.62) ±13.81. The oldest patient was 59 years and the youngest less than one year old. 68.8% fell within the most productive age group of 15 to 45. (Table 1)

Table 1: Age distribution

Age group	Frequency	Percentage
0 – 14	46	16.8%
15 – 25	23	8.4%
26 – 35	70	25.6%
36 – 45	95	34.8%
46+	39	14.3%
Total	273	100%

SECTION B: INDICATIONS FOR ABDOMINAL ULTRASOUND

General indications for abdominal ultrasonography

Most of the indications were non-specific whereby 31.9% indicated right upper quadrant pain, 30.4% para aortic adenopathy while ascites accounted for 13.6% (Table 2).

Table 2: indications for Upper Abdominal Sonography

	Frequency	%age
Right upper quadrant pain	87	32.0%
Pyrexia of unknown origin	83	30.4%
General abdominal pain	75	27.7%
TB peritonitis	68	25.0%
Para aortic lymphadenopathy	56	20.5%
Jaundice	42	15.4%
Ascites	37	13.6%
Abdominal mass	35	12.8%
Total	483	177.4%

Indications for liver ultrasound

Among the 273 patients, 70.3% had no specific indications for liver ultrasonography. The remaining 29.7% had various clinical indications as shown (Table 3).

Table 3: Indications for liver ultrasound

Clinical diagnosis	Frequency	Percentage
Hepatitis	37	45.6%
Hepatomegaly	17	21.0%
Metastasis	25	30.9%
Cirrhosis	2	2.5%
Total	81	100%

Indications for the Pancreas

Three (1.1%) patients were suspected to have acute pancreatitis thus sonography was requested for to confirm the diagnosis. Another one (0.37%) patient had non-specific mid-line upper abdominal pain thought to be of pancreatic origin.

Indications for kidney ultrasonography

The majority, (91.2%) of the patients scanned had no specific clinical indications for renal ultrasonography.

Only 8.8% had clinical indications (Table 4).

Table 4: Indications for kidney ultrasound

Clinical diagnosis	Frequency	Percentage
Renal mass	1	4.20%
Hydronephrosis	2	8.30%
Metastatic disease/infiltrates	2	8.30%
Acute/chronic renal failure	16	66.70%
Recurrent urinary tract infections	3	12.50%
Total	24	100%

Adrenal, spleen and gall bladder

Specific clinical indications for ultrasonography of the gall bladder disease were only eight (2.9%). These were six (2.2%) and two (0.7%) cases for acute and chronic cholecystitis respectively.

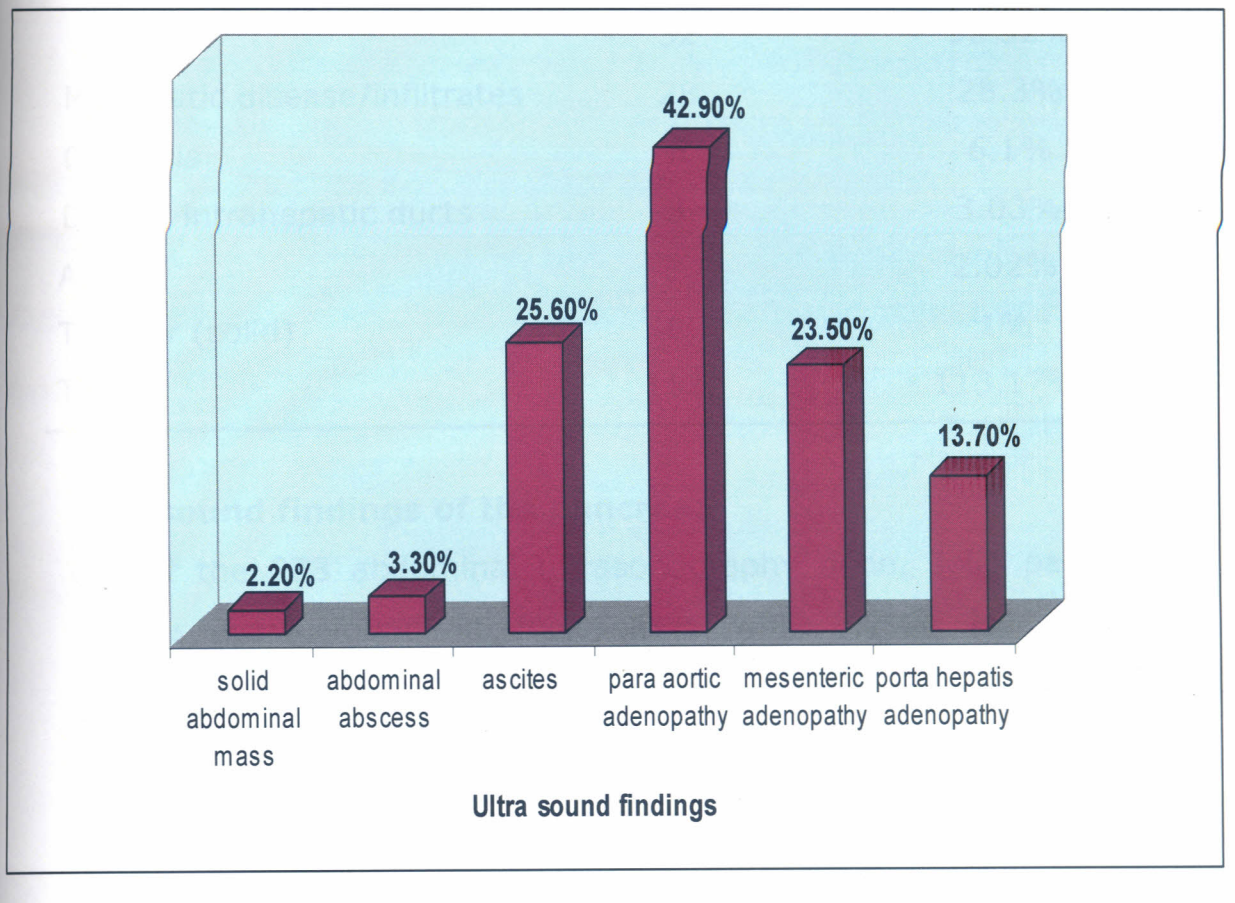
Clinical requests for splenic sonography were made in only 18 (6.6%) patients. All these were requested for in cases of suspected splenomegaly.

SECTION C: ULTRASONOGRAPHY FINDINGS

Upper abdominal ultrasound findings.

Para aortic adenopathy was found in 42.9% of the patients, 25.6% with ascites and in only 2.2% was solid abdominal mass found (Figure 1)

Figure 1: Upper abdominal sonography: non-specific findings



Ultrasonography Findings of the Liver

More than half of the patients (63.7%) had normal liver findings at sonography while, 36.3% exhibited various sonographic findings (Table 5).

Patients below the age of 12 years had a mean midclavicular liver span of 10.35cm (95% CI 9.54 – 11.15) ±2.5. The largest span in this age group was 16cm and the smallest was 6cm. patients above 12 years of age had a mean span of 13.0cm (95% CI 12.66 – 13.24) ±2.26. The largest span being 20cm and the smallest was 6cm. Thirty two patients had midclavicular span above 15 cm (14cm±1.7) and were classified as having hepatomegally.

Table 5: Ultrasound findings - liver

Sonographic diagnosis	Frequency	Percentage
Fatty liver	40	40.4%
Hepatomegaly	32	32.32%
Metastatic disease/infiltrates	28	28.3%
Cirrhosis	6	6.1%
Dilated intrahepatic ducts	3	3.03%
Abcess	2	2.02%
Tumour (solid)	1	1%
Total	112	113.17%

Ultrasound findings of the pancreas

Out of the 273 abdominal ultrasonography done, solid pancreatic masses were found in four cases while cystic lesions were demonstrated in three patients. The rest of the study group exhibited normal homogenous pancreatic echogenicity.

Kidneys – Ultrasonic findings

The majority of the kidneys scanned were normal (55.7%). The rest of the cases exhibited various sonographic findings (Table 6). For patients below 12 years of age, the average width of the left kidney was 2.98cm (95%CI 2.73 – 3.24) ±0.7914. The largest was 6.2cm and the shortest was 1.8cm.

Patients above the age of 12 years had a mean of 4.0cm (4.10-4.26) ±0.590.The smallest was 2.5cm and the largest was 6.0cm. Length (bipolar measurement) of the left kidney of patients below 12 years had a mean of 7.69cm (95CI 7.12 – 8.26) ±1.73.The longest was 14cm in length while the shortest was 4.5cm. For those patients above 12 years of age, the mean bipolar length was 10.58cm (95%CI 10.42 – 10.74) ±1.28. The longest length was 14cm and the shortest was 5.7cm.

The mean width of the right kidney for those cases below the age of 12years was 2.88cm (95%CI 2.61 – 3.15) ±0.83.The minimal width being 1.8cm while the maximum was 6.7cm. For patients above 12 years of age, the mean width was 4.01cm (95%CI 3.93 – 4.09) ±0.63. Minimum width was 2.4cm while the maximum width was 6.0cm.

The mean bipolar measurements for the right kidney of those patients below 12 years of age was 7.40cm (95%CI 6.82 – 7.98) ±1.76 with a minimum of 4.3cm and a maximum of 14cm. For those patients 12 years of age and above, the mean bipolar length was 10.22cm (95%CI 10.05 – 10.38) ±1.26. The minimum length was 6.1cm while the maximum was 14cm.

Twelve (5.1%) patients had right kidneys with bipolar lengths above 12cm while 23 patients (9.8%) exhibited left kidney lengths above12cm. The prevalence of having large right kidney is 5.1% (95%CI 2.29-7.92%) and that of having large left kidney is 9.8 %(95%CI 7.08-12.52%).

A total of 113 (41.4%) patients had increased renal parenchymal echogenicity. Type 1 change accounted for 48.67% while type II contributed 51.33%. There was however no significant differences in increased renal parenchymal changes versus gender of patients (χ^2 = 059: 1df P>0.05 (P=0.808) and age (χ^2 = 5.405: 4df P>0.05 (P=0.248)

Table 6: Ultrasound findings - Kidneys

Ultrasound diagnosis	Frequency	Percentage
Increased renal parenchymal echogenicity	113	93.39%
Hydronephrosis	4	3.31%
Solid renal mass	3	2.48%
Others	1	0.83%
Total	121	100%

Table7: Distribution of increased renal parenchymal change and age of patient

Age Group	0-14	15 -25	26 - 35	36 - 45	46+
Type I	52.6%	41.7%	32.1%	59.5%	50.0%
Type II	47.4%	58.3%	67.9%	40.5%	50.0%

Ultrasound findings of the adrenal glands

In 264 cases (96.7%), the adrenal glands were not visualized, while in the remaining 9 cases, (3.3%) the glands were normal.

Ultrasound findings of the Spleen

In 79.9% of the cases, the spleen exhibited normal size, shape and homogenous echogenicity.

One patient, however, had had post traumatic splenectomy. 20.15% of the patients showed various sonographic findings (Table 10).

