

Original Research Article

The presence of filarial worms in patients with elephantiasis in Benin

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ABSTRACT

Background: Lymphatic filariasis (LF) occurs in tropical and subtropical regions of the world with 40 million disabled. It is the second leading cause of disability in the world. LF is found in places with poor socio-economical conditions and large number of insects and other vectors that favor the transmission of infections. Clearly a disease of poverty. Ultrasound (USG) has been introduced for several years in the study of nematodes and lymphatic filariae in several countries. In Benin, detection was limited to the search for circulating antigen and this is the first study, carried out to study LF in Benin using USG. In LF, most of the severe disease patients have less circulating antigens, while USG allows detection and monitoring and also help clarifying the cause of the disease, still considered a curse.

Methods: We used a Mindray DP 8800 machine equipped with a Doppler mode and a multi-frequency linear probe (6.5 to 10.5 MHZ) to search for the presence of filarial worm in patient with elephantiasis. All affected parts, the axillary and inguinal regions were examined. The images obtained from a total of 107-patients were recorded, recovered, processed and analyzed.

Results: We found filarial dances (20.7%), lymphedema (26.2%), lymph nodes (30.7%), and worm pockets and necrotic pockets (7.8%) with more than one found in the same patient.

Conclusions: We conclude with the use of USG that LF is still present in the area of study and affects both sexes, with a male predominance.

Keywords: Lymphatic-filariasis, Ultrasound, Benin, Elephantiasis, Atlantic-department

INTRODUCTION

Lymphatic filariasis (LF), commonly called elephantiasis, is a disease caused by the parasitic nematodes *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori*. It affects more than 120 million people worldwide, particularly in South Asia, sub-Saharan Africa, and the Pacific Islands with 40 million disabilities. Its transmission to humans is through mosquitoes of the genera *Culex* (in India), *Anopheles* (in Africa), or *Aedes polynesiensis* (French Polynesia).^{1,2} In sub-Saharan

Africa, LF is caused by infection with the parasitic nematode *W. bancrofti* and transmitted by nocturnal biting mosquitoes of the genus *Anopheles* (*Gambiae* or *funestus*) and *Culex quinquefasciatus*.³ Infection occurs in early childhood but the first signs often occur around adolescence.⁴ The disease, because of its particular morphological manifestations and the deformities it sometimes causes to the affected person, leads to serious social stigma and is responsible for serious economic and mental stress for those affected.⁵

Adult filariae are located in the lymphatic vessels and lymph nodes and induce lymphatic dilation.⁶ Involvement of the lymphatic system results in acute and chronic manifestations: lymphangitis (scrotum, limbs), adenitis, and elephantiasis.⁷ It affects several parts of the body namely the limbs (pelvic and thoracic) but also the external genitalia of men and women. It is more common in men than in women.⁸ Elephantiasis can have other causes, apart from filarial parasites, such as lymphatic malformations, tumor compression, or lymphangitis (inflammation of the lymphatic vessels).^{2,9} Transmission of parasites begins with the deposit of infectious larva (L3) in the skin of the host during the mosquito bite. The larvae then penetrate through the piercing wound and reach the lymphatic system of the individual. They enter the lymphatic vessels, causing localized adenolymphangitis.⁷ The surviving larvae continue their migration to the large lymphatic vessels where they complete their maturation within a few months, especially in the pelvic and periaortic regions. Adults with a longevity of 12 years produce many microfilariae that are released into the peripheral blood. By ingesting them during a blood meal, mosquitoes complete the transmission cycle.⁴ Elephantiasis, due to LF, leads not only to physical but also psychological and social disabilities. In groups where the disease is endemic, 10-50% of men have genital lesions, including edema (swelling) of the bursa, and have elephantiasis of the penis and scrotum. Swelling of the entire leg, arm, vulva, or breasts, which can reach several times their normal size, can affect up to 10% of women.¹⁰

The fight against the disease has consisted of the mass distribution of drugs albendazole and ivermectin in endemic areas and the administration of antibiotics and anti-inflammatories to individuals affected by the disease in order to alleviate the symptoms of the disease.¹¹ LF is the cause of stigma and discrimination, especially for women and girls, because it causes visible injuries and disabilities that sometimes affect women more, thus reducing the possibilities of marriage.¹²

