

Case Report



A Case Report of an Appendicitis and Parasitosis

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Abstract

Appendicitis is a common clinical problem but is not specific to a parasite. A 43-year-old patient consulted for digestive troubles, mostly acute abdominal pain, in the right part. *Taenia saginata* was found in appendectomy. Different parasites were found in the histopathological evaluation of the appendix, mostly *Enterobius vermicularis*, but also *Ascaris*, *Taenia*, *amoeba*, and *Schistosoma*. Acute appendicitis was proven by submucosal fibrosis, active suppurative inflammation, and active granulomas surrounding eggs or larvae of parasites. However, parasites were detected by chance in uninflamed and histologically normal appendices or appendices with chronic inflammation removed during other surgical procedures. The role of parasites in the pathogenesis of acute appendicitis is unclear. An adapted antiparasitic treatment is always necessary after appendectomy following finding parasites.

Keywords: Appendicitis, *Enterobius vermicularis*, *Ascaris*, *Trichuris trichiura*, *Taenia-Schistosoma-Entamoeba histolytica*

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Introduction

Parasitic infections are an uncommon cause of acute appendicitis with usual symptoms such as pain in the lower right abdomen, nausea, abdominal swelling, and fever. Nevertheless, when an acutely inflamed appendix is removed, parasites are sometimes found in the lumen of the appendix. However, the role of parasites (mostly worms) in the etiology of acute appendicitis is controversial. The occurrence of acute appendicitis is not specific to some parasites, even if some worms are located frequently in the caecum. According to previous research (1), various helminths and some protozoans are found in the appendix (Table 1). Histopathological sections of appendices detect pathological changes from lymphoid hyperplasia to acute inflammation with peritonitis. In a study on 1600 appendectomy specimens, the appendix was normal or gangrenous in the same percentage of appendices with parasitic infestations (88 cases) or without parasitic infestation (1 512 cases). On pathological examinations, the appendices may have a catarrhal, suppurative, or normal appearance (Table 2) (2).

Case Presentation

A 43-year-old man, without medical history, was consulted for digestive disorders (abdominal pain, nausea, and diarrhea) that had persisted for several weeks despite various symptomatic treatments. The biological assessment was normal apart from blood

hypereosinophilia at 850/mm³. No allergic or toxic etiology was found, and a single stool parasitological examination remained negative. The patient was treated with flubendazole without any results. Fifteen days later, he faced with the aggravation of disorders and acute pain in the right iliac fossa, thus it was decided to accede to the patient's request and perform an appendectomy. Indeed, this patient was a great traveler and wanted to avoid an attack of appendicitis during an exploration trip. During surgery, the surgeon extracted a white, flatworm from the appendix, which was identified as *Taenia saginata*. The pathological study of the operative specimen showed a section of the taenia. This patient, a great lover of rare beef, was cured in a few days with praziquantel. However, he continued to consume rare beef and the like without new infestation by a tapeworm.

Discussion

Nematodes

Oxyuriasis

Enterobius vermicularis (2-15 mm) is one of the most common worldwide helminths, occurring mostly in children between 5 and 10 years of age. Adult worms inhabit the caecum and often the appendix (Figure 1), as observed since 1634. The females migrate down the colon and crawl out of the anus to deposit their eggs. The most specific symptom is an itchy rectal area, which is worse at night.



Table 1. Parasites Found in a Study of 50000 Human Appendices

Parasites	Number	%
<i>Entamoeba histolytica</i>	2510	3.02
<i>Enterobius vermicularis</i>	319	0.63
<i>Trichinella</i> sp	191	0.38
<i>Trichuris trichiura</i>	146	0.29
<i>Ascaris lumbricoides</i>	97	0.19
<i>Giardia intestinalis</i>	61	0.12
Hookworms	51	0.10
<i>Taenia saginata</i>	24	0.04
<i>Strongyloides stercoralis</i>	21	0.04
<i>Hymenolepis nana</i>	17	0.03
<i>Taenia solium</i>	16	0.03
<i>Diphyllobothrium latum</i>	11	0.02
<i>Paragonimus</i>	9	0.01
<i>Balantidium coli</i>	6	0.01
<i>Schistosoma mansoni</i>	6	0.01
<i>Schistosoma japonicum</i>	5	0.01
<i>Fasciolopsis buski</i>	2	0.004
<i>Wuchereria bancrofti</i>	2	0.004
<i>Fasciola hepatica</i>	1	0.002

Source. Collins (1).