For those patients below the age of 12 years, the mean spleen span was 8.75cm (95%CI 7.44 – 9.70)±3.48. A minimum span of 5cm and a maximum of 19cm were recorded.

Patients above 12 years of age had a mean span of 10.23cm (95%CI 9.89 – 10.56) ±2.59 with a minimum span of 7cm and a maximum of 18cm. Splenomegaly (axis greater than 12.5cm) was found in 52 patients (94.54%) of those who had abnormal spleen at sonography

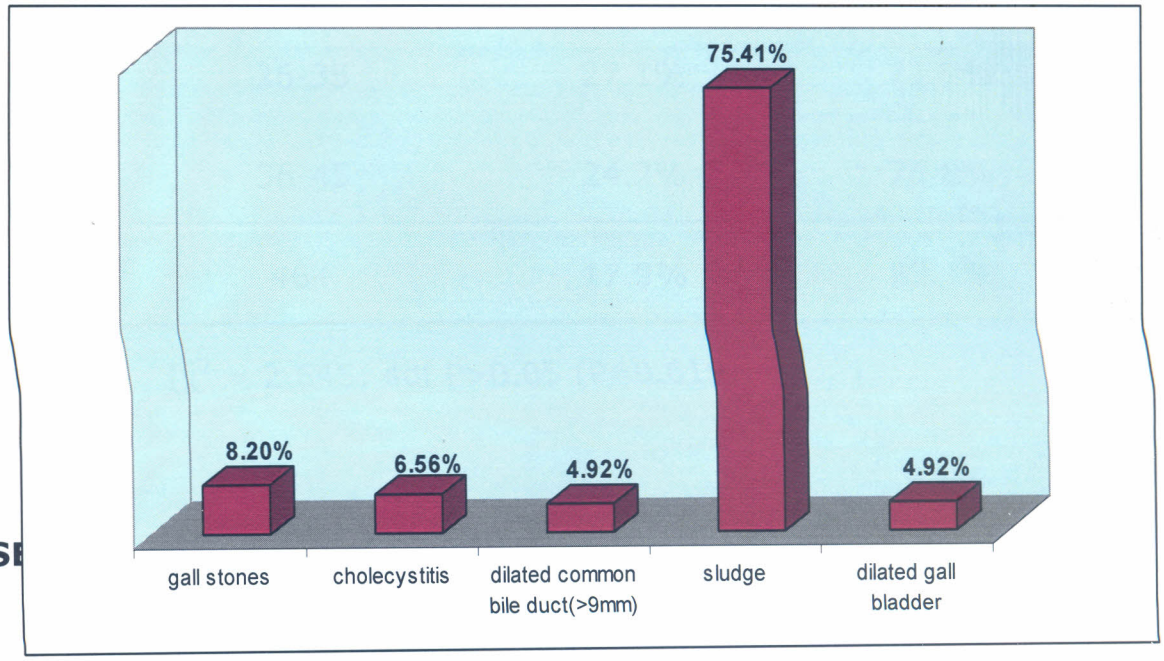
Table 8: Ultrasound findings - Spleen *n*=55

Ultrasound diagnosis	Frequency	Percentage
Splenomegaly	52	94.54%
Metastatic disease/infiltrates	21	38.2%
Solid (tumour)	1	1.18
Others	1	1.18%
Total	75	135.1%

Ultrasound findings of the gallbladder.

The majority (77.7%) of the gall bladder was normal at sonography. The rest (22.34%) had features as shown in the figure below.

Figure 2: Ultrasound findings of the Gall Bladder



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SECTION D: ASSOCIATIONS AND CD4 LEVELS

Associations between ultrasonography findings with patients' age and sex

A total of 70(25.6%) patients had ascites. Males with ascites were 22.1% whereas 29.5% of females had ascites. Para-aortic lymphadenopathy was found 117 (42.9%) patients. Males accounted for 39.7% while 46.2% were females. Table 9 bellow shows the association between ascites and age while table 10 show the association between para-aortic lymphadenopathy and age.

There were no significant differences in the presence of ascites and patient's gender (χ^2 = 1.948: 1df P>0.05 (P=0.163), or age (χ^2 = 2.645: 4df P>0.05 (P=0.619); para-aortic lymphadenopathy and gender (χ^2 = 1.175: 1df P>0.05 (P=0.278), or age (χ^2 = 7.566: 4df P>0.05 (P=0.109).

Table 9: Association between ascites and age at ultrasound

Age group	Ascites	No ascites
0-14	28.9%	71.1%
15-25	34.8%	65.2%
26-35	27.1%	72.9%
36-45	24.2%	75.8%
46+	17.9%	82.1%

(χ^2 = 2.645: 4df P>0.05 (P=0.619)

Table 10: Association between para-aortic lymphadenopathy and age.

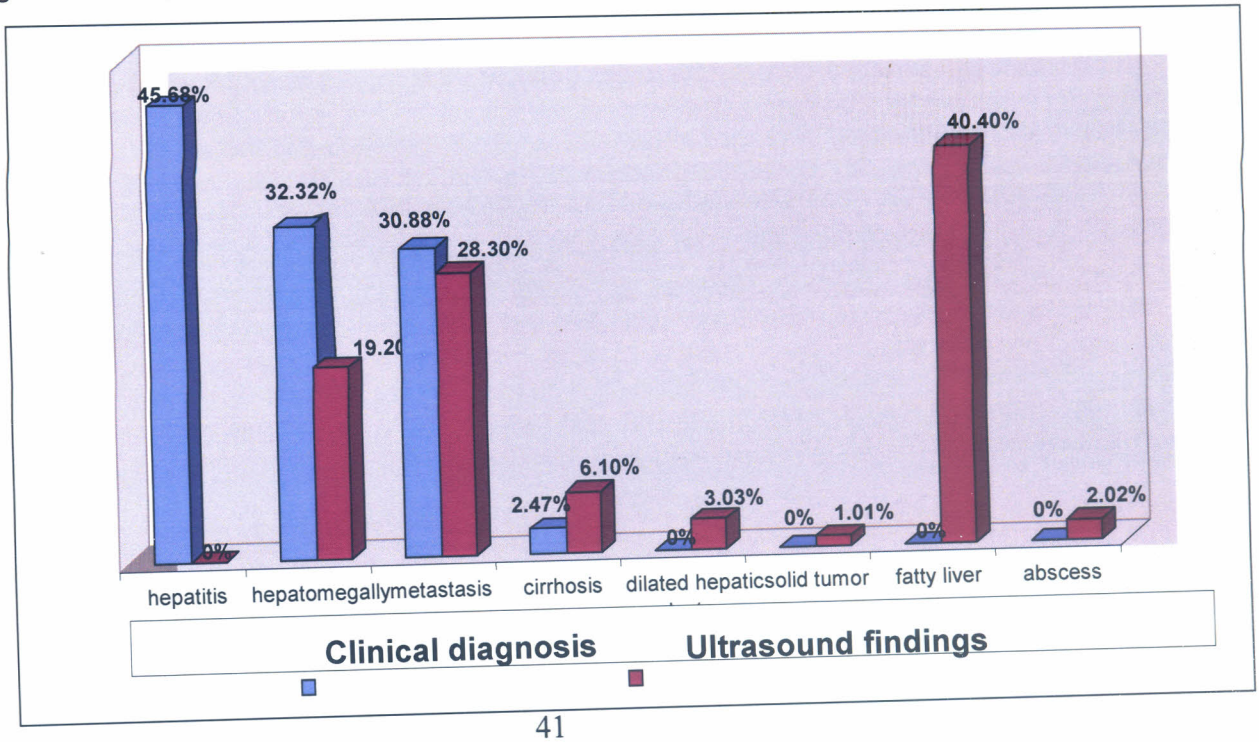
Age group	Para-aortic adenopathy	No para-aortic adenopathy
0-14	28.9%	71.1%
15-25	34.8%	65.2%
26-35	27.1%	72.9%
36-45	24.2%	75.8%
46+	17.9%	82.1%

$\chi^2 = 7.566$: 4df $P>0.05$ ($P=0.109$)

Comparison of ultrasonography findings of the liver and clinical indications

In some instances as in fatty liver, there were no clinical indications but ultrasound features were demonstrated, whereas there were a large number of patients with clinical diagnosis of hepatitis but no imaging characteristics to suggest the same.

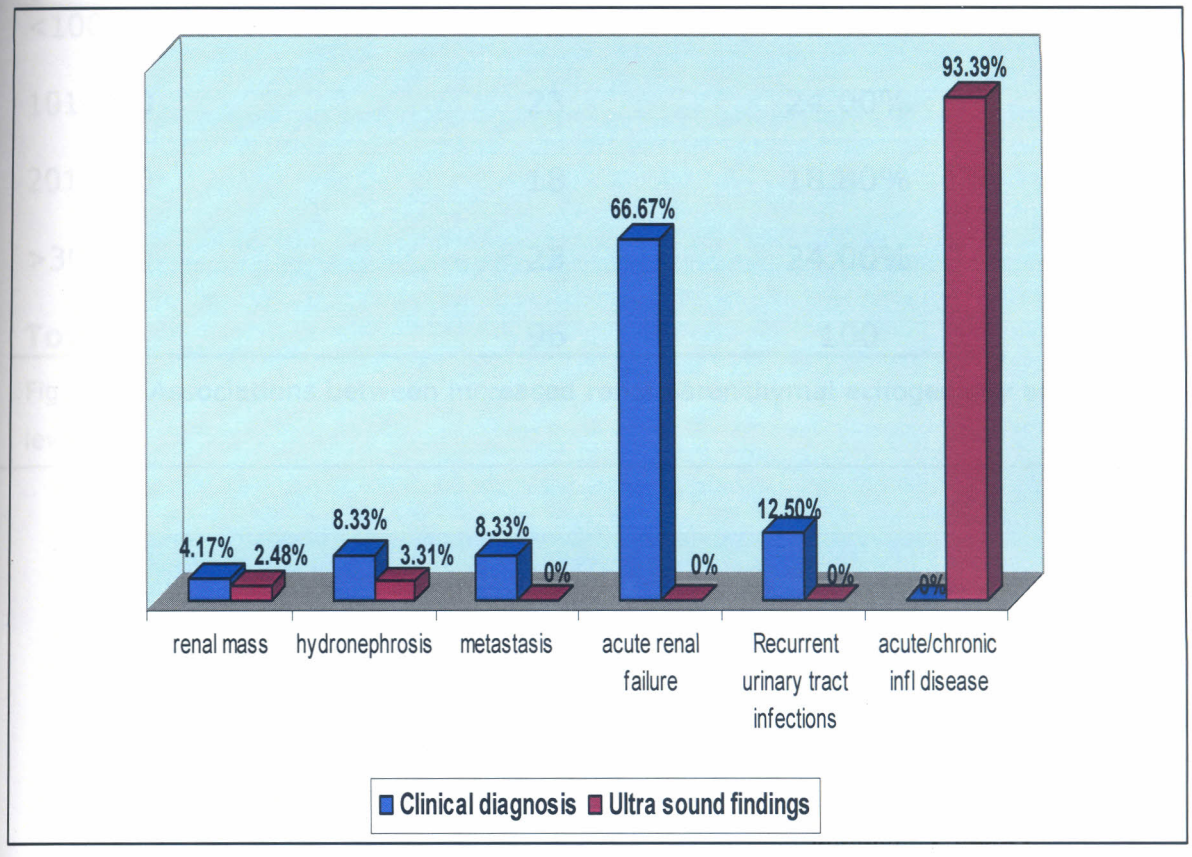
Figure 3: Comparison of clinical diagnosis and ultra sound findings in the liver



Comparison of ultrasonography findings of the kidneys and *clinical indications*

Ultrasound showed increased parenchymal echogenicity in 113 (93.4%) of patients amongst those who exhibited renal abnormalities.