Benin, a West African country located in the Gulf of Guinea is 700 km from north to south, and 140 km from east to west for an area of 112,674 km² with a population of about 12 million inhabitants have elephantiasis in some of its twelve Departments including that of the Atlantic, Department of our study. Since 2000, about 7 billion treatments have been administered worldwide without the complete eradication of the infection.¹³ The massive administration of medicines (MAAs) proposed by the WHO in several countries around the world in general and particularly in sub-Saharan Africa has some limitations. Among these limitations, there is no means of verifying the complete elimination of worms from the affected person's body. It would therefore be necessary to find other follow-up techniques in order to overcome this disease. Thus, for about a decade, ultrasonography has been introduced into the study of nematodes and particularly lymphatic filariae.¹⁴ This imaging technique

has proven to be a tool for highlighting wireframes in recent years and has made it possible to locate and count worms in different organs in elephantiasis patients, and also in asymptomatic individuals living in endemic areas. Several studies around the world and in Africa have shown the importance and usefulness of ultrasound in the diagnosis, monitoring, and treatment of elephantiasis (citations needed). In the study done by Khatri et al the preferred sites of adult *W. bancrofti* worms were highlighted as the spermatic cord and the epididymis.¹⁵ Several species of filarial nematodes have been studied by ultrasound in humans and Mongolian gerbils, the results of which are published in several scientific journals and journals such as the research of *W. bancrofti* through ultrasound in which Sabine Mand showed the reliability and frequency of the discovery by ultrasound of *Wuchereria* in women in Ghana.² Another study was done with the aim of comparing *B. malayi* and *W. bancrofti* by ultrasound, which showed the limits of ultrasonography in the search for *B. malayi*.¹⁶

Ultrasound, a non-invasive technique, can thus become a valuable tool in the study and monitoring of lymphatic filariae and especially in their localization. Amaral et al used it to highlight wireframes in 7 (seven) asymptomatic carriers.¹⁷ Reddy et al highlighted the preferential sites of adult *W. bancrofti* worms in humans Khatri et al namely the scrotum, spermatic cord, and epididymis in Pondicherry (India).^{15,18} This technique may be essential at times when the highlighting of the infection is no longer evident and the larvae are no longer detectable in the blood. In Sabine Mand's 2006 study of patients from India and Indonesia, she showed not only that the *B. malayi* worms could be visualized by ultrasound in the lungs, thigh skin, and lymph nodes and inguinal lymph nodes, although the latter is smaller than *W. bancrofti*.² This technique may have limitations due to the instability of the worm nests in the body. Another study highlighted the different signs of recognition of *W. bancrofti* by ultrasound that is: the sign of the dance of the wireframes filariasis dance sign (FDS); accumulation of testicular fluid, dilation of lymphatic vessels, thickening and roughness of the skin of the scrotum. These signs are noticeable in both adults and children.¹⁰

In Benin, the fight against neglected diseases in general and LF is based on the mass drug administration of albendazole and ivermectin. The diagnosis of patients is mainly based on immune-chromatography filariasis test strip (FTS) and microfilaremia tests.¹⁹ These diagnostic methods are invasive, expensive and not accessible to individuals. In addition, immune-chromatography strip tests do not allow to locate, thus to know the number of worms whether before or after therapeutic management. Ultrasound, on the other hand, is a non-invasive and easily accessible technique. The introduction of ultrasound in the diagnosis and therapeutic follow-up will not only avoid invasive methods but will promote better management and follow-up of patients to ensure the complete elimination or not of worms.

METHODS

Study framework

Our study took place in the Atlantique Department located in the south of Benin. With an area of 3,233 km² and a population of 801,683 inhabitants in 2002, the population density is 248 inhabitants/km².²⁰ It extends over nearly 100 km from the coast towards the interior of the country and is limited to the south by the Atlantic Ocean, to the north by the Department of Zou, to the west by the Department of Mono, and to the east, by that of Oueme. The border passes through the middle of the Oueme valley and crosses Lake Nokoue to reach the coast at the limit of the Littoral Department.²¹ It is essentially marked by a subequatorial climate characterized by two dry seasons and two rainy seasons. It has a fairly large hydrographic network made up of the Couffo River and the Nokoue and Aheme (23) lakes.

