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Radiology, Diagnostic Imaging and Instrumentation



Diabetes Mellitus Type 2 Patients

Imaging Contribution in Headache

Highlights

Cerebral Venous Thrombosis (CVT)

Review of the Ultrasonographic Findings

Discovering Thoughts, Inventing Future

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Shear Wave Elastography Detects Asymptomatic Changes of the Liver among Diabetes Mellitus Type 2 Patients

By Dr. Bárbara L. Riestra-Candelaria, Juan Carlos Jorge, Miriam Rodríguez, Gory Ballester-Ortiz & Loida A. González-Rodríguez
University of Puerto Rico. San Juan

Abstract- Damage to the liver is a common clinical consequence of chronic diabetes mellitus type 2 (DM2). This study evaluates whether ultrasound shear wave elastography and hemodynamics of the portal vein and the hepatic artery can complement traditional clinical work-up data for the monitoring of liver health among DM2 patients.

Methods: Sixty-four (64) participants (31 controls and 33 patients with confirmed type 2 diabetes mellitus) between 21 to 74 years of age were recruited. Liver size, stiffness and hemodynamics of the portal vein and the hepatic artery were evaluated. Glycated hemoglobin (HbA_{1c}), aspartate aminotransferase (AST), alanine a minotransferase (ALT), and alkaline phosphatase (ALP) were monitored. Student's t-test was employed with significance attained at $p \leq 0.05$.

Results: Asymptomatic significant differences were detected among DMT2 patients: (1) Largest Liver size ($p=0.04$); (2) Higher liver stiffness ($p=0.04$); (3) Higher alkaline phosphate levels ($p=0.03$); (4) Higher HbA1c levels (<0.001) and (7) presence of moderate to severe liver fibrosis. DM2 F1 stage has higher liver stiffness (0.006) and HbA1c levels (<0.001).

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Shear Wave Elastography Detects Asymptomatic Changes of the Liver among Diabetes Mellitus Type 2 Patients

Dr. Bárbara L. Riestra-Candelaria[α†], Juan Carlos Jorge[σ], Miriam Rodríguez [ρ], Gory Ballester-Ortiz[ω] & Loida A. González-Rodríguez[¥]

Abstract- Damage to the liver is a common clinical consequence of chronic diabetes mellitus type 2 (DM2). This study evaluates whether ultrasound shear wave elastography and hemodynamics of the portal vein and the hepatic artery can complement traditional clinical work-up data for the monitoring of liver health among DM2 patients.

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Discussion: The use of shear wave elastography provides an insightful first-line clinical assessment of liver health among DM2 patients.

I. Introduction

According to the International Diabetes Federation, in 2019, diabetes affects 463 million people around the world. It is a source of major concern that this prevalence is expected to increase to 700 million by 2045.[1] Detrimental effects on liver health such as steatosis or fatty liver are common clinical consequences of chronic diabetes mellitus type 2 (DM2). More than 70% of adult patients with DM2 develop steatosis or non-alcoholic fatty liver disease (NAFLD), with significant anatomical and physiological detrimental effects.[2-4] In fact, NAFLD is a worldwide epidemic of great financial impact with an estimated prevalence as high as 30% of the worldwide population, most likely due to the fact that obesity and diabetes are risk factors of this fatal condition when left untreated.[5-7]

Nonalcoholic steatohepatitis (NASH) usually precedes NAFLD, as the liver becomes inflamed and fibrosis develops.[8-9] Fibrosis is characterized by an excess of connective tissue that produces an increase in liver density, which in turn, eventually leads to organ dysfunction. Liver fibrosis can worsen into cirrhosis and cancer. Unfortunately, as is the case for NAFLD, liver fibrosis can also be asymptomatic. Therefore, a gap in standard clinical algorithms for the long-term management of DM2 is to be able to monitor liver health with a cost-effective approach.

Even though liver enzymes are used as screening for liver disease, they may not correlate with severity of disease.[10] Liver biopsy is considered the gold standard to confirm liver pathology, but this is an expensive diagnostic tool. In addition, it is a high risk invasive procedure with unwarranted potential side effects.[11] In contrast, shear wave hepatic elastography is a non-invasive and a cost-effective diagnostic tool that measures the elasticity and hardening of liver tissue across the organ.[12-14] We aim to determine whether the use of shear wave hepatic elastography can complement traditional clinical work-up data for the monitoring of liver health among DM2 patients.

II. Material and Methods

a) Subjects

Sixty-four (64) participants (31 controls and 33 patients with confirmed type 2 diabetes mellitus) between 21 to 74 years of age were recruited in two clinical sites: a university based endocrinology hospital clinic in Puerto Rico and an endocrinology clinic, associated with a Puerto Rican school of medicine. The recruitment was carried out with the following exclusion criteria: previous hepatic disease, hyperlipidemia, right upper quadrant trauma, chronic kidney disease, morbid obesity, alcoholism, and cardiac disease. The study

Author α: PhD Department of Medicine, Endocrinology, Diabetes and Metabolism Division, School of Medicine, University of Puerto Rico. San Juan, PR.
†Current address: Department of Anatomy and Cell Biology, Universidad Central del Caribe. Bayamón, PR.
Author σ: PhD Department of Anatomy and Neurobiology, School of Medicine, University of Puerto Rico.San Juan, PR.
Author ρ: BSD Department of Medical Imaging, School of Sciences and Technology. Universidad Central del Caribe. Bayamón, PR.
Author ω: MD Department of Radiological Sciences, School of Medicine, University of Puerto Rico. San Juan, PR.
Corresponding Author ¥: MD Department of Medicine, Endocrinology, Diabetes and Metabolism Division, School of Medicine, University of Puerto Rico. San Juan, PR. e-mail: loida.gonzalez@upr.edu

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adhered to the approved research protocol by the Protection of Human Research Participants Office of the Medical Sciences Campus, University of Puerto Rico (protocol number A9000113). All participants signed and provided written informed consent prior to recruitment. All sonographic images were made by one of the authors (BLRC) who is an experienced sonographer; and were independently evaluated by the same diagnostic radiologist who is the president of the Radiological Society of Puerto Rico (GBO).

b) Laboratory test results

Laboratory test results were obtained from medical records: blood levels of glycated hemoglobin (HbA_{1c}), hepatic enzymes (aspartate aminotransferase [AST], alanine aminotransferase [ALT], and alkaline phosphatase [ALP]. Laboratory test report were obtained within a time window of 6 months of the ultrasound imaging session. For the purpose of this study, HbA_{1c} levels were used to confirm diabetes, whereas ALT, AST and ALP levels were used as indicators of liver function.