Figure 4: Comparisons between clinical indications and findings at sonography of the kidneys



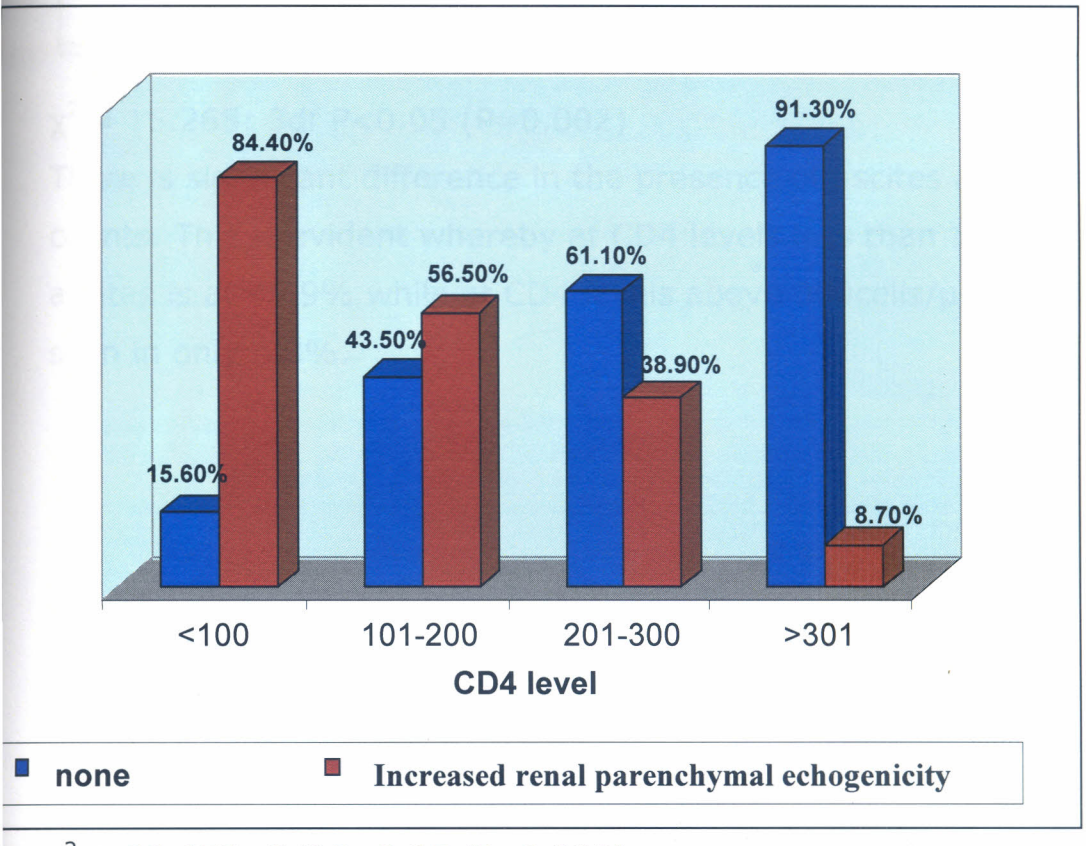
CD4 Count

In this study, CD4 cell count for 96 (35.2%) patients was known. The mean CD4 cell count was 212 cells / µl (95%CI 177.05 – 46.91) ±172.40, the lowest count being 2.0 cells/µl and the highest 755cells/µl. There was no significant difference in gender of the patients and CD4 counts with both the sexes exhibiting similar distribution patterns. (χ^2 = 2.780: 3df P<0.05 (P=0.427)

Table 11:CD4 Count Distribution n=96

CD4+ count (cells/µl)	Frequency	Percentage
<100	32	33.30%
101-200	23	24.00%
201-300	18	18.80%
>301	23	24.00%
Total	96	100

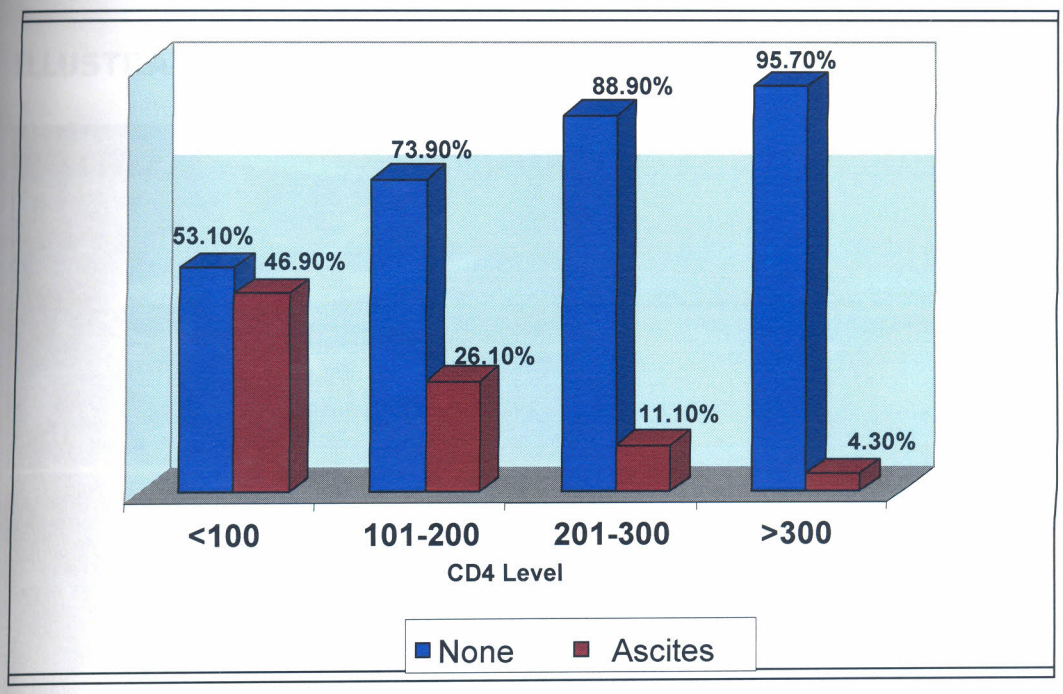
Figure 5: Associations between increased renal parenchymal echogenicity and CD4 level



χ^2 = 32.073: 3df P<0.05 (P=0.000)

There is significant difference in the presence of increased renal parenchymal echogenicity and CD4 counts. This is evident whereby at CD4 counts less than 100cells/µl the increased renal parenchymal echogenicity is at 84.40% whereas at CD4 counts more than 301cells/µl similar renal changes are seen in only 8.7% of the cases.

Figure 6: Association between ascites and CD4 levels



χ^2 = 15.265: 3df P<0.05 (P=0.002)

There is significant difference in the presence of ascites and CD4 counts. This is evident whereby at CD4 levels less than 100cells/μ ascites is at 46.9% while at CD4 levels above 300cells/μ ascites is seen in only 4.3%.

ILLUSTRATIONS

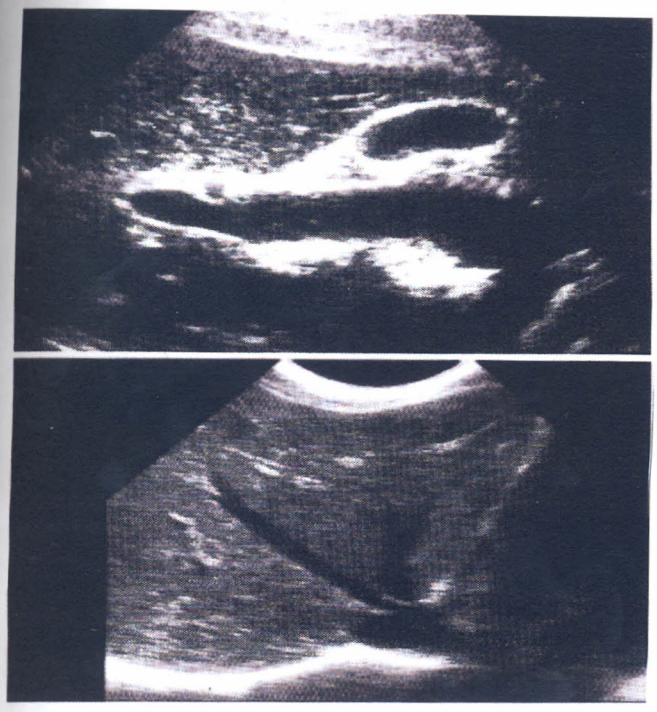


Illustration 1: Normal liver and gall bladder.

Patient had two weeks history of upper abdominal pain.

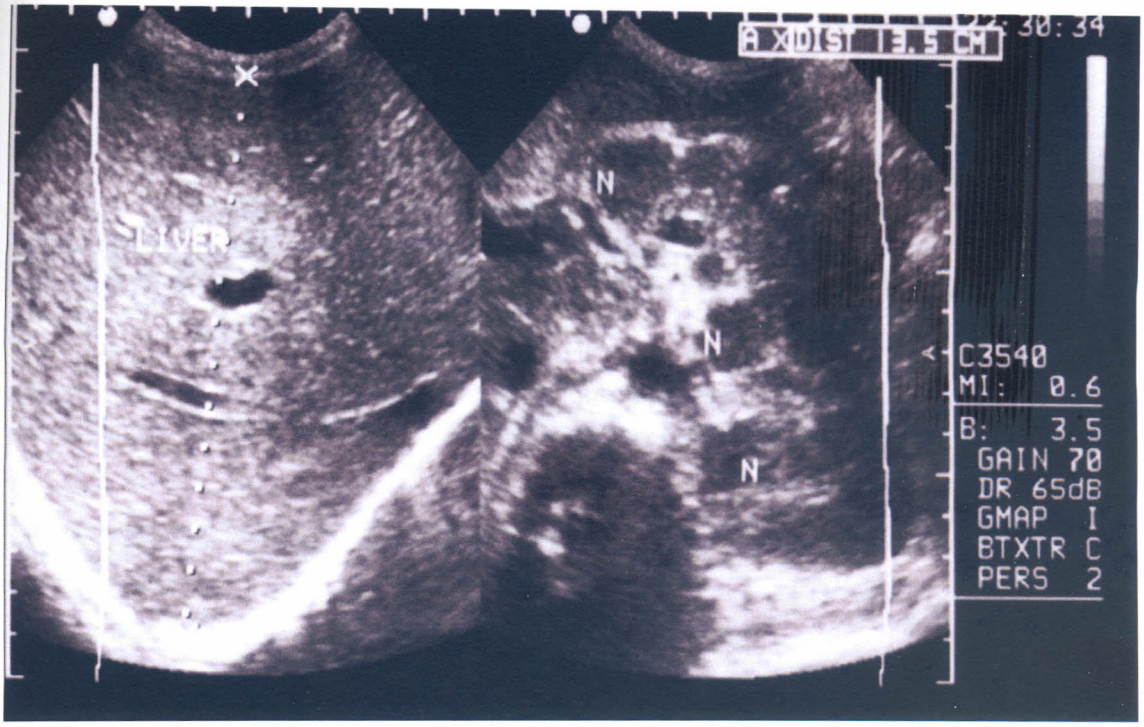


Illustration 2: Normal liver and para aortic / messenteric adenopathy.