This Department is subdivided into eight (8) communes, 74 boroughs, and 501 village and city districts. The Department of Atlantique comprises 22 500 ha of lakes and lagoons and 240 000 ha of arable land, of which less than 100 000 ha are cultivated.²⁰

The ethnic groups encountered mainly in terms of the settlement are the Fon and related 76.3%, the related Adja 15.6%. The populations of the Atlantic are mainly Catholic (39.3%), followers of traditional religions (12.9%) and also practice Celestial Christianity (11.0%).²⁰

In terms of health, the Department is subdivided into three (3) health zones and includes (64) health centers, (11) dispensaries, (14) maternity hospitals, 2 hospitals of the first reference called Zone Hospitals, and a university center (25). Access to drinking water is not easy for people. Just over half of households (54.2%) have access to safe drinking water. In terms of school infrastructure, there is a significant effort because almost all villages and city districts have a primary school, and 1st cycle and 2nd cycle colleges are present in many districts including the University of Abomey Calavi which is the largest in the country. Its population is the largest, but the socio-community infrastructure does not always meet the demands of the population.²⁰

The dominant activities in the Department are agriculture, fishing, and hunting with a strong disparity within the communes. LF is one of the most common diseases among the populations of this Department.

The study population consists of people selected in the eight municipalities of the Department of Atlantique who are farmers, fishermen, hunters, etc. or coming from areas bordering the Department. The sampling focused on 107 patients randomly identified from November 2019 to December 2020 for all 4 sites of the two zone hospitals.

The patients recruited are those who voluntarily came to consult without prior publicity about the study.

Inclusion criteria

Being a resident of the study area (Atlantique Department) and suffering of elephantiasis disease, or reside a close relative; belonging to the family of an elephantiasis and agreeing to participate in the study.

Exclusion criteria

All subjects that reside out of the study area were excluded from the study.

Our samples come from patients coming to consult for problems of swelling of limbs (thoracic or pelvic), bursa, breasts, etc. To do this, an information sheet (surname, first name, and contact) is deposited at the various receptions of medicine and surgery of the zone hospitals of Calavi de Ouidah and Allada after authorization of the directors of these centers, that of the ethics committee (CE). These sheets are collected at the end of the day after the daily consultations, for registration in an Excel file. Patients are then contacted for a group interview to explain to them the purpose of the study and the risks and benefits of their participating. Those who freely chose to participate after signing a consent form underwent the ultrasound examination. On the day of the examination, patients from the same area were grouped together and transported to and from the imaging center by us. At the imaging center, patients were seated on a bench in the waiting room and took turns entering the exam room. In the waiting room, a public interview followed by questions and answers took place to explain once again the objective of the study and especially the course of the examination. In the ultrasound room, they were answered a questionnaire (surname, first name, sex, age, profession, commune of origin, origin of the disease, previous treatment, use of mosquito nets etc.)

In this study, we used a Mindray DP 8800 ultrasound scanner. With the patient lying on the bed, the examination was done with a multifrequency linear probe from 6.5 to 10.5 MHZ. All parts affected by the disease in patients were examined as well as the axillary and inguinal regions. The resulting images were stored in a logger associated with the device; they were then retrieved, processed, and analyzed.

The study received approval from the National Ethics Committee for Health Research (CNER/SA) on April 23, 2021.

Statistical analysis

All the data collected were entered into an excel 2010 file. They were analyzed through the parameters of descriptive statistics and the realization of graphs.

Need a section on ethical clearance/use of human subjects: explains the case report form, assurance of patient privacy, name and approval number of the agency that approved the study.

RESULTS

The study population consisted of people living near rivers and lakes and practicing crafts, agriculture, hunting, and fishing. The sampling involved 107 patients including 61 men (57%) against 46 women (43%) with an average age of 43 years randomly identified from November 2019 to December 2020 for all 4 sites of the two zone hospitals (Table 1). The patients recruited are those who voluntarily came to consult without prior publicity about the study. The study concentrated in the south of Benin as shown in Figure 1, which also shows the 8 communes of provenance of the patients and controls. They also came from almost all the communes of the Department of Atlantique and even from neighboring Departments, Littoral and Ouémé (Figure 1). However we found few cases of LF in these neighboring Departments in the cities of Cotonou and Porto Novo (Figure 1).