Table 2. Histopathological Study on 1600 Appendectomy Specimens

Parasite	Number (1600)	Appendix		
		Normal	Catarrhal	Suppurative
N = Positive	88	34	35	19
%	5.5 (%)	20.4 (%)	2.2 (%)	1.1 (%)
<i>Enterobius vermicularis</i>	51.6 (%)	1 (%)	1.2 (%)	0.6 (%)
<i>Ascaris lumbricoides</i>	26.1 (%)	0.8 (%)	0.3 (%)	0.4 (%)
<i>Schistosoma</i> sp.	9.1 (%)	0.25 (%)	0.2 (%)	0.06 (%)
<i>Trichuris trichiura</i>	8 (%)	0.13 (%)	0.25 (%)	0.06 (%)
<i>Taenia saginata</i>	5.7 (%)	0 (%)	0.3 (%)	0.006 (%)

Source. Zakaria (2).

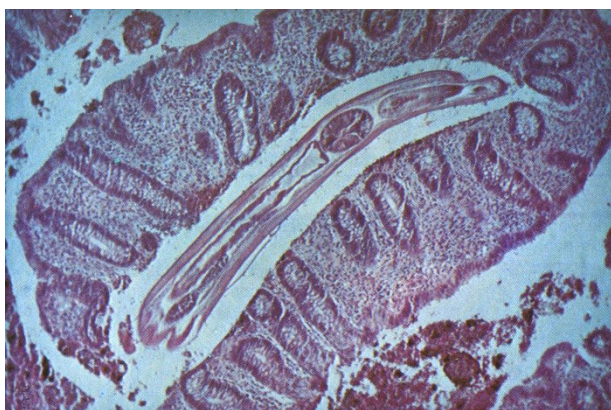


Figure 1. Longitudinal Section of *Enterobius vermicularis* in Appendix

The relationship between *E. vermicularis* and appendicitis is difficult to dissect. Some studies suggest a relationship between the presence of *E. vermicularis* and acute inflammation and granulomas, but this opinion needs discussion. The mature worm is attached to the mucosa of the caecum and the appendix. Usually, *Enterobius* are found in the lumen (Table 3) in the cross-section of the appendix (Figure 2) without any other abnormality and may occasionally penetrate the intestinal wall without any reaction. Hence, it may be present, mostly if there are numerous worms associated with suppurative appendicitis by coincidence. However, in some cases, this parasite had a causal role in appendicular pain and sometimes a perforation, including in adult patients (3), and was found in inflamed appendices removed at operation (4) with hyperplasia of lymphoid follicles (5). The exit of pinworms adults was already observed by the scar of an appendectomy (6).

In a study in a children’s hospital (USA), of 1540 appendectomies performed during five years, 21 specimens (1, 4%) were found to contain *Enterobius*, including 15 cases with symptoms of acute appendicitis and 6 cases with incidental appendectomies (7). More female *E. vermicularis* are found in the appendix than male ones with eggs in the lumen (Figure 3) (12). The diagnosis is based on acquiring worms and specific eggs in stools examination and from the perianal skin and by the adhesive tape. Flubendazole and albendazole are active, and it is necessary to treat the whole family and to practice good hygiene. Even if the diagnosis is made

Table 3. *Enterobius* and Appendicitis

Country	Numbers of Appendectomies	<i>Enterobius vermicularis</i> Found in the Appendix (Ref.)
USA	1549	1.4% (6)
Turkey	890	2% (7)
Nepal	624	1,6% (8)
Denmark	2267	4.1% (9)
Iran	5048	2.9% (10)
Great Britain	293	2.7% (11)



Figure 2. Cross-section of *Enterobius vermicularis*

by the pathologist only in the appendix sample, the treatment is necessary.