Patient on treatment for PTB

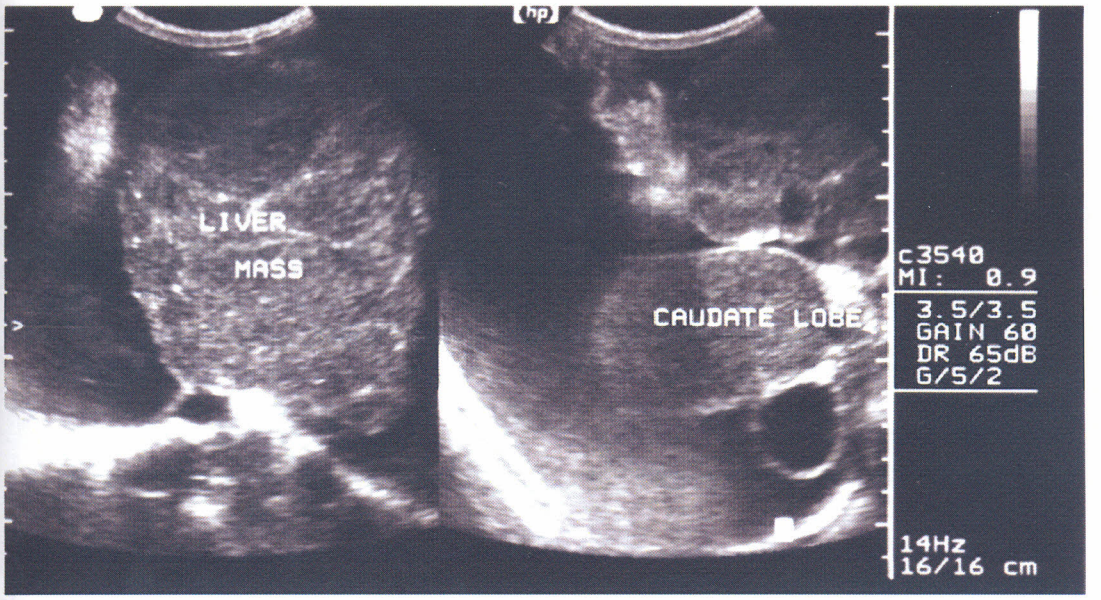


Illustration 3: Liver cirrhosis with ascites. Long standing history of abdominal distension.

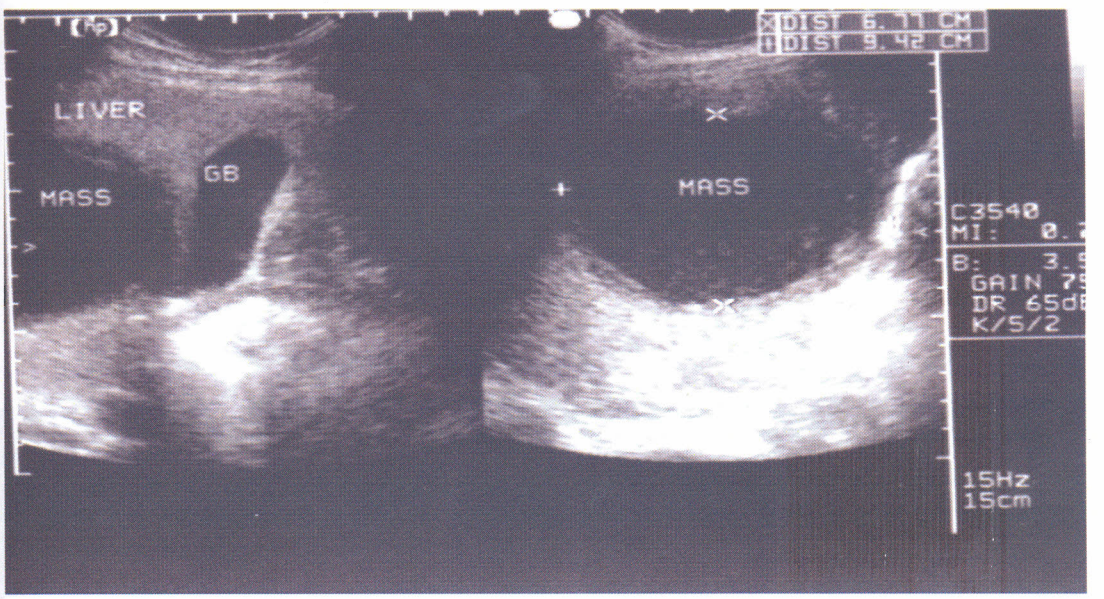


Illustration 4: Liver abscess (Aspiration and Microbiology confirmed Amoebic liver abscess). History of fever and right upper abdominal pain for twp weeks

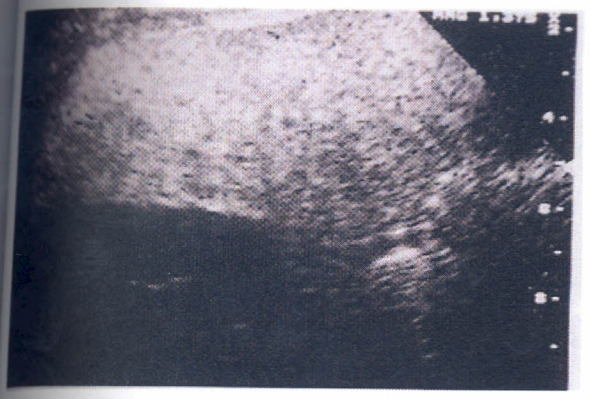


Illustration 5: Fatty liver. The patient presented with generalised abdominal pain for two weeks

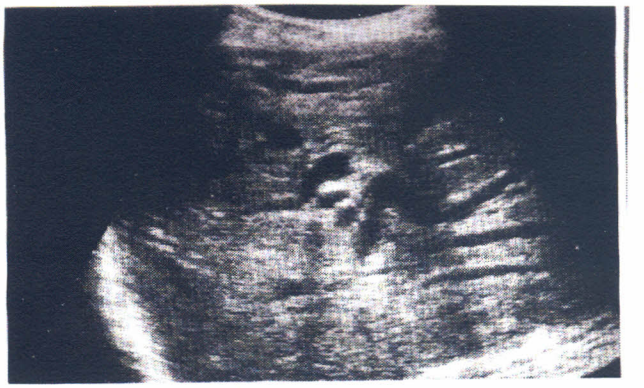


Illustration 6: Dilated intrahepatic ducts. A middle-aged female patient with three weeks history of jaundice and generalised body pruritis.

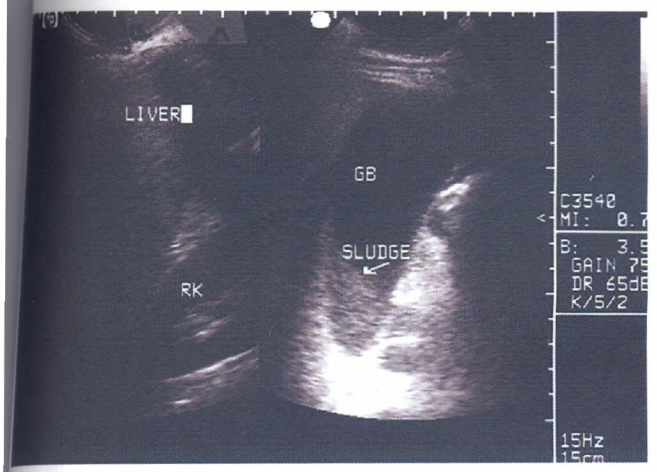


Illustration 7: Sludge in the gall bladder. A bed-ridden female patient with abdominal discomfort

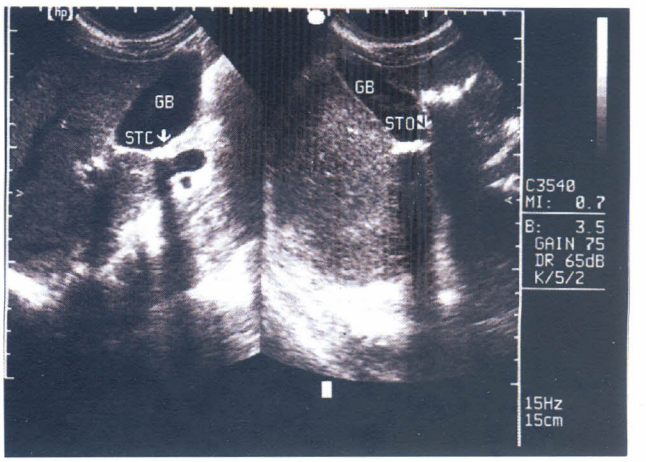


Illustration 8: Gallstones showing posterior acoustic shadowing.
A male patient with long standing history of intermittent right upper abdominal pain

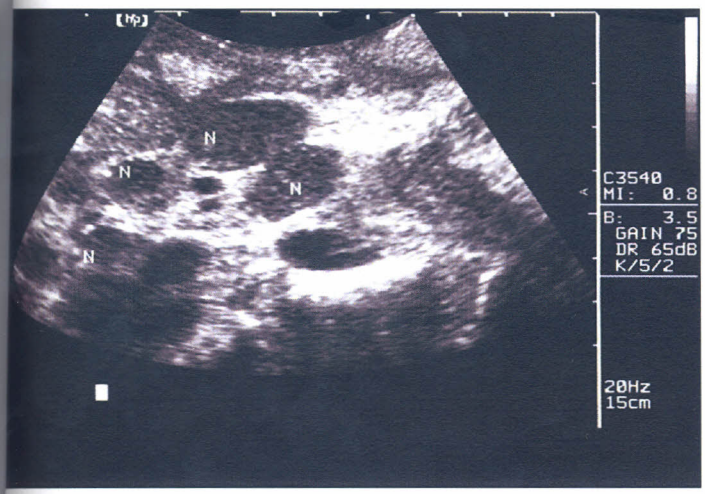


Illustration 9: Mesenteric adenopathy. Male patient who is on anti-TB treatment. Has diffuse abdominal tenderness