c) Sonographic imaging of the liver

A real time abdominal sonogram study was performed to evaluate liver anatomy and hemodynamics of the portal vein and hepatic artery, with a Logiq E9 ultrasound machine (GE Healthcare, Milwaukee, Wisconsin, USA) with a C1-6-VN 2D convex probe. Hepatic ultrasound images and craniocaudal measurements were obtained with the patient in a left anterior oblique position (15^o - 20^o) with the right arm placed above the head. The scan was performed in the anterior axillary region (AAR). The craniocaudal measurement of the right liver lobe (RLL) was traced from the highest right hemi-diaphragm visualized in the ultrasound image to the inferior tip of the right lobe, as parallel as possible to the anterior wall of the liver.[15] Ultrasound images of the main portal vein (MPV) and hepatic artery (HA) were also obtained in oblique position to evaluated MPV vein diameter (cm), MPV velocity (cm/seg), MPV pulsatility index ($PI = V_2 / V_1$), HA velocity (cm/seg) and HA resistive index ($RI = V_1 – V_2 / V_1$).

For liver stiffness, RLL images were obtained with study participants placed in a left anterior oblique position (15°–20°), with the right arm placed above the head and with the skin exposed from the hip to the xiphoid process. The intercostal right upper quadrant was scanned to obtain a longitudinal image of a given region of interest (ROI) in the segment VIII of the liver, at a depth of < 8 cm under the skin to avoid blood vessels, shadowing areas and anatomical boundaries between organs. Patients were asked to hold breath and avoid deep inspiration while elastography measurements were taken. Mean values (in kPa) are reported. The presence and degree of fibrosis was identified following METAVIR Scale classification for GE LogiqE9: Healthy liver F0 (< 5.48 kPa), Normal to Mild fibrosis F1 (5.48 – 8.29 kPa), Mild to Moderate fibrosis F2 (8.29 –9.40 kPa), Moderate to severe fibrosis F3 (9.40 – 11.9 kPa), and Cirrhosis F4 (> 11.9 kPa).

d) Statistical Analysis

Data shown is expressed as mean ± standard deviation unless otherwise specified. Analyses were performed with XLSTAT-Biomed software (Version 2018.5, Add in soft, New York City, New York, USA). Normality was assessed by the Shapiro-Wilk test and homogeneity of variance was evaluated according to normality results.[16] Normally distributed data were analyzed with a Student's t-test; otherwise, Mann-Whitney test was used. Statistical significance was attained at $p \leq 0.05$.When significance reached four decimal points, p value is reported as < 0.001, otherwise specific value is reported.

III. Results

Significant ultrasound differences of the liver were noted between controls and diabetes mellitus type 2 patients (Table 1). Patients with DM2 showed larger ($p=0.04$) and stiffer livers ($p=0.01$) in comparison with controls patients. $HbA1_c$, ALT, AST and were also measured. As expected, $HbA1_c$levels confirmed diabetes status ($p< 0.001$). With regard to liver function, alkalinephosphate ($p=0.03$) was significantly higher amongDM2 patients (Table 1).

A distinct patient distribution was detected when stratified by fibrosis category. Specifically, the distribution of control patients was as follows:F0 (n=6), F1 (n=19), F2 (n=3), F3 (n=1) and F4 (n=0), whereas the distribution of DM2 patients was as follows: F0 (n=4), F1 (n=18), F2 (n=4), F3 (n=7), F4 (n=1). Table 2 shows the HbA1c, liver enzymes and stiffness values when stratified by fibrosis category. It is of interest that a significant difference was noted between F1 groups for liver stiffness ($p=0.006$) and $HbA1_c$levels ($p< 0.001$). Regarding blood vessels hemodynamics, no statistical difference was found in main portal vein (MPV) velocity and hepatic artery velocity (HAV) between controls and DM2 patients (Table 3). In contrast, a significant difference was noted between MPV diameter ($p=0.05$), MPV pulsatility index (PI) ($p=0.002$) and hepatic artery resistive index (HARI; $p=0.002$).

IV. Discussion

Diagnostic ultrasound with shear wave elastography of the liver shows some asymptomatic differences in DM2 patients. This study reported that the liver size was larger and liver stiffness was higher in DM2 groups when compared to controls. Although the largest number of patients in our cohort showed to be in an early stage category (F1), the diabetic group showed a greater proportion of patients in advanced stages (F2 to F4) of liver fibrosis. In agreement with previous

studies, no significant differences in the levels of the liver enzymes AST or ALT was detected, which further supports the emergent opinion that liver enzymes may not always correlate with the severity of liver disease.[10] Hence, accurate and cost-effective diagnostic tools are needed for the long-term monitoring of liver health.

Among the hemodynamic parameters of interest, we found higher hepatic artery resistive index (HARI) in diabetic patients, which is consistent with the findings of greater liver stiffness among this group. This finding is similar to other studies that found a positive correlation between HARI and fibrosis degree.[17-18] Our study also found lower portal vein pulsatility index (PVPI) among DM2 patients. There is evidence of decreased venous pulsatility index in patients with NAFLD.[19-20] Taken together; these findings suggest a compensatory mechanismin vascular compliance that is secondary to fatty infiltration of the liver. This hypothesis warrants further research.

Over the last decade, NASH has become one of the main indicators for liver transplantation.[21-22] Our study detected significant changes in liver stiffness in diabetic patients at early stages (F1), where changes can be potentially reversible with early treatment to avoid further clinical complications. This is of great significance in preventive care as advanced stages of liver fibrosis had been associated with increased cardiovascular risk and mortality.[23] Whether the changes observed in hemodynamic parameters correlates with cardiovascular disease in our patient cohort warrants further evaluation.

There are a number of limitations of this study. First, this is a transversal study that did not control for the time with DM2 diagnosis. Therefore, it is of interest to conduct a longitudinal study where timing of the disease ought to be monitored. Second, this study did not include liver biopsy sampling, albeit this still remains as the gold standard confirmation of liver damage. Third, it could have been valuable to collect data on platelets and albumin levels as part of the blood panel to further asses long-term biochemical changes among DM2 patients.

This study supports the notion that hepatic ultrasound with shear wave elastography is a useful tool for the diagnosis and classification of liver fibrosis among DM2 patients.[12-14] A main advantage of this clinical approach is the ability to evaluate the elasticity of the tissue while obtaining a visual image of the area of interest in real time. In addition, it allows for the evaluation of different areas of the organ within a single imaging session. As a non-invasive procedure, it is clinically feasible to follow-up the patient over time to assess liver health and to implement early therapeutic intervention whenever necessary. Taken together, we believe that the use of shear wave elastography in low resource and fast-paced environments provides an insightful first-line clinical assessment of liver health among DM2 patients.

