Open Journal of Radiology, 2014, 4, 201-206
Published Online June 2014 in SciRes. http://www.scirp.org/journal/ojrad
http://dx.doi.org/10.4236/ojrad.2014.42027

Scientific Research

Assessment of Visceral Leishmaniasis Consequences Using Ultrasound

Mustafa Z. Mahmoud[1,2]

[1]Radiology and Medical Imaging Department, College of Applied Medical Sciences, Salman bin Abdulaziz University, Al-Kharj, KSA
[2]Basic Sciences Department, College of Medical Radiological Sciences, Sudan University of Science and Technology, Khartoum, Sudan
Email: m.alhassen@sau.edu.sa

Received 27 April 2014; revised 22 May 2014; accepted 29 May 2014

Abstract

Background and Aim: Visceral leishmaniasis (VL), also known as kala azar, is a parasitic disease that caused by infection with Leishmania parasites, which are spread by the bite of phlebotomine sand flies. An ultrasound examination is strongly advocated for the promote diagnosis and treatment of VL for long term follow up and evaluation of unresponsive cases. The aim of this study was to assess the consequences of VL in the liver, spleen and pancreas of affected participants by using ultrasound. Materials and Methods: A prospective cohort study was conducted in the period of January 2012 to March 2014 in the ultrasound department of Tropical Disease Hospital (TDH) in Khartoum-Sudan, among a group of 100 participants (84% males, 16% females and their ages ranges from 15 to 45 years) positive to VL and had been diagnosed by laboratory tests; either serological or Napier's Aldehyde test. The Aloka portable ultrasound machine equipped with 3.5 MHz convex probe was used for abdominal ultrasound scanning. Standard Statistical Package for the Social Sciences (SPSS) was used to analyze the results. Results: The commonest ultrasound findings in VL participants were hepatomegaly (100%), splenomegaly (100%) and ascites (50%). Other complications such as lymphadenopathy (35%), focal splenic lesions (34%), dilated portal vein (7%) and shrinkage liver (4%) were detected. Conclusion: Ultrasound scanning presents an effective role in VL, because of its ability to detect the consequences of this disease in various abdominal organs such as liver, spleen and pancreas earlier, which in turn allowing the possibility to treat these complications and prevents the deterioration of a patient's health status.

Keywords

Napier's Aldehyde Test, Ultrasound, Serological Tests, Visceral Leishmaniasis

How to cite this paper: Mahmoud, M.Z. (2014) Assessment of Visceral Leishmaniasis Consequences Using Ultrasound. *Open Journal of Radiology*, **4**, 201-206. http://dx.doi.org/10.4236/ojrad.2014.42027

1. Introduction

Visceral leishmaniasis (VL), known as kala azar in India, is the cause of much death and disease in developing countries. It is one of several diseases caused by over 20 species of Leishmania; it is transmitted by Sandfly bites [1]. The infection of humans appears with multiple clinical manifestations, including cutaneous (CL), mucocutaneous, diffuse and VL. The latter is responsible for approximately 59,000 deaths per year, a parasitic disease surpassed only by malaria [2] [3]. There are two types of VL, anthroponotic and zoonotic. Zoonotic VL (ZVL) is widespread and occurs in Latin America, Northern Africa, Southern Europe and in areas of the Middle East and Asia [2]-[4]. Two forms of leishmaniasis (VL and CL) present in Europe are caused by Leishmania infantum [4]. While cases of cutaneous leishmaniosis were reported in France, Italy and Spain, ZVL is endemic in all countries bordering the Mediterranean Sea [5].

Geographically, the distribution of leishmaniasis is limited by the distribution of its vector Sandfly species. The Sandfly vectors are mainly active during the night, and therefore the highest risk for contracting the infective stages of the parasite from Sandfly bites is between dusk and dawn [6]. The reservoirs of the pathogen can be several wild and domestic canid and rodent species, but domestic dogs are considered as the main reservoir of Leishmania infantum playing a key role as the source of human infection. Indeed, there is a clear association between a high rate of infection in dogs and an increased risk of human disease [2] [7].

VL is endemic in 62 countries, with a total of 200 million people at risk, an estimated 500,000 new cases each year worldwide, and 41,000 recorded deaths in the year 2000 [8] [9]. As is the case for other tropical diseases, epidemiological data are incomplete, and official figures are likely to underestimate grossly the real prevalence of the disease [10]. Both the number of recorded cases and the geographic areas affected have grown in the past two decades [11].