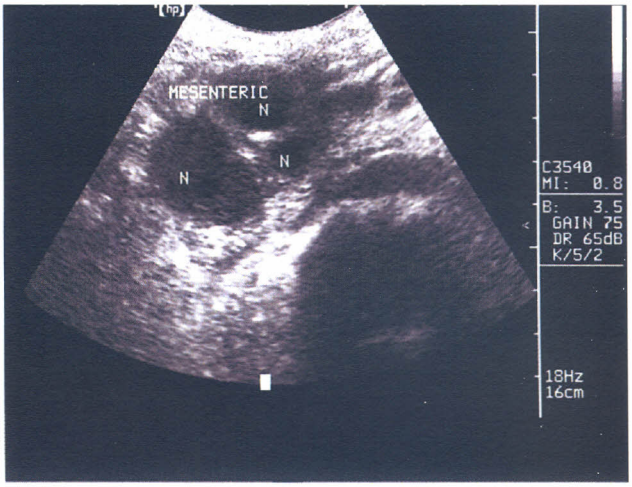


Illustration 10: Para-aortic adenopathy. Male patient who is on anti-TB treatment. Has diffuse abdominal tenderness

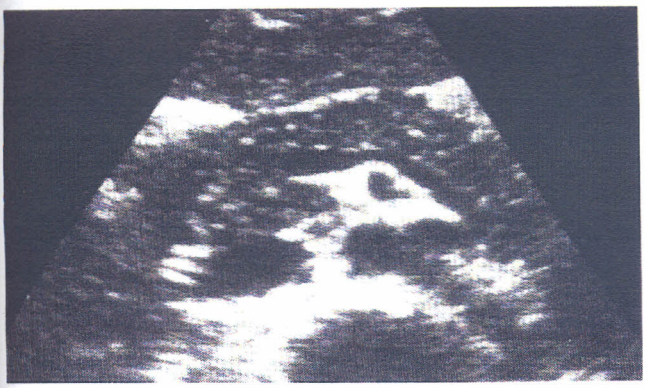


Illustration 11: Normal pancreas. Male patient with vague upper abdominal pain

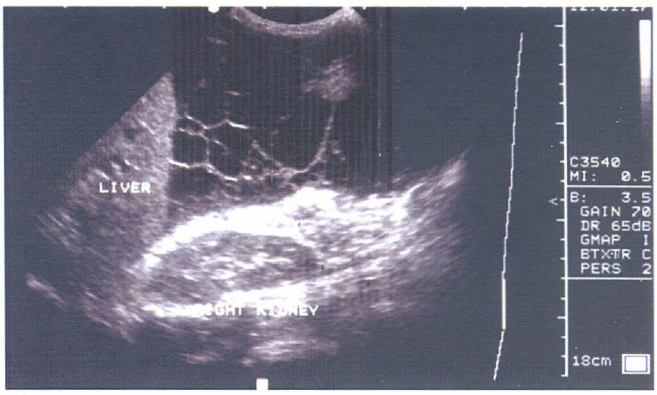


Illustration 12: Multiseptated ascites. Patient with pyrexia of unknown origin and abdominal pain

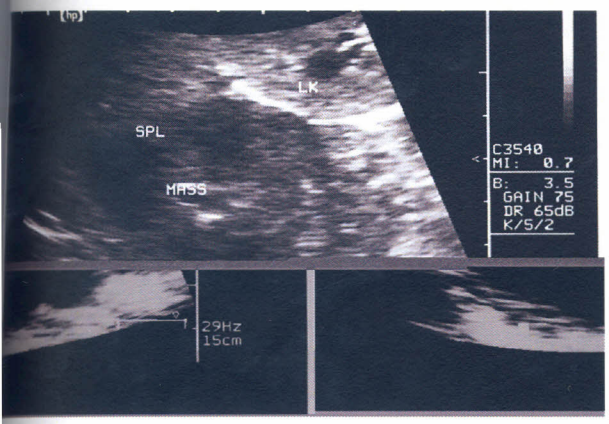


Illustration 13: Mass in spleen. Patient with left upper abdominal discomfort.

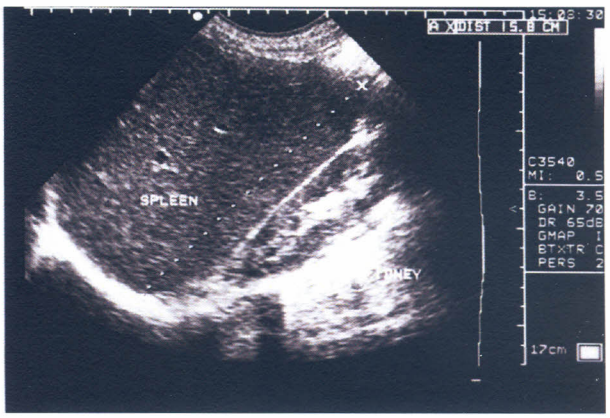


Illustration 14: Splenomegaly with normal left kidney. Patient with left upper abdominal discomfort and dragging sensation

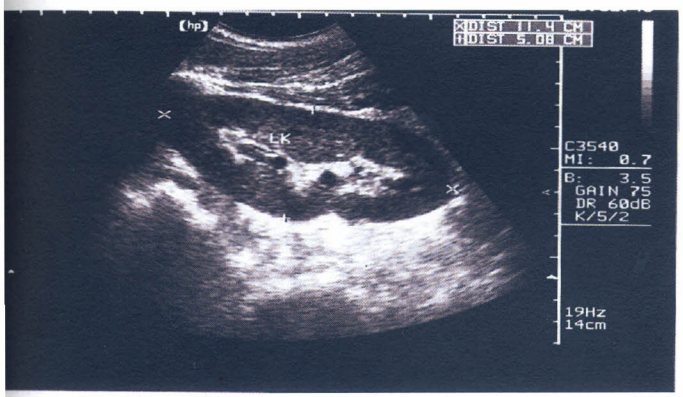


Illustration 15: Normal left kidney

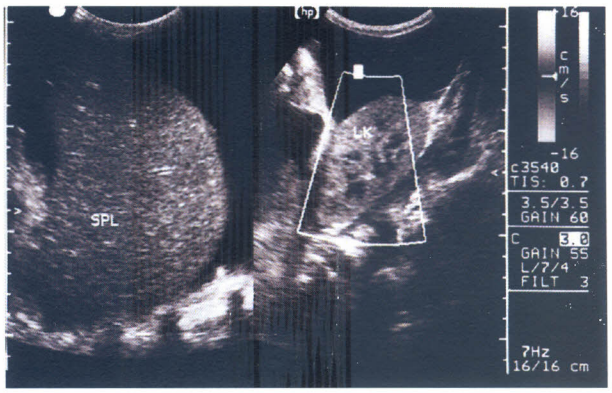


Illustration 16: Type 1 kidney change with ascites and normal spleen. A young patient presented with abdominal discomfort and distension.

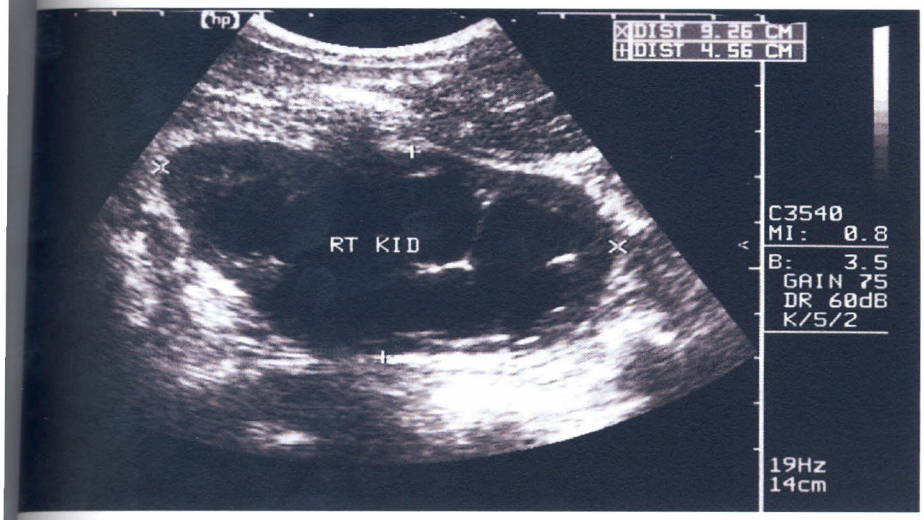


Illustration 17: Hydronephrotic right kidney. Patient with history of recurrent urinary infection and right kidney flank pain.

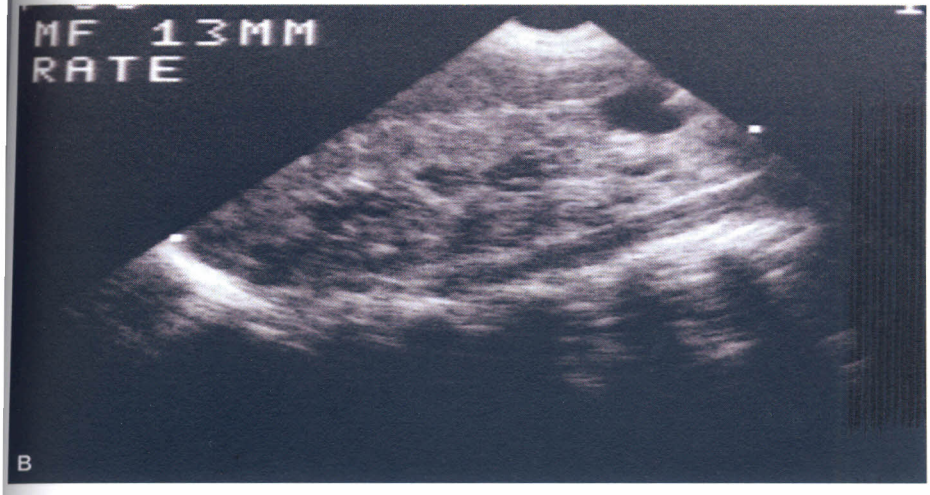


Illustration 18: Autosomal recessive polycystic kidney disease showing increased cortical and medullary echogenicity.

DISCUSSION

In this study of 273 HIV infected patients, an attempt has been made to determine the pattern of upper abdominal findings at sonography and to correlate these with clinical presentations. All the 273 patients examined were referred by clinicians from the wards, clinics and casualty departments of Kenyatta National Hospital (K.N.H) and Armed Forces Memorial Hospital (Table 1). Because the government of Kenya has been at the fore front of the fight against HIV/AIDS, several specialized HIV/AIDS clinics have been set up predominantly in urban centers and in particular Nairobi. This explains the fact that most of the patients studied were from clinics (55.3%). Very few cases were, however received from casualty, as the very sick patients were either in the wards and the ambulant ones attended clinics instead.

The gender distribution patterns (Table 2) show that there are roughly an equal number of male and female cases. This ratio is consistent with that found by the national HIV/AIDS surveillance study in Kenya [6].