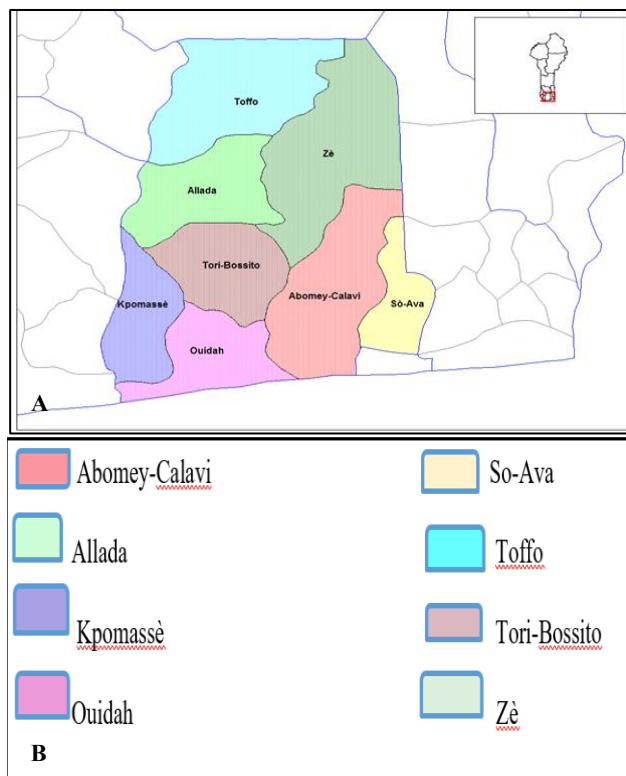


Figure 1: Map of the department of Atlantique.

The highest prevalence was seen in patients between 20 and 60 years of age (Table 1).

Figure 2 shows a high prevalence of the disease in the municipalities of So-Ava and Abomey-Calavi, which are the lakeside cities of the Department of Atlantique with a strong predominance among men.

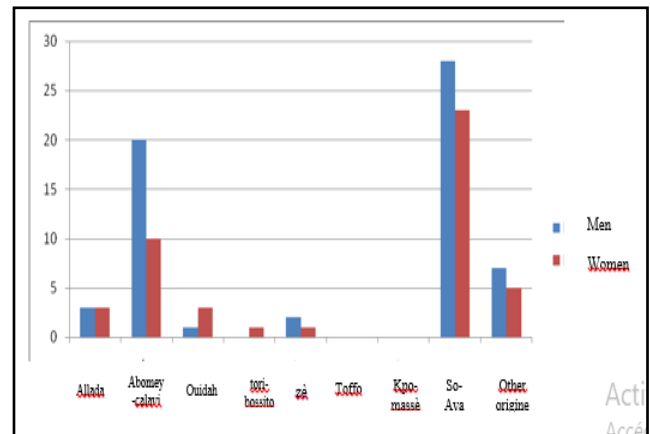


Figure 2: Distribution of subjects by the commune of origin and sex.

Figure 3 shows the various lymphatic pathologies encountered among patients. They are present in both sexes, with the exception of hydrocele. Most of patients have more than one symptoms and carry several of these pathological conditions at the same time. Women were the most common carriers, although they represent only 43% (46 individuals) of our study population. The most common conditions were lymphedema and inflamed lymph nodes, while the least common were filarial dance, worm pockets, necrotic pockets, hernia and hydrocele.

The following ultrasound images (Figure 4) show the lymphatic conditions observed in patients who received ultrasound. Ultrasound images of LF are characterized by filarial dance sign (FDS) (A, Figure 4); lymphedema which shows an accumulation of fluid in the tissues (D, Figure 4) the hydrocele which is abnormal increase in the volume of the scrotal fluid (C, Figure 4). There are some changes in the genital tract of humans such as thickening and roughness of the skin of the scrotum, dilation of the epididymis and spermatic cords, as well as dilation of the lymphatic vessels (B, Figure 4). Some patients have pockets of worms and pockets of necrotic tissue (E, Figure 4). Inflammatory lymph nodes appear in the axillary and inguinal hollows justifying the existence of an infectious process (F, Figure 4).

Table 1: Distribution of patients received by age group and sex.