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Table 1: HbA1c, liver enzymes and stiffness by groups

	CONTROL	DM2	P value
STIFFNESS (kPa)	6.6 (1.5)	7.9 (2.1)	0.01
LIVER SIZE (cm)	14.3 (1.6)	15.5 (2.8)	0.04
HbA1c (%)	5.4 (0.3)	7.7 (1.7)	< 0.001
ALT (units/L)	25.7 (14.4)	34.2 (27.1)	0.12
AST (units/L)	21.8 (6.0)	25.5 (15.2)	0.21
ALK PHOSP (units/L)	71.8 (15.2)	82.7 (23.9)	0.03

DM2=diabetes mellitus type 2

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Table 2: HbA1c, liver enzymes and stiffness by fibrosis category

	C-F0	DM2-F0	P value	C-F1	DM2-F1	P value	C-F2	DM2-F2	P value
STIFFNESS (kPa)	5.1 (0.6)	4.4 (1.1)	0.28	6.6 (0.7)	7.2 (0.6)	*0.006*	8.9 (0.4)	8.8 (0.4)	0.83
LIVER SIZE (cm)	14.2 (1.7)	14.8 (1.8)	0.57	14.2 (1.7)	15.8 (3.1)	0.13	14.6 (0.7)	13.7 (1.0)	0.24
HbA1c (%)	5.4 (0.4)	7.7 (2.0)	*0.01*	5.4 (0.3)	7.6 (1.9)	*< 0.001*	5.3 (0.3)	7.8 (2.4)	0.06
ALT (units/L)	22.1 (11.0)	27.3 (12.3)	0.56	25.5 (16.2)	37.6 (31.3)	0.11	37.0 (7.5)	28.0 (12.4)	0.32
AST (units/L)	21.3 (6.2)	23.0 (6.8)	0.66	21.3 (6.0)	27.3 (16.6)	0.20	27.7 (3.8)	22.0 (5.3)	0.18
ALK PHOSP (units/L)	68.6 (17.3)	92.5 (12.4)	*0.04*	72.4 (14.0)	83.3 (28.0)	0.14	82.3 (17.1)	67.0 (18.8)	0.32

C= Control, DM2=diabetes mellitus type 2

Table 3: Hemodynamics of Portal vein and Hepatic artery by groups

	Control	DM2	P value
Portal vein diameter (cm)	1.1 (0.2)	1.0 (0.2)	0.05
Portal vein velocity (cm/seg)	26.1 (5.7)	25.7 (7.3)	0.80
Portal vein Pulsatily index	0.3 (0.13)	0.2 (0.07)	0.002
Hepatic artery velocity (cm/seg)	92.6 (22.0)	82.0 (19.9)	0.06
Hepactic artery Resistive index	0.7 (0.07)	0.8 (0.09)	0.002

DM2=diabetes mellitus type 2

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Imaging Contribution in Headache and Cerebral Venous Thrombosis (CVT)

By Cherif Mohamadou Aidara, Simon Joël Manga, Léra Géraud Akpo, Nfally Badji, Sokhna Astou Gawane Thiam, Ndeye Bigue Mar, Aissata Sall, Hamidou Deme, Abdoulaye Dione Diop, Abdoulaye Ndoye Diop, Sokhna Ba Diop & Elhadj Niang

Abstract- Headache is the most frequent and the mean onset symptom in cerebral venous thrombosis (CVT). Recognizing CVT to start treatment early enough is a challenge for both the clinician and the radiologist. They must find the right balance between not to expose the patient to the unnecessary risks of anticoagulants and not to miss a condition that could be fatal. CVT has a wide variety of clinical manifestations that often causes of a delay in diagnosis. Neuroimaging techniques have significantly improved to explore the brain parenchyma and its vascular structures. High-field MRI is the current gold standard because of its high tissue resolution and its multiform contrast without equality. But its limits lie on the accessibility and availability, especially in our developing countries. CT is more accessible and available. Its fast running and current performance because of multidetector technology make it the first-line examination and the only one in many cases of neuroradiology emergency. These techniques present sometimes some trap pictures that must be recognized not to carry the diagnosis by excess or to miss it. We aim in this article to review the semiology of headaches in CVT, some risk factors, CT semiology, and some CT trap pictures.

Keywords: *headache; Cerebral Venous Thrombosis; CT semiology; CT trap pictures.*

GJMR-D Classification: *NLMC Code: QT 34*

IMAGINGCONTRIBUTIONINHEADACHEANDCEREBRALVENOUSTHROMBOSISCVT

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Imaging Contribution in Headache and Cerebral Venous Thrombosis (CVT)

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Abstract- **Headache is the most frequent and the mean onset symptom in cerebral venous thrombosis (CVT). Recognizing CVT to start treatment early enough is a challenge for both the clinician and the radiologist. They must find the right balance between not to expose the patient to the unnecessary risks of anticoagulants and not to miss a condition that could be fatal. CVT has a wide variety of clinical manifestations that often causes of a delay in diagnosis. Neuroimaging techniques have significantly improved to explore the brain parenchyma and its vascular structures. High-field MRI is the current gold standard because of its high tissue resolution and its multiform contrast without equality. But its limits lie on the accessibility and availability, especially in our developing countries. CT is more accessible and available. Its fast running and current performance because of multidetector technology make it the first-line examination and the only one in many cases of neuroradiology emergency. These techniques present sometimes some trap pictures that must be recognized not to carry the diagnosis by excess or to miss it. We aim in this article to review the semiology of headaches in CVT, some risk factors, CT semiology, and some CT trap pictures.**

Keywords: headache; Cerebral Venous Thrombosis; CT semiology; CT trap pictures.

I. Introduction

Cerebral venous thrombosis (CVT) is a neurovascular emergency. It occurs about 1-2% causes of stroke. Its clinical presentation is non-specific, and often causes a delay in diagnosis. Headache is the most common onset symptom. This condition has benefited significantly from the development of CT and MR imaging techniques. MRI is the current gold standard imaging technique due to its high resolution and multiform contrast. MRI is not available in our developing country in terms of cost and coverage. CT is more available and stay on first line neuroimaging examination. It seems useful to use CT efficiently to not "miss" a CVT. The imaging examination must also consider the existence of possible risk factors amenable to etiological treatment at the same time as the thrombosis treatment. In this paper, we aim to remind semiology of headache in CVT, some risk factors, CT semiology, and some trap pictures.