Delays and difficulty in diagnosis are common due to the long incubation period of the agent, nonspecific symptoms, and the difficulty of identifying the intracellular protozoa (Donovan bodies) in tissue aspirates. It is usually diagnosed by serology or bone marrow examination. Liver biopsy is rarely required for diagnosis [12]. The role of imaging techniques as diagnostic tools remains to be established in VL [13]. This study designed with an aim to assess the consequences of VL in the liver, spleen and pancreas of the affected participants by using ultrasound, which will contribute in the treatment of the disease in an early period, before the exacerbation of complications and the condition become difficult to control.

2. Materials and Methods

2.1. Selection and Description of Participants

This prospective cohort study was performed in the period of January 2012 to March 2014. Participants were scanned in the ultrasound department of Tropical Disease Hospital (TDH) in Khartoum-Sudan. Prior to participants scanning, a formal approval was obtained from Ethics and Scientific Committee of TDH and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and all subsequent revisions.

After the nature of the procedure was fully explained, informed consents were obtained from participants and the ultrasound department. Sudanese participants were included in this study, after they were diagnosed to be affected by VL on the basis of noninvasive laboratory tests, either immunodiagnostic (serological tests) or nonspecific serological tests (Napier's Aldehyde test). Participants were excluded if they were pregnant or breastfeeding, human immunity virus (HIV) positive, had a serious concurrent infection such as tuberculosis, bacterial pneumonia, malaria or if they had a granulocyte count <1 × 109/l, hemoglobin concentration <40 g/l, or platelet count <40 × 109/l.

2.2. Technical Information Identifies

Abdominal ultrasound scanning was performed using Aloka (SSD-500) portable ultrasound machine equipped with 3.5 MHz convex probe (serial number of 1028924YM7, manufactured date of February 2010 and made by the Yokogawa medical system, Ltd. 7 - 127 Asahigaoka 4-chome Hino-shi Tokyo, Japan). Printing facility issued through the ultrasound-digital graphic-printer (serial number of 3-619-GBI-01 made by Sony Corporation-Japan), 100 V; 1.5 A; and 50/60 Hz.

2.3. Abdominal Ultrasound Scanning Technique

Abdominal ultrasound scanning technique used was in accordance with the protocols established by the American Institute of Ultrasound in Medicine (AIUM) [14]. The examination of the liver should include long-axis and transverse views. The liver parenchyma should be evaluated for focal and/or diffuse abnormalities. If possible, the echogenicity of the liver should be compared with that of the right kidney [15]-[17]. Whenever possible, all portions of the pancreas -head, uncinate process, body, and tail-should be identified. Orally administered water may afford better visualization of the pancreas [18]-[20]. Representative views of the spleen in long-axis and transverse projections should be obtained. Splenic length measurement may be helpful in assessing enlargement. Echogenicity of the left kidney should be compared to splenic echogenicity when possible.

An attempt should be made to demonstrate the left hemi diaphragm and the adjacent pleural space [21] [22]. The potential benefits and risks of each examination should be considered. The ALARA (as low as reasonably achievable) principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times.

2.4. Statistical Analysis

Data were initially summarized as mean ± SD in a form of comparison tables. Statistical analysis was performed using the standard Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 15 for windows.

3. Results

Study population comprised 100 positive participants to VL (84% males and 16% females). Participants' ages ranged from 15 to 45 years; with a mean age of (29.8 ± 2.2) years (**Table 1**). Out of the scanned participants, a total of 34 subjects were in the age group (35 - 39) years, representatives (34%) of the population. The age group of (40 - 45) years was the smallest and representing only (6%) of the population (**Table 1**). The highest mean ± SD of ages was (43 ± 1.4) years and found in the age group 40 - 45 years, while the lowest mean ± SD of ages was (18 ± 1.4) years found in the age group 15 - 19 years (**Table 1**).

Regarding symptoms and signs of VL; abdominal distention was detected in (50%) of participants, while hepato-splenomegaly, weight loss and fever were present in (100%) of participants. Cough and diarrhoea were the least clinical features detected only in (2%) of participants for each (**Table 2**). Sonographically, hepatic complications of VL were hepatic lesions as hepatomegaly (100%), increased liver echogenicity (18%), dilated portal vein (7%), and shrinkage liver (4%) (**Table 3**).