About 68.8% of the patients that underwent the study (Table 1) were between the ages of 15 and 45. Since this is the most economically productive part of the population, the illness and deaths arising there from constitute an important economic burden. This as well is the age when investments in education are just beginning to pay off and also when these patients are raising young children. The peak age group of patients in this study is 36-45 as opposed to a relatively lower one of 30-34 found in the national HIV/AIDS surveillance [6]. A significant number of children (16.8%) in the (0-14) age group were also studied. Most of these are likely to have been victims of vertical transmission of the virus from mother to child and those of them who survived to reach puberty was possibly due to a combination of good healthcare and sufficient nutrition.

Upper abdominal findings at ultrasound

The most common findings were intra abdominal lymphadenopathy and ascites. Lymphadenopathy was further classified as follows: (*illustrations 2, 9, 10*)

(1) Para-aortic – (42.9%)
(2) Mesenteric – (23.5%)
(3) Porta hepatic – (13.7%)

Ascites was documented in 70 (25.6%) of the patients. At ultrasound, the lymph nodes were predominantly large, well defined and hypoechoic. Large para-caval nodes showed a tendency to compress and distort the inferior vena cava thus reducing its lumen significantly. The para-aortic nodes in a few instances caused marked elevation and distortion of the overlying pancreas

In HIV infected individuals, studies have shown that intra-abdominal lymphadenopathy and ascites are a common occurrence with variable and multiple aetiologies. One study documented intraabdominal lymphadenopathy of 31% and ascites in 22% of the study population. [35]

These findings compare reasonably well with the findings of this study. This similarity is likely due the fact the two study populations have comparable behavioral patterns and immunological response to disease processes. The health service system and the type of imaging facilities are available could be possible contributors to the similarity in these findings.

In our set up, pulmonary tuberculous infection is a common opportunistic infection and in some instances, widespread dissemination does occur.

Thus tuberculous peritonitis (TBP) is often suspected whenever a patient with pulmonary disease develops non-specific abdominal symptomatology. The results of this study reveal that 47 (69.1%) out of the 68 patients suspected to have tuberculous peritonitis

exhibited enlarged para aortic lymphnodes while 33(48.52%) showed ascites at sonography.

Tuberculous peritonitis (TBP) at ultrasound shows features of loculated ascites with septations (*illustration12*), thickening of peritoneum, mesentery and omentum as well as para-aortic/ paracaval, mesenteric and porta hepatic adenopathy. Tuberculous infection involving the omental surface and the peritoneum initiates an exudative inflammatory process. This results in the formation of predominantly exudative and cellular ascites hence the propensity to form *loculations and septations seen at imaging. CT – scanning* does, otherwise delineate these features better than ultrasound. Dynamic contrast CT – scans show enlarged lymph nodes with a central area of hypo density and characteristic peripheral enhancement. Identical appearances are, however, seen in infections with other organisms such as Cryptococcus, Histoplasma capsulatum, Pneumocystis carinii, Mycobacterium avium complex and AIDS related neoplasms but these are much less frequent than M.tuberculous peritonitis. Microscopy and culture of organisms/samples form blood, tissues, faeces, bone marrow are therefore required for confirmation of diagnosis. [48,57,58,59]

Liver findings

In this study, 32 patients (32.32%) of sonographically diagnosed liver conditions had hepatomegally. One study reported hepatomegally in 35% of the cases in a study involving 900 HIV infected individuals.[35] These findings compared reasonably well with this study thus implying that hepatomegally is a common phenomenon in this group of afflicted patients. The sensitivity of ultrasound in picking hepatomegally was over 100% as only 17 cases were clinically diagnosed with hepatomegally. However, it was possible to establish some of the causes of liver enlargement such as diffuse fatty infiltration based on ultrasonic features. Six (15%)

cases that had characteristic features of diffuse fatty liver as well as 42.9% of those who had ill defined liver infiltrates (metastasis/infiltrates) had hepatomegally.

Fatty infiltration of the liver is characterized pathologically by intracellular deposition of triglycerides within the hepatocytes. This is a common condition in North America, and usually due to obesity. Other frequent causes include alcohol abuse, steroid use, diabetes mellitus, malnutrition, and total parenteral nutrition, toxins such as carbon tetrachloride, HIV infection and anti-retroviral drugs.

Fatty liver infiltration can be focal or diffuse. Focal fatty liver infiltration appears at sonography as ill defined hyperechoic areas with no mass effect. Most often fatty liver infiltration manifest in diffuse form and results in uniformly increased parenchymal echogenicity (*illustration5*). This is often accompanied by diffuse liver enlargement with rounding of the edges but in this study only 15% of those who were diagnosed to have fatty liver had hepatomegally. Forty (40.4%) patients of those who showed liver pathologies at sonography had features of fatty liver despite the fact that none of them had a clinical diagnosis of fatty liver. Its aetiology is likely multifactorial. Malnutrition and antiretroviral drugs being the most probable culprits. A study carried out at K.N.H concluded that fatty liver is a rare occurrence as only 0.5% of those found with liver pathologies at sonography had the condition [34]. This study, however, reveals that fatty liver is a relatively common phenomenon in HIV- infected individuals.

Suspected metastatic disease as a specific reason for request of liver sonography accounted for 30.86% (25 cases). At sonography, 28 patients were found to have non-specific ill defined infiltrative liver lesions which were referred to in this study as Metastatic disease/ infiltrates. Most of these lesions had variable sonographic patterns but were predominantly multiple and hypoechoic. The classical text book descriptions of bull's eye appearance or target

lesions were, however, not visualized. These appearances could have been due to any infiltrative liver pathology be it metastatic disease, primary tumor or disseminated opportunistic infections. The leading fact to the most appropriate sonographic diagnosis was clinical information on the presence of primary malignancy prior to scanning. In this study, "four" patients had histologically confirmed carcinoma of the cervix (cacx) and non-Hodgkin's lymphoma while another "eight" had Kaposi's sarcoma. Ultrasonography was therefore used as screening procedure for metastatic disease as primary malignancy had already been identified. Hepatomegally was demonstrated in 42.9% of these patients. However, sonographic findings per se cannot confidently differentiate between metastatic disease and infective hepatic infiltrates, hence the need for histological diagnosis.

Liver cirrhosis

In this study, only "six" cases, (6.1%) of those patients with liver pathology at sonography had features of liver cirrhosis. Two patients had features of macro nodular cirrhosis often associated with chronic viral infection (HBV). Multiple widespread hypoechoic nodules with associated distortion of liver architecture and shrunken size were demonstrated in two cases. More often than not, these features are also seen in hepatic abscesses and liver necrosis. (*Illustration 3*).The remaining four cases had features of micro nodular cirrhosis characterized by coarsening of the liver texture and homogeneously increased inter parenchymal echogenicity. Nodular surface, shrunken liver with round edge was also seen. In this study, the over all pick up rate of cirrhosis at sonography as six cases were diagnosed as opposed to two cases that were suspected clinically.

Cirrhosis is caused by hapatocellular death resulting in fibrosis and regeneration. It most commonly occurs due to alcohol abuse which causes micro nodular changes (less than 1cm in diameter) and viral hepatitis which leads to macro nodular pattern. Surface nodularity can easily be detected sonographically in the presence of ascites and is a reliable sign of cirrhosis. Cirrhosis per se is an uncommon finding in HIV patients unless there is a pre-existing predisposing pathology.

Liver abscess/masses

The diagnosis of liver abscess was made sonographically in 2 cases (6.1%) of those who had liver pathologies. Ultrasonography showed well defined, thick walled hypoechoic lesions in the right lobes of the liver in both cases. Ultrasound guided aspiration and subsequent microbiologic analysis confirmed a diagnosis of amoebic liver abscess in both cases. In a number of case reports, similar hypoechoic intrahepatic lesions have been documented and ultrasound guided aspiration and subsequent microbiology has revealed M.tuberculous, MAC, amoebic and pyogenic infections as the common culprits. Tuberculous, pyogenic and amoebic abscesses as well as a lymphoma may not be differentiated with ease by ultrasound. Histological or microbiological analysis is therefore often required to make an aetiological diagnosis. In most cases, the clinical information of right upper quadrant pain, fever, and tenderness is useful in differentiating an abscess from a malignant, primary or metastatic neoplasm [57]. Suffice it to say that there was no clinical requirement for sonography of the liver due to suspected liver abscess.

One left liver lobe mass was shown in the study. Given its ill defined borders and solitary nature, a conclusion of a possible primary liver malignancy was made. However, no histological diagnosis was achieved as biopsy was not performed. This may have

been a lymphoma or hapatocellular carcinoma (HCC). A case report of hapatocellular carcinoma in a patient with HIV and hepatitis B virus coinfection has been documented. [58]

Hapatocellular carcinoma (HCC) is a highly malignant tumor, and hepatitis B virus (HBV) chronic carriers have a 100 to 233 fold increased risk of developing HCC. Although there is clear evidence that HCC occurs after a shorter period of hepatitis C virus (HIV) infection and at a younger age in HCV/HIV co-infected patients, there is paucity of information on HBV/HIV co-infection as it relates to HCC. Infections with Hepatitis B virus (HBV) and HIV have similar risk factors and routes of transmission. It is estimated that 64-84% of HIV infected individuals have positive markers for anti-HBC antibodies, with the chronic HBV Infection rate approaching 16% [58]. Chronic hepatitis B virus infection (HBV) often leads to liver cirrhosis. Thus sonographically the liver exhibits uneven surface with inhomogeneous parenchymal echotexture and irregular edges (margins). Primary carcinoma usually develops as one large dominant mass with variable echogenicty and may not be easily differentiated from metastatic disease or an abscess.

Hepatitis

In this study, 25 cases (9.16%) were suspected clinically to have hepatitis, but there was not even a single ultrasonic diagnosis of hepatitis. This clinical-ultrasonic discordance is due to unavailability of characteristic ultrasonic diagnostic features for hepatitis. Thus the diagnosis of hepatitis depends predominantly on clinical history, physical examination and serology; imaging plays a minimal non-specific role.

With the rapid decline of traditional opportunistic infections and increasing life expectancy of HIV-infected persons treated with HAART, the contribution of Hepatitis B and C co-infection is

becoming increasingly recognized. The majority of persons with HIV have evidence of HBV exposure as discussed above [60].

For HCV, only 15 to 20% of patients ever clear their infection and the major determinant of co-infection rate is the mode of acquisition (≥ 80% for haemophiliacs, 70 to 80 for injection drug users, 10 to 15% for homosexuals and 3 to 5% for heterosexuals). For HBV co-infection, the immunosupression seen in more advanced disease affords some protection, as hepatic damage is immune mediated. Patients with HCV co-infection have a higher HCV viral load, accelerated natural progression to cirrhosis (5 to 8 years after infection) and an increased risk of complications [42,60].