Ascariasis

Ascaris lumbricoides is a worldwide roundworm (about one billion people infected) recognized since Antiquity. The infection is often asymptomatic if the number of worms is small. A heavy infestation may cause digestive troubles and sometimes some complications such as the obstruction of the bowel, of the bile or pancreatic duct, and the issue can be fatal. Sometimes, *Ascaris* are located in the appendix (13) and may cause inflammation and appendicitis, and even peritonitis (14). The diagnosis of *Ascaris* in the appendix is made by ultrasonography or computerized tomography (CT) scanning showing long filling defects (15) and multiple air-filled elongated tubular structures with diffuse wall thickness increase of the appendix (16). The diagnosis is confirmed by appendectomy with occasional adult worms presenting from the orifice of the appendix (Figure 4) and by the section of the appendix (Figure 5). The eggs are found in stool examinations. The diagnosis is confirmed by the section of the appendix with the cross-section of worms

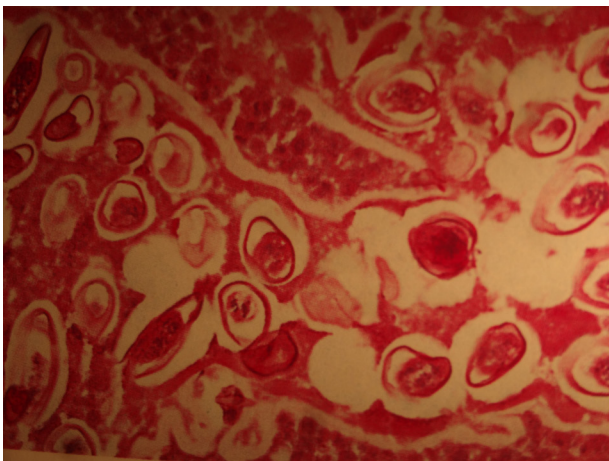


Figure 3. Cross-section of the Eggs of *Enterobius vermicularis*

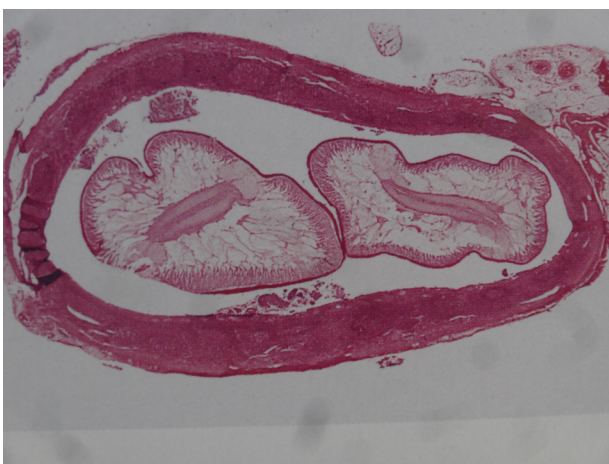


Figure 4. Cross-section of *Ascaris* in Appendix

(Figure 4) and sometimes by appendectomy with adult worm presenting from the orifice of appendix (Figure 5). Ascariidiosis is treated with albendazole and surgery in the case of intestinal obstruction.

Trichuriasis

Trichuriasis is a worldwide parasitic infection (500 million people) due to the ingestion of infective eggs with contaminated food. High numbers of worms can cause oedema, rectal prolapse (with visible worms), and appendicitis (17,18). The sections of *Trichuris trichiura* with a narrow anterior portion and a thicker posterior position are occasionally found in the cross-section of the appendix (Figures 6A and 6B). Diagnosis is based on the stool examination, which reveals the typical eggs. Treatment with flubendazole is effective.

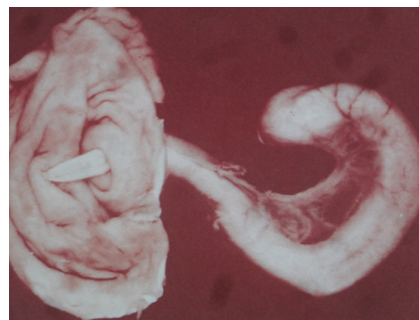


Figure 5. *Ascaris* Adult in Appendix

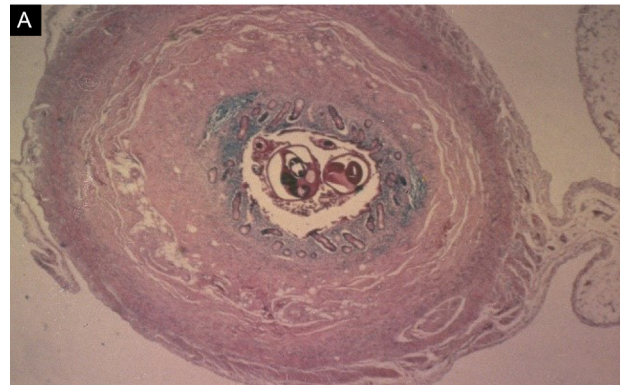


Figure 6. (A) Cross-section of *Trichuris trichiura* in Appendix ($\times 20$). (B) Cross-section of *Trichuris trichiura* in Appendix With Narrow Anterior and Thicker Posterior Portions ($\times 200$)