In the Spleens of the affected participants, ultrasound detects features of splenomegaly (100%), hypoechoic spleen (19%), and focal splenic lesion (34%). While in pancreas, acute pancreatitis (2%) and decreased pancreatic echogenicity (1%) were the commonest sonographic findings (**Table 3**). Other complications of VL such as ascites (50%) and lymphadenopathy (35%) were also detected (**Table 3**).

4. Discussion

Kala azar is a protozoal infection common in developing countries; there are an estimated 500,000 new cases

Table 1. Distribution of participant's ages (years).

Age ranges (years)	Percentage (%)	Mean ± SD (years)
15 - 19	11	18 ± 1.4
20 - 24	19	23 ± 2.4
25 - 29	16	27 ± 2.7
30 - 34	14	33 ± 2.3
35 - 39	34	35 ± 3.1
40 - 45	6	43 ± 1.4
Total	100%	29.8 ± 2.2 years

Table 2. Distribution of symptoms and signs in VL participants.

Symptoms and Signs	Percentage (%)
Abdominal distention	50
Hepato-splenomegaly	100
Weight loss	100
Fever	100
Cough	2
Diarrhoea	2

Table 3. Ultrasound findings in the liver, spleen and pancrease of VL participants.

Ultrasound Findings in VL Participants			
Liver	Spleen	Pancreas	Others
Hepatomegaly (100%)	Splenomegaly (100%)	Acute pancreatitis (2%)	Ascites (50%)
Increased echogenicity (18%)	Hypoechoic spleen (19%)	Decreased echogenicity (1%)	Lymphadenopathy (35%)
Dilated portal vein (7%)	Focal splenic lesions (34%)	-	-
Shrinkage liver (4%)	-	-	-

every year and there were 41,000 recorded deaths in the year 2000 [23]. From the early 1900s, VL has been among the most important health problems in Sudan, particularly in the main endemic area in the eastern and central regions. Several major epidemics have occurred—in the Western Upper Nile province in southern Sudan, detected in 1988—and the most recent claiming over 100,000 lives [24].

Delay and difficulty in diagnosis are common, especially in the early stage of the disease, due to non-specific symptomatology and difficulty in demonstrating intracellular protozoa in tissue aspirates [25]. In this study there was a wild diversity in clinical patterns (**Table 2**) and this was caused because the pathogenicity depends mainly on parasite genotype versus host immungenetic profile [26].

Study results showed that abdominal ultrasound can detect the changes occur in organ size as well as to demonstrate the echo texture changes—hyper or hypo echogenicity—in case of VL complications in liver, spleen and pancreases (**Table 3**). Such findings were confirmed in another study of ultrasound findings in patients with VL, where their results showed that abdominal ultrasound can detect the changes in organ size in an appropriate manner as well as to demonstrate the echo texture changes as hyper or hypo echogenicity in case of inflammation as pancreatitis and renal inflammatory diseases resulted from VL [27].

Also ultrasound findings of hepatosplenomegaly, and abdominal lymphadenopathy secondary to VL had been reported when VL was diagnosed by ultrasound guided fine needle aspiration of an axillary node and when ultrasound is used to study changes occur in the organ parenchyma in VL participants [28] [29].

Abdominal ultrasound has the capability to diagnose VL and differentiating it from mimicking conditions, in complement with other laboratory tests. Delayed diagnosis due to a typical manifestation can lead to fatal outcome in patients. Instead of relying solely on the classical clinical features of visceral leishmaniasis, simple abdominal ultrasound examination can help to make an early diagnosis even in atypical cases, thereby reducing the mortality of visceral leishmaniasis. The use of ultrasound as a primary model in the diagnosis of patients with VL, and characterization of the signs and complications in Tropical Sudanese hospitals is enlightening.

This study is limited because the obtained results cannot be applied to the whole society in Sudan, because it was conducted only in Khartoum state rather than other states in Sudan.

5. Conclusion

In conclusion, ultrasound scanning presents to be an effective tool in the diagnosis of VL consequences because of its ability to detect these complications in various abdominal organs such as liver, spleen and pancreas, which

in turn allowing the possibility of prevent and treat related deterioration in the patient's health status.

Acknowledgements

The author would like to thank the staff of the ultrasound department at the Tropical Disease Hospital (TDH) for their cooperation and support during data collection.

References

[1] Desjeux, P. (1992) Human Leishmaniases: Epidemiology and Public Health Aspects. *World Health Statistics Quarterly*, **45**, 267-275.