II. Discussion

a) Headache in CVT

Most of the time, CVT occurs in young adults and females. Its clinical presentation is widely variable and non-specific, often causes a delay in diagnosis. Headache is the major onset symptom; 75 to 95% of lot of series [1, 2, 3, 4, 5, 6]. It may be the only manifestation throughout the disease. It is described as rapidly progressive but can be sub-acute (between two and 30 days) in 50%, acute (less than two days) in 30% or chronic (beyond 30 days) in 20%. The severity is variable but often moderate to severe, continuous, and often unresponsive to usual analgesics. Rough presentation "thunderclap" is also described. Headache is sometimes the only reason for admission into the emergency room. Sparaco et al. described it as typically severe and throbbing, with sudden onset, and non-remitting characteristics [4]. According to the IHS (International headache society) classification [7], headache caused by cerebral venous thrombosis has no specific characteristics: it is most often diffuse, progressive and severe, but can be unilateral and sudden (even thunderclap), or mild, and sometimes is migraine-like. Its pathophysiology lies in intracranial hypertension, venous distension, the venous infarction alone, or in association [2].

The headache could be associated with other symptoms such as coma, seizure, focal sign syndrome, intracranial hypertension. Tanislav noticed a strong association between headaches, seizures and CVT. Neurological deficit is another major symptom. These signs are not exhaustive. The paper of Ulivi et al. describes the clinical signs according to the affected venous structure [2, 5, 6, 8].

b) Risk factors

Risk factors are numerous and meet Virchow's triad, an alteration of the venous wall, circulatory slowdown, and a thrombophilia condition. It is important, in real time imaging examination, to identify a

Corresponding Author α: Radiology Office of De la Paix Hospital. Av Djignabo, Ziguinchor, Senegal. e-mail: cfm.aidara@univ-zig.sn
Author σ: Cardiology Office of De la Paix Hospital. Av Djignabo, Ziguinchor, Senegal.
Author ρ Ω ¥ § χ ν Θ ζ € : Radiology Office of Aristide Le Dantec University Hospital. 30, Av Pasteur, Dakar.
Author £: Radiology office of Fann University Hospital (Dakar Sénégal). Avenue Cheikh Anta Diop BP 5035 Dakar-Fann.

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regional risk factor such as cervical facial infection. It may be sinusitis, a tonsilar abcess, an otomastoiditis, facial cellulitis, a cholesteatoma etc. (figure 1). These infections must be considered as part of the thrombosis treatment. Anatomical and vascular relationship between sinonasal cavities and the endocranium on the one hand and neck spaces and the endocranium on the other are spreading factors of septic thrombosis in intracranial vein sinuses. Pregnancy and postpartum are frequent thrombophilia situation; unusual headache in these conditions must pay a special attention [6, 9].

The achievement of the superior sagittal sinuse seems predominant in most of series in the literature. And follow the lateral sinuse. Achievement of the deep veins and the cavernous sinuses is rare [5, 10]. Figure 1D shows thrombosis of the cavernous sinuses due to facial cellulitis associated with purulent eye and brain abscess in a young diabetic type 1 patient.

c) CT scan semiology

Post-processing images are more and more efficient and offer opportunities for multi planar reconstruction. Correct visualization of the venous sinuses requires a good window and level to dissociate the vein and parenchyma on the one hand and the sinuses and the vault of the skull on the other hand (figure 2).

i. *Direct signs*

Hyperattenuating of the thrombosed sinus on unenhanced CT is the most important sign to look after (Figure 3A). It's due to the X-ray beam attenuation by the thrombus and gives to the sinus a triangular dense aspect (figure3B and 3C) and to a cortical vein a cord aspect called "cord sign". It is the protein fraction of the hemoglobin that is responsible for this hyperdensity. This aspect explains the possibility of spontaneous hyperattenuating in polycythemia or children without underlying thrombosis. And conversely, a thrombus can appear hypodense in case of anemia and induce a false negative [11]

Therefore, the objective measurement of density becomes of great importance in interpreting CT scan images. Linn et al. found mean values hyperdensity of 62.3 ± 8 HU and 57.8 ± 18 for sinuses and veins, respectively [10]. Garetier et al. report mean density values between 62.47 and 71.1 HU depending on the sinus affected [12]. Buyck et al. found an average density of 73.9 ± 9.2 HU.

Because of the hematocrit is directly related to the measured density of blood; Buyck introduced the H:H ratio (ratio between the density of the sinus and the percentage of the hematocrit). For an average density of 62 HU and a ratio of 1.52 the diagnostic efficiency of sinus hyperdensity is 95% and 97.5%, respectively [11, 13].

Can a thrombus be hypodense apart from anemia? Neal et al. recently reported an aspect of cerebral venous thrombosis with a hypodense thrombus without an underlying anemia for an acute cerebral venous thrombosis progressing for three days after onset. This observation underlines, in my opinion, the evolving aspect of the thrombus, which appeared subacute on the MRI data and very probably the relative delay of the onset headache [14].

Apart from the sinus content to analyze objectively, it's important to take into account the morphology of the thrombosed venous sinus. Normally triangular on a perpendicular slice (figure 4), it very often appears in event of thrombosis, enlarged with thickened hyperdense walls in addition to its content (figure 3B). After the injection of the iodinated contrast medium, the thrombus appears as an endoluminal defect surrounded by the contrast product and the inflamed and enhanced wall of the sinus (figure 3C).

On miniMip (mini Maximum Intensity Projection) images, the thrombosed sinus appears with a circulatory defect (Figures 5A and 6A).

Parenchymal signs are important to consider but are non-specific such as subarachnoid hemorrhage, edema or, parenchymal hematoma [6, 10].

In summarize, hyperattenuating sign has reported with a high accuracy value (95%) diagnosis in acute CVT with the threshold of 62 HU, and increase to 97.5% when using the H:H ratio with the threshold of 1.52 [11]. Garetier et al. found that spontaneous hyperdensity had a high value of sensitivity, specificity, and negative predictive value (100%, 95%, and 99 to 100%) on the first two weeks after onset [12]. "Cord sign" has been reported to be insensitive [15]. Linn et al. reported that the sensitivity and specificity of attenuated vein signs are 100% and 99,4% respectively for the diagnosis of deep venous thrombosis less than for cord sign values; 64,6 and 97,2%. This study of Linn et al. evaluated the sensitivity and specificity value of non-contrast CT 93,7 and 98% [10]. On contrast-enhanced CT, the delta sign has been reported with a sensitivity of 73% [11]. Linn et al. [8] also demonstrate that multidetector CT venography had a 100% value of sensitivity and specificity in the diagnosis of CVT.

This, underlines the importance of this technique in our so-called "developing countries" where MRI is not available in terms of coverage and cost. If available, it should be the first-line examination if CVT is suspected.