Angiostrongyliasis

Angiostrongylus costaricensis is an intestinal nematode in Central and South America, causing eosinophilic gastroenteritis. The main locations of the lesion are the caecum, the ascending colon, the small intestine, and the appendix (19). Usually, the diagnosis is made after surgical exploration, including the eosinophilic infiltration of the caecum and appendix, with eggs, that are larvae on the adult forms of *A. costaricensis*. Sometimes, the parasites can cause severe ischemic lesions with gastrointestinal hemorrhages.

Strongyloidiasis

Strongyloides stercoralis (or threadworm) is a tropical roundworm, where sanitation standards are poor (80 million people). The infection occurs when infectious larvae penetrate the skin in contact with the soil. Because of autoinfection, humans can be infected more than 60 years old after they left tropical areas.

Most cases of strongyloidiasis are asymptomatic. However, adult worms burrow into the duodenal mucosa and may cause severe gastrointestinal symptoms. In the case of immunosuppression (corticosteroid, transplantation, HTLV-1, and leukemia) (20), there is a large number of larvae worms that disseminate throughout the body. In heavy infection, other complications are possible, including necrotizing jejunitis, gastrointestinal bleeding, or appendicitis. The wall of the appendix is edematous or acutely inflamed in case of appendectomy (21), with eosinophilic granulomas surrounding *Strongyloides* larvae (22). The diagnosis is confirmed by the stool examination which reveals rhabditiform larvae. A serological diagnosis of *Strongyloides* infection is possible. Ivermectin is the drug of choice in a single oral dose.

Hookworms

Hookworms are tropical roundworms (*Ancylostoma duodenale* and *Necator americanus*) that are transmitted by skin penetration. They induce abdominal pain, nausea, anorexia, and blood loss. Some abdominal pain may evoke appendicitis, including *Ancylostoma caninum* (23). Diagnosis is confirmed by the stool examination showing the eggs. Albendazole is an effective treatment.

Cestodes

Taeniasis

Humans are the definitive host for large tapeworms such as *Taenia saginata* (beef tapeworm), *Taenia solium* (pork tapeworm), and *Diphyllobothrium latum* (fish tapeworm). These worldwide worms live in the small intestine, and the symptomatology includes abdominal pain, nausea, headache, weight loss, and increased appetite. Out of 660 patients, *E. vermicularis* and *Taenia* were found mostly in children and adults, respectively (24).

Sometimes symptoms are mimicking appendicitis (25,26). The proglottids of the adult tapeworm may be found in the lumen of the appendix (27), with a cross-section of intact proglottids (Figure 7). The ova of *T. saginata* may be found singly or inside a section of the adult worm because the proglottids of *T. saginata* easily release their uterine contents of eggs, while the ova of *T. solium* are extremely seldom in the appendix because the proglottids of *T. solium* are to be crushed in order to liberate their eggs. Other cestodes such as *Hymenolepis nana* or *H. diminuta* can be found very rarely in the appendix (28). Praziquantel and albendazole are effective.

Hydatidosis

Hydatid disease is due to infection by the larval form of the dog tapeworm, *Echinococcus granulosus*. Eggs hatch in the stomach and release oncosphere and penetrate the mucosa, enter circulation, and develop in the viscera, particularly in the liver (70%), lungs (40%), and other locations such as the kidney, spleen, brain, and heart. The location in the appendix is very seldom, with scolex and hooklets found in the lumen of the appendix (29), and is often associated with the hydatid disease of the other organs (30). Occasionally, it seems to be a uterus lateral mass (31). Surgery is the treatment of choice with albendazole for several months.