[2] Collin, N., Gomes, R., Teixeira, C., Cheng, L., Laughinghouse, A., Ward, J.M., Elnaiem, D.E., Fischer, L., Valenzuela, J.G. and Kamhawi, S. (2009) Sand Fly Salivary Proteins Induce Strong Cellular Immunity in a Natural Reservoir of Visceral Leishmaniasis with Adverse Consequences for Leishmania. *PLOS Pathogens*, **5**, Article ID: e1000441. http://dx.doi.org/10.1371/journal.ppat.1000441

[3] Péterfi, Z., Nemes, Z., Vigvári, S., Szomor, Á., Kereskai, L., Kucsera, I., Tánczos, B. and Ternák, G. (2011) Visceral Leishmaniasis in an Immunocompetent Hungarian Adult Patient. *Health*, **3**, 1-5. http://dx.doi.org/10.4236/health.2011.31001

[4] Dujardin, J.C., Campino, L., Cañavate, C., Dedet, J.P., Gradoni, L., Soteriadou, K., Mazeris, A., Ozbel, Y. and Boelaert, M. (2008) Spread of Vector-Borne Diseases and Neglect of Leishmaniasis, Europe. *Emerging Infectious Disease*, **14**, 1013-1018. http://dx.doi.org/10.3201/eid1407.071589

[5] Kovats, S., Menne, B., McMichael, A., Bertollini, R. and Soskolne, C. (2000) Climate Change and Stratospheric Ozone Depletion. Early Effects on our Health in Europe. WHO Regional Publications, European Series, No. 88. World Health Organization Regional Office, Copenhagen, 43-44.

[6] Lindgren, E., Naucke, T. and Menne, B. (2004) Climate Variability and Visceral Leishmaniasis Report of the Scientific Working Group on Leishmaniasis. Report of the Scientific Working Group on Leishmaniasis, Geneva, 88-93.

[7] Colomba, C., Saporito, L., Vitale, F., Reale, S., Vitale, G., Casuccio, A., Tolomeo, M., Maranto, D., Rubino, R., Di Carlo, P. and Titone, L. (2009) Cryptic Leishmania Infantum Infection in Italian HIV Infected Patients. *BMC Infectious Diseases*, **9**, 199. http://dx.doi.org/10.1186/1471-2334-9-199

[8] Desjeux, P. (1996) Leishmaniasis. Public Health Aspects and Control. *Clinics in Dermatology*, **14**, 417-423. http://dx.doi.org/10.1016/0738-081X(96)00057-0

[9] World Health Organization, (2001) The World Health Report 2001. World Health Organization, Geneva.

[10] Thakur, C.P. (2000) Socio-Economics of Visceral Leishmaniasis in Bihar (India). *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **94**,156-157. http://dx.doi.org/10.1016/S0035-9203(00)90255-4

[11] Arias, J.R., Monteiro, P.S. and Zicker, F. (1996) The Reemergence of Visceral Leishmaniasis in Brazil. *Emerging Infectious Diseases*, **2**,145-146. http://dx.doi.org/10.3201/eid0202.960213

[12] Koshy, A., Al-Azmi, W.M., Narayanan, S., Grover, S., Hira, P.R., Idris, M. and Madda, J.P. (2001) Leishmaniasis Diagnosed by Liver Biopsy: Management of Two Atypical Cases. *Journal of Clinical Gastroenterology*, **32**, 266-267. http://dx.doi.org/10.1097/00004836-200103000-00021

[13] Bükte, Y., Nazaroglu, H., Mete, A. and Yilmaz, F. (2004) Visceral Leishmaniasis with Multiple Nodular Lesions of the Liver and Spleen: CT and Sonographic Findings. *Abdominal Imaging*, **29**, 82-84. http://dx.doi.org/10.1007/s00261-003-0076-0

[14] American Institute of Ultrasound in Medicine (2012) AIUM Practice Guideline for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum. *Journal of Ultrasound in Medicine*, **31**, 1301-1312.

[15] Benedetti, N.J., Desser, T.S. and Jeffrey, R.B. (2008) Imaging of Hepatic Infections. *Ultrasound Quarterly*, **24**, 267-278. http://dx.doi.org/10.1097/RUQ.0b013e31818e5981

[16] Desser, T.S., Sze, D.Y. and Jeffrey, R.B. (2003) Imaging and Intervention in the Hepatic Veins. *American Journal of Roentgenology*, **180**, 1583-1591. http://dx.doi.org/10.2214/ajr.180.6.1801583

[17] Muradali, D. and Chawla, T. (2010) Organ Transplantation. In: Rumack, C.M., Wilson, S.R., Charboneau, J.W. and Levine, D., Ed., *Diagnostic Ultrasound*, 4th Edition, Elsevier-Mosby, Philadelphia, 639-707.