The radiologist has important and exhaustive semiological data to integrate both clinically and radiologically (analysis of sinus morphology, sinus density, H:H ratio) to establish an evidence-based diagnosis and decide if the conditions allow him to continue his exploration by CT venography or MRI. This, would minimize the false negative rate estimated at 10 to 25% [16].

Given the importance of CT in the management of neurological emergencies, Kozic stressed the

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importance of training practitioners and trainers in neuroimaging to be able to detect early signs of CVT.

ii. *Traps pictures*

Provenzale et al. [15, 17] put a lot of emphasis on trap pictures. We just want to emphasize two points relating to our modest experience:

– If a large thrombus cannot be missed, a very thin thrombus can be missed on multiplanar reconstruction (MPR) and mini-MIP images; it will be drowned by the contrast giving a false appearance of permeability of the sinus.
– Secondly, the thrombus appears better defined on MPR images than on the miniMIP images (figure 5). Hence MPR images should be preferred for the diagnosis of CVT. Figures 5B and 6B show a thrombus embedded by the circulating part of the sinus and the inflamed and enhanced wall on Mini MIP images.

iii. *Treatment of CVT*

Treatment is mainly based on curative anticoagulation. Other therapeutic methods include an endovascular procedure (thrombectomy, endovascular thrombolysis), or neurosurgical procedure (decompressive craniotomy) and are part of a multidisciplinary management strategy [6].

III. Conclusion

CT scan (non-enhanced or CT venography) is an essential tool in neuroradiological emergencies. Its performance is sufficient in many cases to establish the diagnosis of CVT. However, MRI is more efficient and should be reserved in doubtful cases where it is available. The authors stress the importance of training practitioners to not overlook the diagnosis or conversely not to overdo it. Its management must be part of a practice of multidisciplinary consensus.

Conflict of interest: no

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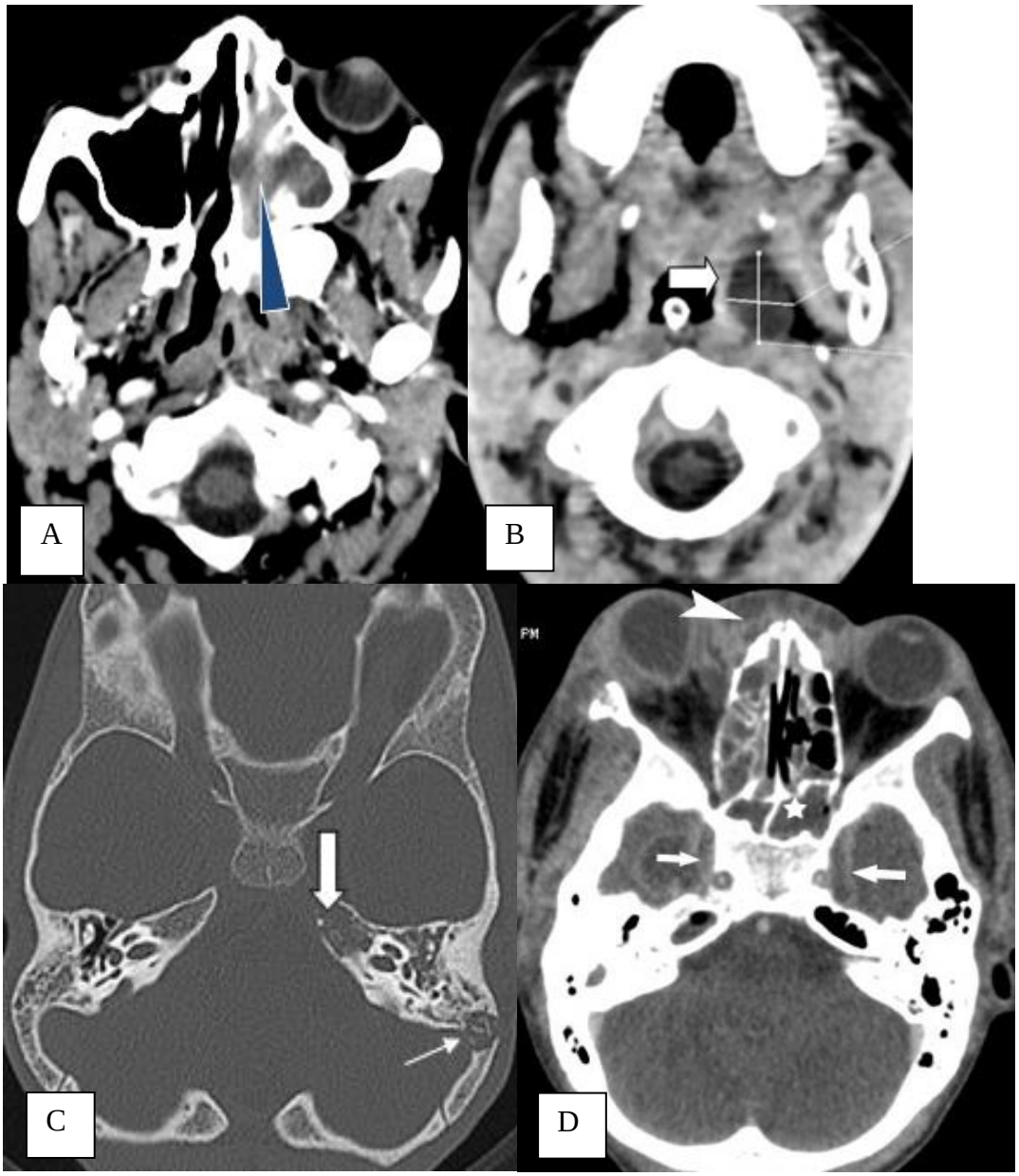


Figure 1: Left maxillary sinusitis on A (arrowhead A). A left peritonsillar abscess on B (arrow). The figure C a drained Bezold's abscess in a child complicated by lateral sinus thrombosis. Osteitis of the petrous apex (thick arrow C) and close to the sigmoid sinuse (thin arrow C). The figure D shows a facial cellulitis (arrowhead D) and sinusitis (star D) in a patient with diabetic type 1 patient (arrow head D) complicated with a right purulent eye, septic thrombosis of the cavernous sinus (arrow D) and cerebral abscesses.