Intervals	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	Total
Men	4	4	10	10	11	8	11	2	1	61
Women	0	5	5	8	12	9	3	4	0	46
Total	4	9	15	18	23	17	14	6	1	107

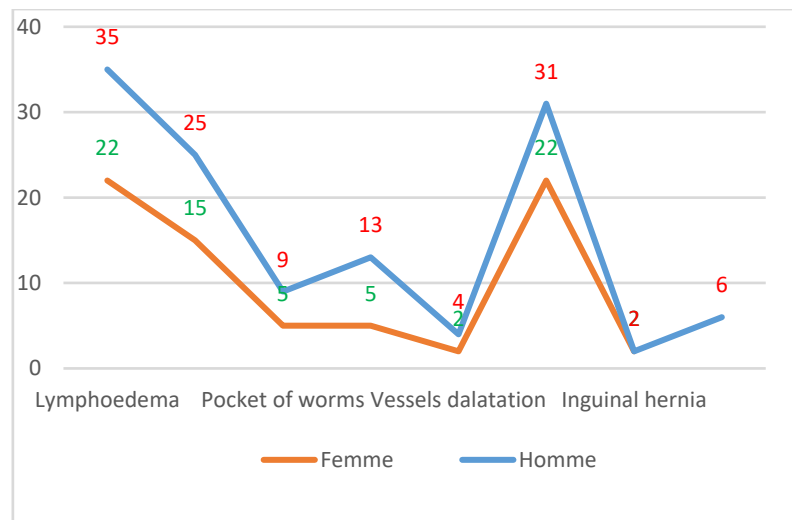


Figure 3: Distribution of the different lymphatic pathologies encountered by sex.

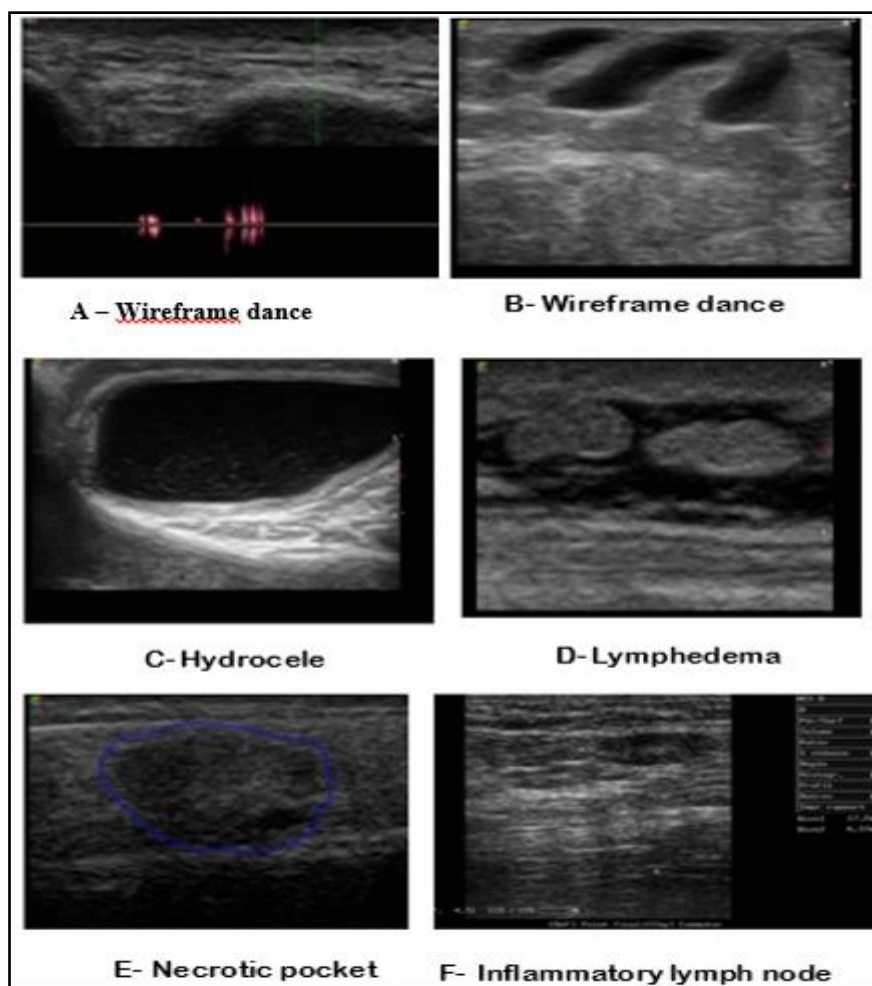


Figure 4: Pathological images in patients received on ultrasound.