Gallbladder and biliary system

Specific clinical indications for gallbladder ultrasonography were only eight (2.9%). Six cases (2.2%) were suspected to have acute cholecystitis while the remaining two cases (0.7%) were thought to have chronic cholecystitis. At sonography, 77.7% of patients had normal gallbladder findings while only 22.34% had features of gallbladder disease (Figure 2). A large study of 900 HIV infected individuals revealed biliary tract abnormalities in 25% of the cases.

Gallbladder sludge was the most common findings (75.41%) in these patients who had sonographically identifiable gall bladder anomalies. Sludge is common in bed ridden patients and those on hyperalimentation. In these patients, the gallbladder does not adequately contract due to inadequate stimulation hence leading to prolonged periods of bile stasis and sludge formation. At sonography, sludge appears as relatively hyperechoic layer with sonolucent bile above, and is mostly seen in the most dependent part of the gall bladder. It however, does not show posterior acoustic shadows as opposed to gallstones.

Gallstones on the other hand appear as mobile echogenic intraluminal structures with attendant posterior acoustic shadow.

(*Illustrations 7-8*). The main differential consideration of gallstone is a polyp (soft tissue structure) adherent to the gallbladder wall but does not show posterior acoustic shadow.

Out of eight cases clinically suspected to have cholecystitis four had sonographic features consistent with chronic cholecystitis. In these patients, the gallbladders were contracted, thick walled, and never distended despite adequate fasting. Two of the cases had gallstones which showed the characteristic posterior acoustic shadows. None of the patients however had sonographic features characteristic of a cute cholecystitis.

Grossly dilated gallbladder, common bile duct (CBD) and intrahepatic ducts were present in three patients all of whom turned out to have a mass in the region of the head of the pancreas. Features of acute cholecystitis such as thickened gallbladder walls, sonographic Murphy's sign, gallstones and pericholecystic fluid collections were absent in all the cases. Abdominal CT scanning was otherwise recommended for further evaluation of those patients.

In HIV infected patients, HIV associated cholangiopathy is a frequent complication of opportunistic infections by Cryptosporidium and Cytomegalovirus (CMV). Quite often at sonography, the liver, intrahepatic and extra hepatic ducts are unremarkable and no evidence of gallbladder wall thickening or pericholecystic fluid may be apparent. In such cases, computerized tomography (CT) scanning may reveal intrahepatic biliary duct dilatation and minimal gallbladder wall thickening. Endoscopic Retrograde Cholangiopancreatography (ERCP) is otherwise superior to the other imaging modalities in such cases as it reveals clearly the characteristic features of sclerosing cholangitis such as diffuse biliary strictures, focal dilatations, and mucosal irregularity consistent with HIV associated cholangiopathy [61].

This study shows that it is challenge to clinically make a diagnosis of gallstone disease, sludge, and dilated biliary ducts. Thus

sonography assumes an important screening role in evaluation of the gallbladder and biliary system. However, as discussed above ERCP and not sonography is the appropriate imaging modality for the diagnosis of HIV associated cholangiopathy. Ultrasonography is otherwise the preferred method of investigation of gall bladder disease even in obese patients.

Pancreatic abnormalities

Only three cases (1.10%) were clinically suspected to have acute pancreatitis while one case (0.37%) presented with non-specific midline upper abdominal pain thought to be of pancreatic origin. At sonography, the pancreas in the four cases exhibited homogeneous echotexture with smooth regular outlines with no evidence of pancreatic pathology. A case report of primary HIV infection presenting as acute pancreatitis has been documented. Sonography revealed markedly enlarged pancreas with decreased parenchymal echogenicity. [62]

Incidental pancreatic findings were noted in four cases (1.47%); with three (1.10%) exhibiting sonographic characteristics of complex cysts and one appeared as an ill defined hypoechoic mass. All were found within the body of the pancreas. In a review of 17 cases with pancreatic tuberculosis, four patients were found to be infected with HIV. In the subsequent literature review, it was concluded that extra pulmonary tuberculosis is common in persons with HIV disease, and pancreatic tuberculosis should be considered in the differential diagnosis of a person with HIV infection and pancreatic mass.[43] In contradistinction from those with bacterial infection, these patients had no features of acute pancreatitis.

Three other patients who had solid masses within the head of the pancreas had actually been referred for sonography due to suspected surgical jaundice. In these cases, concurrent dilated common bile duct, gallbladder and intrahepatic ducts were found at

sonography. A conclusion of distal common bile duct obstruction by pancreatic mass was made and further evaluation by dynamic contrast CT study was recommended.

Acute pancreatitis is an acute inflammatory process of the pancreas with variable involvement of the regional tissues and remote organ systems. The normal pancreas has only a poorly developed capsule and adjacent structures, including common bile duct; duodenum, splenic vein, and transverse colon are commonly involved in the inflammatory process. Common causes of acute pancreatitis are gallstones, alcohol, idiopathic and post – ERCP.[62]

It is known that HIV infection can present in a variety of ways. Although acute HIV infection may be a symptomatic, some cases have been reported of primary HIV infection manifesting as acute pancreatitis [60]. Acute HIV infection may be mild, with minimal organ dysfunction and uneventful recovery. Alternatively it may be severe and associated with focal complications such as necrosis, pseudo cyst or abscess. The diagnosis of acute pancreatitis is based upon clinical evaluation, elevation of serum amylase or lipase concentration and ultrasound or CT evidence of pancreatic swelling. Ultrasound confirms the diagnosis, although in early stages the gland may exhibit normal sonographic features. The ultrasound may also show gallstones, biliary obstruction or pseudo cyst formation.Contrast dynamic CT scanning is the imaging modality of choice in evaluation of the viability of the pancreas as necrotizing pancreatitis is associated with decreased enhancement. The presence of gas within the pancreas, involvement of colon, blood vessels and other adjacent structures by the inflammatory process is best evaluated by CT scanning [62].

In general, there was paucity of specific clinical indications for ultrasonic examination of the pancreas per se. Besides the cases of suspected obstructive jaundice where pancreatic masses were identified, there was total clinical and imaging discordance as the

results shows. Finally ultrasound guided FNAC would have been useful for definitive diagnosis of these masses to be made.

The spleen

In the study group, only 18 cases (6.6%) had specific clinical indications for imaging of the spleen. And in all these cases the working diagnosis was splenomegaly. At sonography, the spleen exhibited normal size, shape, position and homogeneous echogenicity in 79.9% of the patients. One patient however, had previous post traumatic splenectomy. For the remaining 20.15% of the patients, various findings were documented (Table 8).

Splenic findings at sonography were-

(1) Enlarged spleen (splenomegaly)
(2) Splenic infiltrates/metastatic disease.
(3) Solid mass (1 case).

Splenomegaly

Splenomegaly was the most common splenic finding observed at ultrasound with a total 94.54% of all who had splenic abnormalities (Table 8). Amongst those patients who had splenomegaly, 17 (32.3%) revealed ill defined splenic infiltrates while the remaining 35 (67.7%) showed homogeneously enlarged spleens. It was, however, not possible to determine the exact aetiology of splenic enlargement at sonography. (*Illustration 14*). Several studies reported splenomegaly with one study giving 35% in a study involving 900 HIV infected patients.

The measurement of splenic size in detection of splenomegaly has been subject of many a research and debates and a number of methods have been proposed. At Kenyatta National Hospital (K.N.H) and the Department of Diagnostic Radiology University of Nairobi the criteria for documenting splenic enlargement is still emotive, subjective and controversial. For the purposes of this study, the documented upper limit of the splenic long axis of 12.5cm has been

used [27,28]. Any spleen which had long axis more than 12.5cm was therefore deemed to be enlarged.

The causes of splenomegaly are legion, and in a tropical country like Kenya the aetiology could be infective, parasitic infestation, haemotological or even myeloproliferative. Thus a combination of clinical evaluation, laboratory analysis, imaging and histological evaluation are needed to make a definitive diagnosis.

Splenic infiltrates/metastatic disease

Twenty one patients (38.2%) of those who had splenic lesions at sonography were classified for the purposes of this study as having splenic infiltrates and or metastatic disease. This is because these lesions were ill-defined, multiple, hypoechoic and nonspecific for a particular infective process or neoplastic disease. Seventeen (80.9%) patients amongst those who had splenic infiltrates were found with splenomegaly (long axis of spleen above 12.5cm).

Disseminated opportunistic infections, be they fungal, viral, protozoan or bacterial tend to involve the spleen especially in HIV-infected individuals, unfortunately, they exhibit similar nonspecific sonographic features as already described. AIDS related neoplasms, Kaposi's sarcoma and non-Hodgkin's lymphoma, also give similar sonographic presentation though a solitary mass may be seen.[63] Note has been made of the fact that clinically no request was made for sonographic evaluation for metastatic disease despite the patients having been confirmed to have primary malignancies elsewhere in the body. In spite of all these sonographic features, it is still not possible to make an aetiologic diagnosis without laboratory and histological work up.

Kidneys

In this study of 273 patients, only 8.8% had specific requests for evaluation of renal ultrasound (Table-4). Requests for ultrasonic

evaluation of the kidneys because of renal failure made the bulk of these cases and accounted for 66.67%. The results of this study reveal that in adults the bipolar length was 10.58cm ± 1.28 and that there was no significant difference in length between the right and the left kidneys. For children under the age of 12 years, the bipolar length averaged 7.69cm ± 1.73. These figures compare well with those found in studies carried out elsewhere involving normal subjects [36, 49]. Thus kidney lengths in this study group remained generally within normal limits.

A total of 113 (93.39%) out of 121 patients who had renal pathologies at sonography exhibited increased renal parenchymal echogenicity. Type I renal change accounted for 55 (48.67%) of the cases while 58 (51.33%) had characteristic features of type II renal change as described bellow. Sixteen (5.90%) patients were confirmed cases of chronic renal failure and all showed sonographic features of type II renal change. Thus sonography picked up 97 (35.53%) cases that had renal parenchymal changes with no clinical suspicion of HIVAN. Tables 6/7 (*Illustration 16*). Hydronephrosis was seen in 4 cases at ultrasound yet clinically on two cases had been suspected. It should otherwise be noted that it is difficult to clinically make a diagnosis of hydronephrosis unless there is overt and prolonged lower urinary tract obstruction leading to large hydronephrotic kidneys palpable per abdomen. (*Illustration 17*)

One suspected case of right renal mass turned out at sonography to be a massive hydronephrosis. Three other patients however had ill defined hypoechoic masses in their upper poles. At ultrasound the aetiology could not be delineated and they could as well have been due to infective process metastatic infiltrates (rare) or primary malignancy.

The presence of close relationship between kidney sizes and function has been demonstrated in a number of studies. It has been shown by authors that bipolar kidney length is an accurate indication of

kidney weight and volume, as well as its functional state. That is why longitudinal axis of the kidney is used as a parameter during clinical examinations [49]. The measurement of kidney length by ultrasound is a non-invasive and easy technique. Studies have shown that kidney size varies with age, weight and height of an individual. Those parameters were however not of interest in this study [49].

Generally the linear growth and height are influenced directly by nutrition and generic factors. This therefore suggests that in different populations with different nutritional habits and generic backgrounds the kidney sizes are dissimilar [49].