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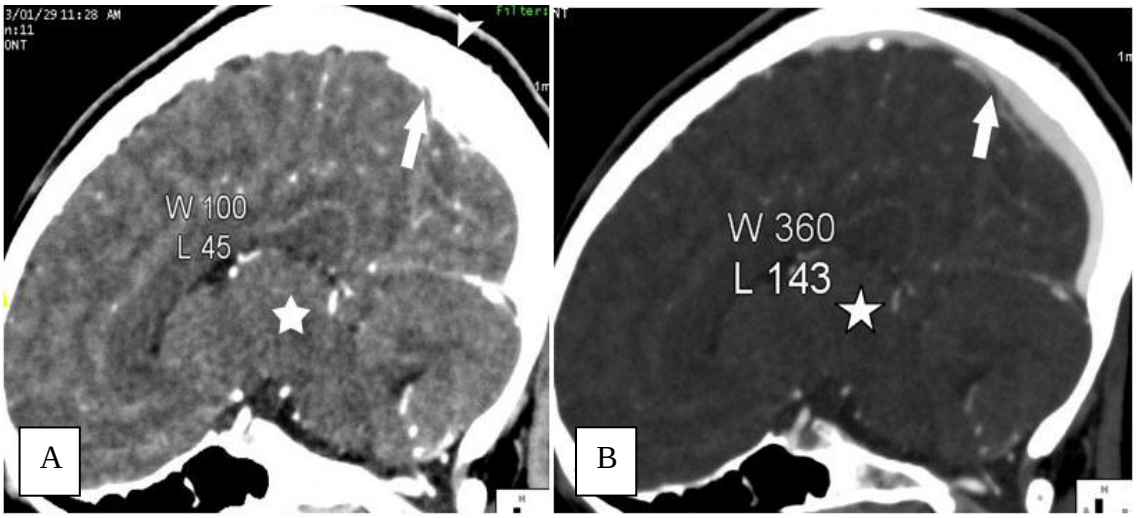


Figure 2: Sagittal reconstruction (A) of injected brain CT with window and level to 100 and 45 respectively. Good parenchymal analysis (star). Incorrect analysis of the sagittal superior sinuse (arrow) and bone (arrowhead) that merge. On B the same slice that with window and level extended to 360 and 143 shows a better differentiation of the vault and the superior sagittal sinuse (arrow). But not optimal analysis of brain parenchyma (star).

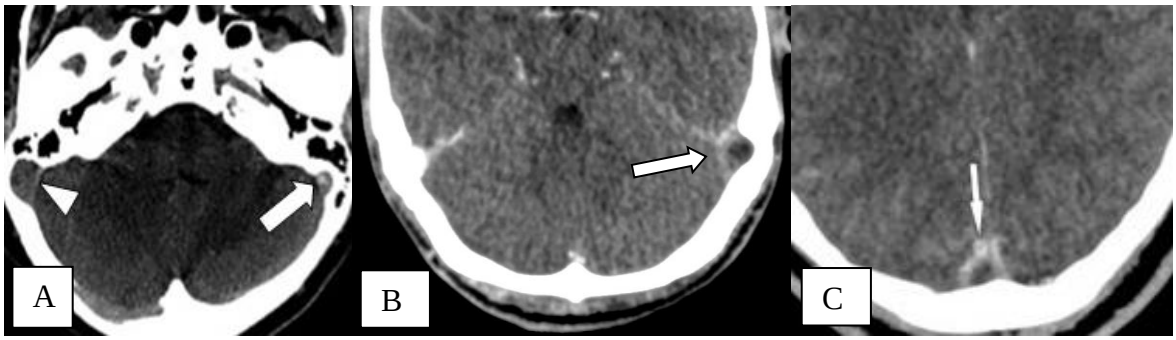


Figure 3: Spontaneous Hyperattenuating sign on the left lateral sinuse (arrow) compared with the right normal side (arrowhead). An injected CT axial section showing a empty delta sign with relatively hypodense central thrombus and enhanced triangular walls arrow B and C.

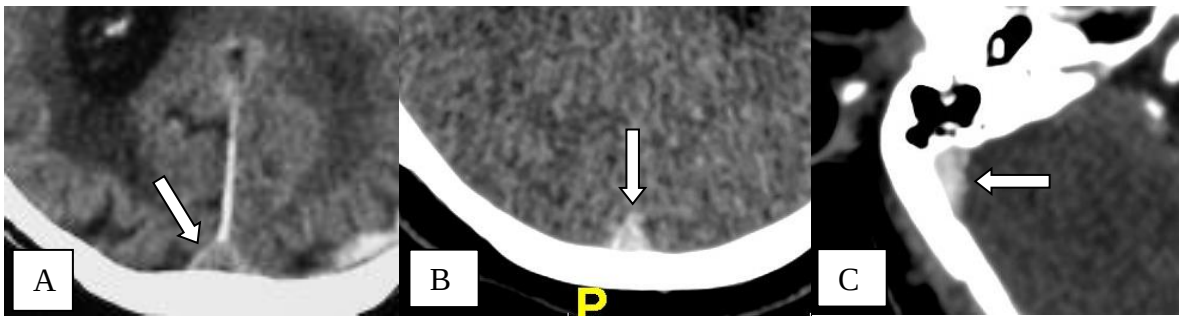


Figure 4: Showing a normal appearance of the sagittal superior sinuse without injection (arrow A) and after injection (arrow B and C)

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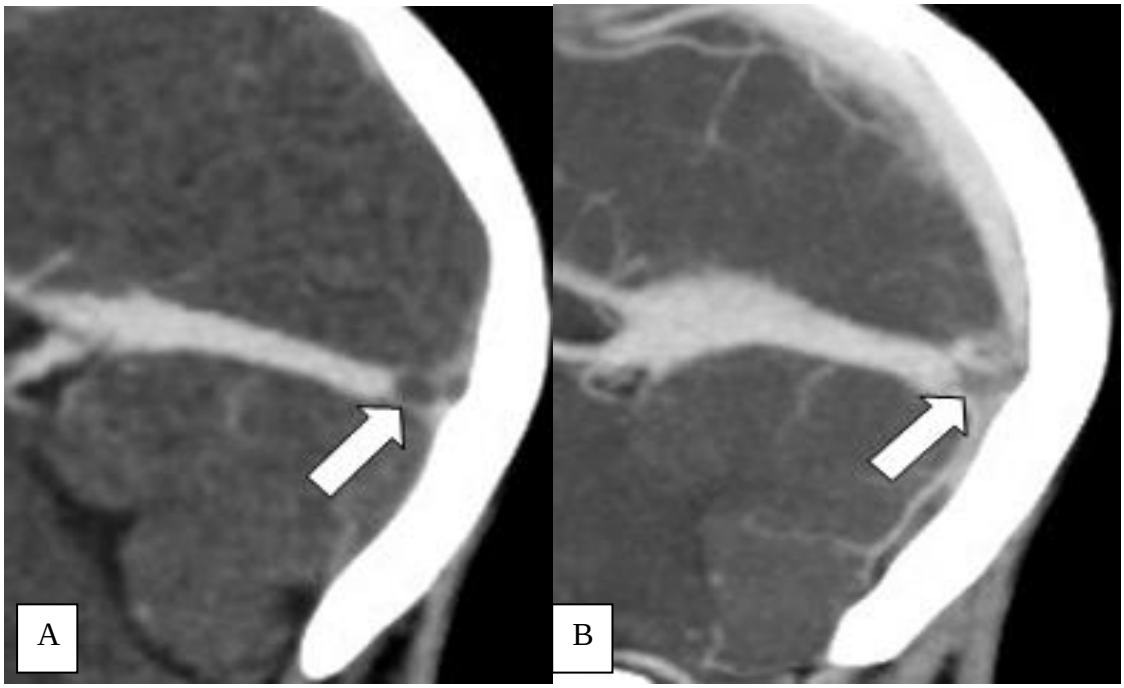