Trematodes

Schistosomiasis

Schistosomiasis (or bilharziasis) is a chronic parasitic disease due to several species of the fluke of the genus *Schistosoma* (Table 4). *Schistosoma* sp. are well adapted to the human host, thus the majority of infected people have mild symptoms. The pathologic lesion in schistosomiasis is the granulomatous reaction observed around eggs trapped in tissues due to the soluble egg antigen which induces both humoral and cellular immune responses. The appendix may be involved (32) and since 1966 there have been various reports (33) of it causing symptoms



Figure 7. Cross-section of Gravid Proglottids of *Taenia* With Eggs

Table 4. Different Species of *Schistosoma*

Species	Geographical Distribution	Intermediate Host	Definitive Host	Pathology
<i>Schistosoma haematobium</i>	Africa, Madagascar, Near East	<i>Bulinus</i>	Man	Haematuria
<i>Schistosoma mansoni</i>	Africa, Madagascar, South America, Caribbean	<i>Biomphalaria</i>	Man, Rodents	Intestinal disease, Portal hypertension
<i>Schistosoma intercalatum</i>	Central Africa	<i>Bulinus</i>	Man	Dysenteric syndrome
<i>Schistosoma japonicum</i>	China, Philippines	<i>Oncomelania</i>	Man, Animals	Katayama syndrome early portal hypertension
<i>Schistosoma mekongi</i>	South East Asia	<i>Neotricula</i>	Man, Animals	Katayama syndrome early portal hypertension

such as acute appendicitis, and intestinal perforation (34). (Table 5), especially in human immunodeficiency virus (HIV)-infected patients (35) and sometimes gangrenous appendix (36) and peritonitis (37,38), including during pregnancy (39). *Schistosoma intercalatum* and *Schistosoma japonicum* (40) can also cause appendicitis. A single oral dose of praziquantel is an effective treatment.

Diagnosis is based on the detection of eggs in stool or urine examinations. After an appendectomy, *Schistosoma* ova can be found in the histopathological examination of the appendix (Figure 8), showing transmural acute appendicitis (41), active granulomatous reaction, necrotizing tissue, fibrosis and calcification in the wall, and sometimes, the presence of purulent pathological exudative secretions (42). Suppuration is probably due to the severe fibrosis induced by numerous calcified ova inside it.

Protozoan

Amoebiasis

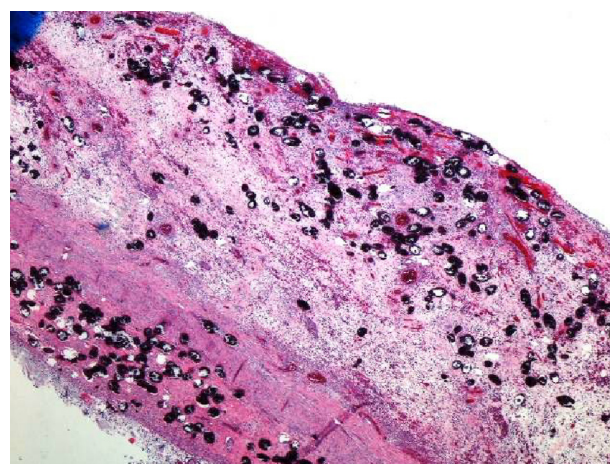
Amoebiasis is highly frequent in tropical areas and is strongly associated with bad sanitation. Infection occurs by swallowing the cysts of *Entamoeba histolytica* with contaminated food and water. Trophozoites invade the intestine, mostly in the caecum, ascending colon, and the sigmoid (43). In fulminating necrotizing amoebic dysentery, the whole colon may be full of ulcers, mostly in HIV-infected patients (44). Clinical symptoms are meteorism, vomiting, tenesmus, and diarrhoea with excessive mucus and blood. Tenderness may develop over the caecum, simulating appendicitis. CT shows a dilated appendix with a thickened cecal wall (45). Perforation is a severe complication of the bowel, leading to peritonitis with a mortality of 3.2% (46). In a study on 50 000 human appendices, *Entamoeba histolytica* was found in 3% of cases (1), and different other parasites can be found in the same appendix (47), sometimes with a necrotic appendix (Figure 9).

Invasive amoebiasis is treated by imidazole derivative (e.g., metronidazole or tinidazole) plus luminal agent (e.g., paromomycin). Prevention requires improved hygiene sanitation and water treatment.