DISCUSSION

It should be noted that LF is, as of the last mapping of 2016, no endemic in the neighboring Departments of Cotonou and Porto Novo.¹⁹ This explained why we have

the lowest number of Patients coming from these areas as as shown in Figure 1.

According to the results of our sampling, elephantiasis is well established in the Atlantic department and affects

both sexes. The 57% of men suffer from the condition, compared with 43% of women, as shown in Table 1; the median age of the sample was 43. In view of this table, men are more affected than women. The age group most affected is that between 30 and 55 years for both sexes, i.e. 58 people, representing 54.2% of the total (Table 1). This can be explained by the fact that this age group represents the active population engaged in common activities in the study area (fishing, hunting, farming, etc.), which are activities at risk of exposure to the bites of microfilaria transmission vectors.

Figure 2 shows that the disease is present in almost all communes in the Atlantic department, and even in some neighbouring communes, with the exception of Kpomassè and Toffo. The most prevalent communes are Abomey-Calavi and So-Ava, the marshy areas of the Atlantic department. This confirms the results of previous work done in Congo.²²

Figure 3 shows the various lymphatic pathologies encountered during our ultrasound study. They are present in both sexes, with the exception of hydrocele. Several patients are carriers of several of these conditions at the same time. Women were the most common carriers, accounting for 43% (46 individuals) versus 57% (61 individuals) of men in our study population. The most common conditions were lymphedema and inflamed lymph nodes, while the least common were filarial dance, worm pouches, necrotic pouches, hernia and hydrocele. All this confirms the work of Mand, Hoerauf et al in Ghana.^{16,23}

The body parts affected by lymphatic pathologies are the limbs (thoracic and pelvic) and the male genital organ. Contrary to the literature, we did not come across cases of elephantiasis of the breasts, buttocks and female genitalia. This can be explained by the fact that, as these are intimate parts of the body, the carriers have not wanted to expose them; especially as the disease has always been considered to be a spell or a curse cast on the carrier, or due to adultery.

The main lymphatic pathologies found in this study were lymphatic vessel dilatation, inflammatory lymph nodes, necrotic pockets on the leg and especially the arm, worm nests, lymphedema, hydrocele and, above all, filarial dance. These results confirm those of Amaral et al in Recife, Brazil, showing the usefulness of ultrasound in the diagnosis of lymphatic pathologies. Amaral et al had demonstrated the dilation of lymphatic vessels and the dance of filaria. Faris et al in Egypt, also demonstrated the dance of filaria using Doppler to study live adult worms.^{14,17}

Figure 4 shows the main lymphatic disorders, and confirms that inflammatory lymph nodes are the most frequently encountered, followed by lymphoedema, filarial dance, necrotic or worm pockets. These results confirm the work of Reddy et al in India; Mand et al in

Ghana showed the localization of lymphatic worms. In Ghana Mand et al Hoerauf et al demonstrated the important role played by ultrasound in the diagnosis and treatment of lymphatic pathologies, enabling us today to demystify the taboo surrounding this condition. Worm and necrotic pockets were observed not only in lymph nodes, but also in leg and thigh muscles. The results obtained by our study are similar to those of the precursors who explored the field before us, as mentioned above. Problems of diagnosis and management must be resolved at the level of the health zone hospital (HZs), which are the first referral centers. The health personnel working in these facilities need to be trained in the management of neglected tropical diseases, particularly elephantiasis.^{16,23}

At the end of our study, we reported those limits. The first one is the limited number of consenting subjects who participated. The second is the unavailability of a portable ultrasound device with Doppler mode which enable to perform home-based ultrasounds exam for subjects.

CONCLUSION

The present study has shown that LF is present in all the municipalities of the Department of Atlantique and affects both sexes. The parts of the body of the affected patients are most often the thigh, leg, ankle and external genitalia of the man. The ultrasound manifestations of pathology observed in the Department of Atlantique of Benin are the same as those highlighted by previous studies except that we had a muscular localization of the FDS and necrotic pockets in some patients such as wireworm dances, worm pockets, necrotic pockets.

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