Figure 5: Sagittale MPR reconstruction of an injected brain CT showing a thrombus on the torcular (arrow A). The thin MIP reconstruction shows a defect within the venous sinuse (arrow B). Notice that the thrombus is worse defined than on MPR image on B.

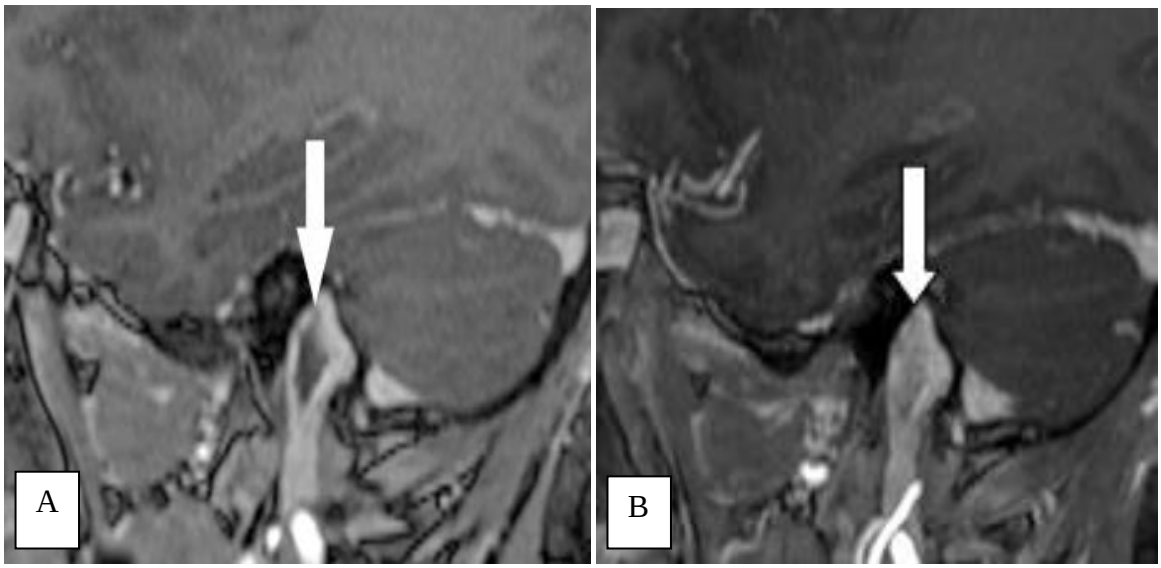


Figure 6: Sagittal reconstruction of MPR T1 gadolinium showing a thrombus in the sigmoid sinus (arrow). Sagittal thin MIP reconstruction on B showing no obvious thrombus (arrow) "drowned" by the summation of hyperintense pixels.

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Appendiceal Abscess in a Young Adult: A Review of the Ultrasonographic Findings: A Case Report

By Sule Muhammad Baba, Sa'idu Sule Ahmed, Ma'aji Sadisu Mohammed, Danfulani Muhammad & Umar Usman Aminu

Usmanu Danfodiyo University

Abstract- An appendiceal abscess is a condition in which an abscess is formed around the appendix as a result of appendiceal perforation or extension of inflammation to the adjacent tissues due to aggravation of appendicitis, these occurs in about 2-6% of patients having appendicitis and more common in males less than 30 years of age.

This is a 24-year-old male patient that was referred from a peripheral health care centre for abdominopelvic ultrasound scan on account of recurrent right iliac fossa pain and discomfort, fever, occasional vomiting, dysuria and increased frequency of micturition.

The abdominopelvic scan showed a deep seated near oval heterogenous collection in the region of the appendix with focal ileus, surrounding hypoechoic inflammatory fluid and mobile echoes in the urinary bladder; cystitis. A diagnosis of an appendiceal abscess with cystitis was made.

We report the radiologic findings of appendiceal abscess due to its peculiarity and to revise the literature.

Keywords: *focal ileus, inflammatory exudate, rebound tenderness, abscess cavity.*

GJMR-D Classification: *NLMC Code: WN 208*

APPENDICEALABSCESSINAYOUNGADULTAREVIEWOFTHEULTRASONOGRAPHICFINDINGSACASEREPORT

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We report the radiologic findings of appendiceal abscess due to its peculiarity and to revise the literature.

Keywords: focal ileus, inflammatory exudate, rebound tenderness, abscess cavity.

I. Introduction

Appendicitis is the most common cause of acute abdomen, presenting as a triad of pain in the right iliac fossa, fever, and vomiting that often requires surgical intervention.

An appendiceal abscess is a condition in which an abscess is formed around the appendix as a result of appendiceal perforation or extension of inflammation to the adjacent tissues due to aggravation of appendicitis[2]. Inflammation of the vermiform appendix is regarded as the most common surgical emergency worldwide with an estimated lifetime risk of about 6 and 8%.

Appendicitis is often a common differential diagnosis among the large number of cases presenting in the emergency unit on account of acute abdominal pain, and more common in the male gender with more than 70% of cases presenting in individuals less than 30 years of age.

The vermiform appendix anatomically has varying location with respect to the caecum and can originate within a 360° circumference around the caecum, this is most likely responsible for the varying form of presentation during appendicitis.

The inflammation in acute appendicitis is often fixed by the patient's self-defense mechanism by either formation of an inflammatory mass (an appendiceal phlegmon) or a circumscribed abscess (an appendiceal abscess). These (appendiceal mass and abscess) present as palpable mass days after onset of symptoms and constitute about 2-7% of all cases of appendicitis.