[18] Gandolfi, L., Torresan, F., Solmi, L. and Puccetti, A. (2003) The Role of Ultrasound in Biliary and Pancreatic Diseases. *European Journal of Ultrasound*, **16**, 141-159. http://dx.doi.org/10.1016/S0929-8266(02)00068-X

[19] Hohl, C., Schmidt, T., Honnef, D., Gunther, R.W. and Haage, P. (2007) Ultrasonography of the Pancreas, 2. Harmonic Imaging. *Abdominal Imaging*, **32**, 150-160. http://dx.doi.org/10.1007/s00261-006-9017-z

[20] Koito, K., Namieno, T., Nagakawa, T., Hirokawa, N., Ichimura, T., Syonai, T., Yama, N., Someya, M., Nakata, K.,

Sakata, K. and Hareyama, M. (2001) Pancreas: Imaging Diagnosis with Color/Power Doppler Ultrasonography, Endoscopic Ultrasonography, and Intraductal Ultrasonography. *European Journal of Radiology*, **38**, 94-104. http://dx.doi.org/10.1016/S0720-048X(01)00294-7

[21] Doria, A.S., Daneman, A., Moineddin, R., Smith, C.R., Mohanta, A., Clarke, J. and Kellenberger, C.J. (2006) High-Frequency Sonographic Patterns of the Spleen in Children. *Radiology*, **240**, 821-827. http://dx.doi.org/10.1148/radiol.2403050529

[22] Sutherland, T., Temple, F., Hennessy, O. and Lee, W.K. (2010) Abdomen's Forgotten Organ: Sonography and CT of Focal Splenic Lesions. *Journal of Medical Imaging and Radiation Oncology*, **54**, 120-128. http://dx.doi.org/10.1111/j.1754-9485.2010.02149.x

[23] Guerin, P.J., Olliaro, P., Sundar, S., Boelaert, M., Croft, S.L., Desjeux, P., Wasunna, M.K. and Bryceson, A.D. (2002) Visceral Leishamniasis: Current Status of Control, Diagnosis, and Treatment, and a Proposed Research and Development Agenda. *The Lancet Infectious Diseases*, **2**, 494-501.

[24] Zijlstra, E.E. and el-Hassan, A.M. (2001) Leishmaniasis in Sudan. Visceral leishmaniasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **95**, S27-S58. http://dx.doi.org/10.1016/S0035-9203(01)90218-4

[25] Pantsari, M.W. and Coleman, T.A. (2003) Images in Clinical Medicine. Kala-Azar. *The New England Journal of Medicine*, **349**, e13. http://dx.doi.org/10.1056/ENEJMicm010681

[26] Abdalla, N.M. (2010) Evaluation of Gene Targeted PCR and Molecular Hybridization Used in Diagnosis of Human Leishmania Isolates. *Biotechnology*, **9**, 212-217. http://dx.doi.org/10.3923/biotech.2010.212.217

[27] Abdalla, E.A., Ayad, C.E., Ahmed, A.M., ElGaddal A.S. and Saeed A. (2014) Ultrasound Findings in Patients with Visceral Leishmaniasis. *International Journal of Medical Imaging*, **2**, 5-9. http://dx.doi.org/10.11648/j.ijmi.20140201.12

[28] Reus, M., García, B., Vázquez, V., Morales, D., Fuster, M. and Sola, J. (2005) Visceral Leishmaniasis: Diagnosis by Ultrasound-Guided Fine Needle Aspiration of an Axillary Node. *The British Journal of Radiology*, **78**, 158-160. http://dx.doi.org/10.1259/bjr/33263789

[29] Meliia, Kh.O. and Zenaishvili, O.P. (2006) Ultrasound Study of Parenchymatous Organs in Visceral Leishmaniasis. *Meditsinskaia Parazitologiia i parazitarnye bolenzi* (*Mosk*), **2**, 31-33.

Scientific Research Publishing (SCIRP) is one of the largest Open Access journal publishers. It is currently publishing more than 200 open access, online, peer-reviewed journals covering a wide range of academic disciplines. SCIRP serves the worldwide academic communities and contributes to the progress and application of science with its publication.

Other selected journals from SCIRP are listed as below. Submit your manuscript to us via either submit@scirp.org or Online Submission Portal.