It has been reported that kidney length (bipolar) lies between 83mm and 113mm in Indian Donors. Using ultrasonography, Ninan et al found kidney lengths to lie within 95.2± 6.2mm in normal population [64]. Other studies found the adult kidney length to vary between 9-12cm, width 4-6cm and thickness approximately 3.5cm. However, there was no significant difference between right and left kidney length and / or width.

HIV associated nephropathy- (HIVAN)

The spectrum of kidney disease among HIV infected patients is extensive. Acute renal failure (ARF) in patients with HIV occurs in general for the same reasons as in patients without the viral infection. Cases of chronic renal failure in patients with HIV generally termed the HIV associated nephropathies (HIVAN) are largely due to focal glomerulosclerosis, immune complex disease, or thrombotic micro-angiopathies. However, the pathogenesis of HIVAN is not well understood. There are conflicting data regarding the presence and role of direct viral infection of renal parenchymal cells. Since this condition is particularly common in men of African descent, and given the racial predilection of the disease, one plausible host factor would be genetic predisposition.[52,53,54,65]

Different studies report large echogenic kidneys and pelvicaliceal thickening on ultrasound. This study however reveals that almost all the kidneys which exhibited different stages of parenchymal changes had bipolar lengths within the normal reference limits. This finding implies that either, black Africans (Kenyans) have relatively small kidneys that despite enlargement still fall within the standard documented normal limits or there is no significant increase in size of the kidneys despite the parenchymal changes. Generalized change in renal echogenicity conforms to two patterns. There may be increased echogenicity of the cortex with normal echodensity of the medullary pyramids and thus enhancement of the cortico-medullary differentiation or increases echogenicity of both cortex and the medulla with loss of cortico-medullary differentiation. The above features are otherwise referred to as Type I and Type II renal changes respectively. Type I is seen in early HIVAN and rapidly progresses to Type II which is a more advanced stage of the disease. Numerous disease processes can produce similar renal changes; there is usually little or nothing on the ultrasound image to indicate one disease from the other, the diagnosis being inferred from the clinical setting and in other cases being made by renal biopsy.[54,65,66,67]

Other abdominal findings at ultrasound

Nine (3.3%) patients were sonographically diagnosed to have intra-abdominal abscesses of these six (2.2%) had psoas abscesses (five bilateral and one unilateral). Subsequent contrast abdominal CT scans revealed characteristic features of TB- spine and concomitant psoas abscesses.

Two of the remaining three cases had superficial anterior midline abscesses confirmed by needle aspiration. The third patient had a suspected appendicular abscess and was started on appropriate antibiotics.

Solid non-specific intra-abdominal masses were demonstrated in six (2.2%) patients two of whom had large masses extending from the pelvis to the epigastrium. These were thought to be large uterine myomas. Two other patients had ill defined, solid epigastric masses whose organs of origin were not elucidated at sonography. Finally, one case had an ill defined mass adherent to the anterior abdominal wall. The case was sent for FNAC but cytological results were not received.

Ultrasound is a useful screening technology; however dynamic contrast CT – scanning is superior in evaluation of retroperitoneal and mesenteric disorders. Guided percutaneous aspiration or biopsies usually provide appropriate samples for establishing the aetiologic diagnosis.

CD4 counts and correlations

CD4 cell counts of 96 (35.2%) patients in this study were known. The mean CD4 cell count was 212 cells/µl with the lowest count being 2.0 cells/µl and the highest 755 cells/µl. The highest CD4 cell count in this study group still fell short of the range of normal value that lies between 800-1200 cells/µl. Fifty five (57.30%) of these individuals had CD4 count values of below 200 cells/µl hence by definition they had acquired the status of full blown AIDS. (Table 11).

Correlation between CD4 counts and ultrasonic features of the kidneys showed that low CD4 counts is associated with characteristic features of parenchymal renal change. The majority (84%) of patients whose CD4 counts were below 100 cells/µl showed features of increased renal parenchymal echogenicity. The changes were either isolated increased cortical echogenicity with accentuation of cortico-medullary differentiation (Type I change) or global increase in renal parenchymal echogenicity with loss of cortico-medullary differentiation (Type II change). As the CD4 counts increased, the

renal changes became less pronounced. A small number (8.70%) of patients with CD4 counts above 301 cells/µl had features of renal parenchymal change. A number of studies have shown an association between CD4 cell count levels and renal parenchymal changes. In a study involving 44 patients, CD4 cell counts less than 100 cells/µl were found to be associated with high incidence of severe chronic interstitial renal changes and nephrotic range proteinuria as well as increased risk of mortality. [54] A similar trend was observed when CD4 count was compared with the presence of ascites at sonography. Almost half (46.9%) of the patients with CD4cell counts less or equal to 100cells/µl were found to have ascites where as only 4.3% of patients with CD4 cell counts more or equal to 301cells/µl had ascites. There was however no significant statistical differences between CD4 levels and age or gender of the patient.

There are two major targets for HIV, the immune system and the central nervous system (CNS). CD4-receptors are found on the surface of lymphocytes, monocytes, macrophage, follicular dendritic *cells and macroglial cells in the central nervous systems.*

Profound immunodeficiency, primarily affecting cell mediated immunity is the hallmark of AIDS. This results from severe loss of CD4 + T cells as well as impairment in the function of surviving T-helper cells. With time, there is gradual attrition of the CD4cell population and inversion of CD4-CD8 ratio in the peripheral blood resulting in increasing impairment of cell mediated immunity with consequent susceptibility to opportunistic infections. This underlies the pathogenesis of clinical disease (21, 23). Normal CD4 cell count in normal, healthy individuals range from 800 to 1200 cells/µl. When the CD4 cell count drop below 200 cells/µl, those HIV infected individuals are classified as having developed AIDS and are highly susceptible to opportunistic infections and AIDS related neoplasms which eventually lead to death (21- 23).

This study reveals that even with this small sample size of patients, low CD4 levels are directly related to renal change. However, a comprehensive and a large study should be conducted at Kenyatta National Hospital and the University of Nairobi to specifically study renal changes as it relates to CD4 cell counts and to provide baseline imaging criteria for diagnostic purposes.

CONCLUSION

The following conclusions were drawn from the study:-

(1) The most common non-specific indication for abdominal sonography is right upper abdominal pain, followed by pyrexia of unknown origin.

(2) At sonography, para-aortic lymphadenopathy accounted for the majority of non-specific abdominal findings. Mesenteric and porta hepatis lymphadenopathy as well as ascites also contributed significantly to the non-specific sonographic findings.

(3) The clinical suspicion of tuberculous peritonitis correlated well with the ultrasonic findings of para-aortic/mesenteric lymphadenopathy and ascites.

(4) The predominant indication for liver ultrasonography is suspected hepatitis followed by hepatomegally and suspected hepatic infiltrates and or metastatic disease. However, common liver pathologies diagnosed at ultrasound were hepatic steatosis and infiltrates and or metastatic disease

(5) At sonography a significant number of patients were found to have renal pathologies despite paucity of requests. The majority of these cases exhibited increased renal parenchymal change.

(6) Gender distribution is almost equal. The mean age of the study group is 32 years with a wide variation in age distribution. The age group 15-45 years accounted for the majority of the patients studied.

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RECOMMENDATIONS

i. Ultrasound should be the first line of investigation in suspected abdominal pathologies in HIV infected individuals.

ii. Sonographers should be familiar with most common abdominal conditions in HIV infected patients and thus maintain high index of suspicion throughout the procedure.

iii. Large studies are required to be done, especially in normal individuals to build up our local baseline parameters so that we may talk of hepatomegally, splenomegaly, large kidneys, in reference to our own population.

iv. Finally, further studies are required to correlate sonopathological findings.

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APPENDIX I

Date:_____

Personal Data

(i) Hospital No:..... (ii) X-Ray No:.....

(iii) Age..... (iv) Sex.....

(v) Source: (a) Ward..... (b) Clinic.....(c) Casualty.....

Clinical Diagnosis / Indications for Upper Abdominal Sonography

A) For General Abdominal (Non-specified)

- □ Right upper quadrant pain
- □ Intra abdominal adenopathy
- □ Abdominal mass
- □ Pyrexia of unknown origin
- □ *General abdominal pain*
- □ Ascites □ Jaundice
- □ Others_____

B) Indications per organ

Liver

- □ Hepatitis □ Hepatic abscess
- □ Metastasis □ Cirrhosis
- □ Hepatomegally □ Tumor (Hepatomas)
- □ Others_____

Pancreas

- □ Pancreatic carcinoma □ Acute pancreatitis
- □ Mid line upper abdominal pain
- □ Chronic pancreatitis
- □ Others_____

Kidneys

- □ Renal Mass □ Acute renal failure
- □ Hydronephrosis □ Acute Pyelonephritis
- □ *Chronic Pyelonephritis* □ *Metastatic disease*
- □ *Recurrent urinary tract infections*
- □ Others_____

Adrenals

- □ Hypertension
- □ Others_____

Spleen

- □ Splenomegaly □ Metastatic disease/infiltrates
- □ Portal hypertension
- □ Splenic Abscess

Gall Bladder

- □ Acute cholecystitis □ Medical jaundice
- □ Chronic cholecystitis □ Tumor
- □ Surgical jaundice

APPENDIX II

Ultra sound findings / diagnosis

I. (i) Hospital No :.....(ii)X-Ray No:.....

(iii) CD4 Count.....

II. **Ultra sound findings**

A. Abdominal (General) findings

- □ Solid abdominal mass □ Normal abdomen
- □ Para aortic lymphadenopathy
- □ Mesenteric adenopathy
- □ Porta hepatis adenopathy
- □ Abdominal abscess
- □ Ascites
- □ Others_____

III. **Ultra sound findings per organ**

Liver

- □ Normal □ Abscess (Hepatic)
- □ Cirrhosis □ Tumor (Solid)
- □ Metastatic disease / infiltrates
- □ Dilated intrahepatic ducts
- □ Hepatomegally □ Fatty Liver
- □ Others_____

Pancreas

- □ Normal □ Acute Pancreatic
- □ Chronic Pancreatic
- □ Solid tumor □ Pancreatic cyst
- □ Others_____

Kidney

- □ Normal □ Hydronephrosis
- □ Renal mass □ Renal cyst
- □ Increased parenchymal echogenicity (Type I)
- □ Increased parenchymal echogenicity (Type II)
- □ Renal stones □ Polycystic kidney
- □ Perinephric abscess
- □ Others_____

Adrenal

- □ Normal □ Adrenal mass
- □ Haemorrhage

Spleen

- □ Normal □ Metastatic disease /infiltrates
- □ Splenic mass □ Splenomegaly

□ Others_____

Gall Bladder and Biliary System

□ Gallstones □ Normal
□ Acute cholecystitis □ Tumor
□ Chronic cholecystitis
□ Normal CBD (Common Bile Duct)
□ Sludge □ Dilated Gall Bladder
□ Dilated Common Bile Duct (>9mm in diameter)
□ Others_____