Acute inflammation of the appendix may also be the initial presentation of primary tumors of the appendix in more than 50% of cases. The patients with acute appendicitis typically present with acute central abdominal pain radiating to the right iliac fossa in vast majority of cases.

Appendiceal abscess are managed traditionally by nonsurgical treatment and interval appendectomy, the nonsurgical treatment comprises of the usage of effective antibiotics with subsequent drainage of the abscess under ultrasound or computed tomographic imaging, the surgical treatment is mainly by interval appendectomy.

II. Case Report

A 24-year-old male patient referred from a peripheral health care centre for an urgent abdominopelvic ultrasound on account of persistent colicky right iliac fossa pain, occasional vomiting, increased urinary frequency and general discomfort with fever.

He has had similar right iliac fossa pain in the past with similar symptoms and has had repeated episodes of intake of antibiotics, analgesics and antipyretics on those occasion.

On physical examination, he is febrile to touch, not pale, anicteric, not dehydrated and not in any form of respiratory distress or in any form of altered conscious state. He had some swelling with rebound tenderness over the right iliac fossa and also warm to touch more in the right iliac fossa.

The patient had result of his packed cell volume (37%), full blood count with differentials showing leukocytosis (13500 white blood cells per microliter) in favor of the lymphocytes (6000 lymphocytes in 1

Author α σ ρ ω: Radiology department, usmanu danfodiyo university, sokoto. Radiology department, gombe state university, gombe.
e-mail: muhammadsule@yahoo.com

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microliter of blood). The erythrocyte sedimentation rate was also normal (12 millimeters per hour).

3.5 and 7MHz transducer probes showed a deep seated, oval area of heterogeneous echo-reflectivity with almost an intact wall and with a volume of about 88mls.; see figure 1. There is surrounding prominence of the bowel loops (local ileus), hypoechoic fluid most likely inflammatory in the region of the vermiform appendix. Rebound tenderness was also demonstrated repeatedly with probe pressure. Mobile echoes were also demonstrated within the contents of the urinary bladder.

A diagnosis of a deep seated appendiceal abscess with focal paralyticileus and cystitis was made,

An abdominopelvic ultrasound scan done in both longitudinal and transverse approach using both a the findings of the scan were collated and given to the patient for onward submission to the referring physician.

The patient in the peripheral health care centre had effective course of both intravenous and oral antibiotics with analgesia, intravenous rehydration, adequate monitoring of the vital signs and monitoring of the size of the appendiceal mass per abdominal assessment on hospital admission, and he is been planned for interval appendectomy later following a successful nonsurgical treatment.

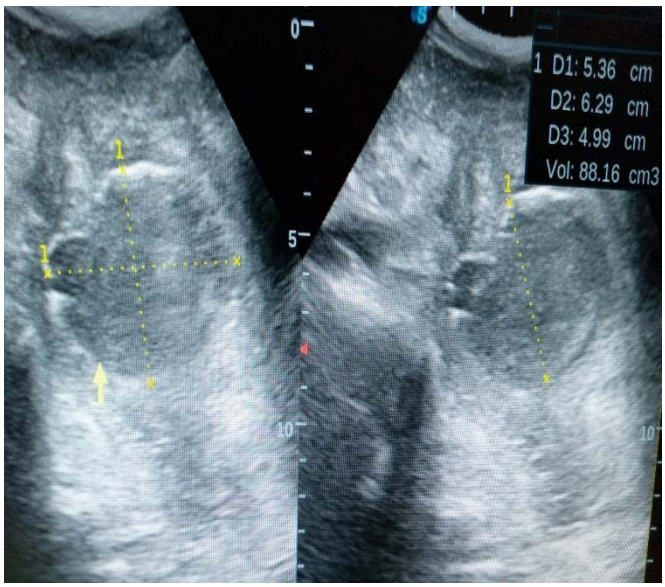


Figure 1: An ultrasonogram of the right iliac fossa region following the use of a 3.5MHz probe transducer showing a near oval area with slight irregularity of the superior walls having a heterogeneous collection with a volume of about 88mls and surrounding hypoechoic fluid; inflammatory and surrounding sentinel loops; focal paralytic ileus. This is the deep seated appendiceal abscess with surrounding focalileus.

III. Discussion

Appendicitis is the most common cause of acute abdomen, presenting as a triad of pain in the right iliac fossa, fever, and vomiting that often requires surgical intervention[1]. The index case presented with recurrent right iliac fossa pain, fever, occasional vomiting and dysuria thereby conforming to this literature.

The inflammation in acute appendicitis is often fixed by the patient's self-defense mechanism by either formation of an inflammatory mass (an appendiceal phlegmon) or a circumscribed abscess (an appendiceal abscess). The index case had a history of recurrent episodes of right iliac fossa pain and discomfort most likely due to appendicitis, the current episode was probably fixed by his immune system forming a deep seated abscess cavity with an estimated volume of about 88mls conforming to these literatures.

An appendiceal abscess is a condition in which an abscess is formed around the appendix as a result of appendiceal perforation or extension of inflammation to the adjacent tissues due to aggravation of appendicitis[2].

The index case had an abscess cavity in the right iliac fossa in the region of the vermiform appendix thereby conforming to this literature.

Appendicitis is more common in the male gender with more than 70% of cases presenting in individuals less than 30 years of age[3,6], the index case is a young male patient aged 24 years conforming to these literatures.

The vermiform appendix anatomically has varying location with respect to the caecum and can originate within a 360° circumference around the caecum, this is most likely responsible for the varying form of presentation during appendicitis[3,7]. The present case had a deep seated appendiceal abscess which was not adequately imaged following the use of a 7MHz transducer ultrasound probe, rather a detailed anatomy

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of the abscess cavity was demonstrated by the use of the 3.5MHz transducer ultrasound probe raising a suspicion of a retrocecal location of the appendix anatomically in this patient hence agreeing to these literatures.

Imaging which primarily include ultrasonography and computed tomography play vital role in the diagnosis of appendiceal abscess[3], the index case had abdominopelvic ultrasonography following which the abscess was demonstrated, thereby conforming to this literature.

Appendiceal abscess are managed traditionally by nonsurgical treatment and interval appendectomy [3,14], the case under presentation was not an exception, he initially had a course of antibiotics and analgesia with adequate monitoring of the vital signs to ensure a successful nonsurgical treatment which will be followed by interval appendectomy to prevent recurrence.

IV. Conclusion

Appendiceal abscess is often as a result of acute appendicitis and common in individuals within the second decade of life, this condition when suspected can be diagnosed ultrasonography and management immediately instituted to prevent further complications (perforation) and save the lives of these individuals.

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5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



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6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



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Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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