Table 5. Different Studies of Appendices Infected With *Schistosoma*

Year	Country	Number of Appendectomy	Appendices Infected With <i>Schistosoma</i> NO. (%)
1987	Saudi Arabia	1 600	26 (1.6)
1987	Nigeria	518	32 (6.1)
1988	Ghana	2584	76 (2.9)
1991	Nigeria	627	15 (2.63)
1994	Saudi Arabia	4708	64 (1.3)
2006	Nigeria	843	35 (4.1)
2009	Nigeria	956	22 (2.3)
2012	Saudi Arabia	1 600	8 (0.5)
2014	Nigeria	1 464	30 (2.0)
2015	South Africa	304	31 (10.1)
2015	Saudi Arabia	1536	2 (0.1)
2019	Libya	4012	8(0.1)

Source. Zacarias (15).

**Figure 8.** Eggs of *Schistosoma* in Appendix

Balantidiasis

Balantidium coli, the only pathogenic ciliate of man, is a common intestinal protozoan of monkeys, pigs, and rats. Human infestation is due to the ingestion of cysts in contaminated food and water. The infection is usually asymptomatic. However, the parasites may occasionally

invade the intestine and provoke symptoms that are similar to those of amoebic dysentery. The involvement of the appendix is rare, and the symptoms are indistinguishable from those of acute appendicitis (48). Diagnosis is based on the histopathologic examination of the appendix, revealing *B. coli* trophozoites (50 µm) throughout the wall of the appendix and adhering to the sloughed mucosal surface (49) (Figure 10). Treatment with cyclines is effective.

Some other parasites may be rarely reported as a cause of appendicitis or are observed in asymptomatic patients, whose appendix was removed as an incidental procedure in patients who complained of abdominal pain as *Capillaria*, *Trichinella*, *Cryptosporidium*, *Giardia* (50,51), or flukes as *Clonorchis*, *Heterophyses*, *Paragonimus*, *Fasciola hepatica* (1), or *Fasciola buski* (48,52,53).

Conclusion

Parasitic infections are detected in different histopathological studies of removed appendices. Intestinal parasites may cause symptoms similar to that of acute appendicitis, chronic appendicitis, and appendiceal perforation. However, these parasitic infestations have also been found in symptom-free patients. The presence of parasites in the appendix may be a co-factor in the development of appendicitis. The stool samples should be examined in the case of appendicitis in endemic areas to diagnose intestinal parasites. Accordingly, careful attention to clinical history and high eosinophilia may aid

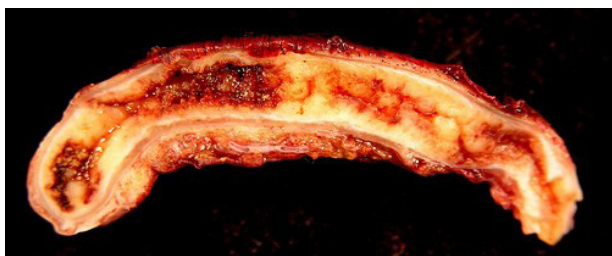


Figure 9. Necrotic Appendix Infested With *Entamoeba histolytica*

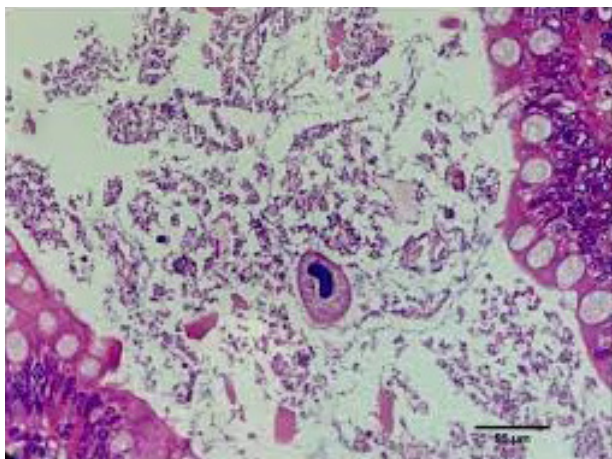


Figure 10. *Balantidium coli* in Appendix

diagnosis and avoid unnecessary appendectomy.

Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

Written informed consent was obtained from the patient for the publication of this clinical case.

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