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Case Report

Endovascular revascularization for isolated renal artery thrombosis following blunt trauma: a rare case report and review of the literature

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Abstract: *Background:* Isolated renal artery thrombosis (RAT) following blunt trauma is very rare. RAT after blunt trauma almost never occurs as an isolated event but rather accompanies major injuries. There has been a relative increase in diagnosis with the help of advanced imaging techniques, such as computed tomography (CT). This study presents selective renal artery stenting in a patient with isolated RAT following blunt trauma. *Case report:* In this case, a young male presented with unilateral isolated RAT, affecting the left kidney, after thoracoabdominal blunt trauma with no clinical and laboratory abnormalities. Contrast enhanced CT (CECT) revealed thrombosis of the left renal artery with no contrast retention. CT angiography showed an occlusion of 2 cm in the middle segment of the left renal artery and an endovascular stent was placed. Renal artery flow was patent in the follow up. Percutaneous endovascular revascularization was successfully implemented in the patient and hypertension (HT) did not develop during short term follow up. Scintigraphy showed that the left kidney had minimal function. *Conclusion:* Minimally invasive treatment is encouraged for young patients with RAT occurring in the late period of trauma to save kidney function and prevent probable renal HT, although risk of low kidney function remains present. Percutaneous endovascular revascularization can be used safely instead of surgical revascularization, due to the minimally invasive nature and lower morbidity.

Keywords: Angiography, blunt abdominal trauma, percutaneous endovascular revascularization, renal artery thrombosis

Introduction

Isolated renal artery thrombosis (RAT) following blunt trauma is very rare [1]. There has been a relative increase in its diagnosis with the help of advanced imaging techniques, such as computed tomography (CT) [2]. It is not possible for a single center to have enough experience on the subject since clinical presentation is so rare. Collecting case reports may gather enough clinical data (**Table 1**). The classical approach to renal artery traumas is early nephrectomy but recent attempts have preferred kidney-preserving treatments [3]. This article presented selective renal artery stenting in a patient with isolated RAT after blunt trauma.

Case report

A 21-year old male patient was referred to our clinic after primary intervention, in a peripheral hospital, following thoracoabdominal trauma received when a truck fell on him. He was working as a car serviceman when the truck fell on him due to a jack dysfunction. The primary hospital treated the patient with bilateral thoracotomy tubes for pneumothorax. The patient was sent to our clinic for further evaluation, 48 hours later, after he was hemodynamically stabilized.

Patient vitals were clinically stabile (pulse rate was 100/min, blood pressure was 100/60 mmHg, and oxygen saturation was 96%) at the time of administration. Physical examination revealed edema and hemorrhage in both eyes and a bilateral thoracotomy tube was present. Abdominal examination did not reveal any pathology. Thorax and abdomen were tender with palpation and defense and rebound were not present. Patient was evaluated for other internal injuries by thoracoabdominal CT with

Table 1. Details of reported cases along with their treatment in the English literature over the past decade

Study No.	Authors, year	Age, Sex	Number of cases and side	Investigations	Time to intervention	Management	Results/follow-up
1	Garge et al., 2013 [1]	4, F	1, U/L	CECT, IVU, DMSA Scan, CT Angiography	No intervention	Conservative	After a follow-up of one year, the child remains normotensive and had no febrile urinary tract infections. The follow-up DMSA scan showed % function of the left kidney
2	Singh et al., 2011 [3]	8, M	1, U/L	CT-IVU, Color doppler	No intervention	Conservative	CT-IVU was repeated after 2 weeks which showed a normal-sized left kidney with normal excretion of dye
3	Jawas et al., 2008 [4]	7, F 19, M 21, M 35, M 43, M	3, U/R 2, U/L	CECT	Not mentioned 12 h	3, conservative 1, damage control laparotomy 1, attempted repair of renal artery failed and nephrectomy was performed on the same setting	1 developed hypertension 2 months after the injury and had elective nephrectomy. Creatinine was normal in all patients in follow up of 9 months
4	Kushimoto et al., 2011 [5]	34, M	1, U/R	CECT, Angiography, DMSA Scan	10 h	Endovascular stent	The follow-up DMSA scan performed at 4 months showed %11 function with severe atrophy of the right kidney
5	Breyer et al., 2008 [8]	43, F	1, U/R	CECT, angiography, MAG-3 scan	Not defined	Endovascular stent	A 1-month follow-up computed tomography scan and lasix MAG-3 renal scan, respectively, showed patchy contrast uptake and 5% relative function in the stented kidney
6	Bala et al., 2009 [9]	20, M	1, U/R	CECT, angiography	3 h	Endovascular stent	At 10 months follow-up, blood pressure was 130/80 mmHg and serum creatinine was normal. DMSA scan showed 42% of the total renal activity was supported by the affected right kidney
7	Abu-Gazala et al., 2013 [11]	24, M 4.5, M 19, M	3, U/R	CECT, Angiography, DTPA Scan	171 min, 110 min, 180 min	3 Endovascular stents	All patients were normotensive and had normal creatinine in follow up. DTPA scan showed renal function of 49%, 11% and 40% on the affected side, respectively
8	Lopera et al., 2011 [15]	17-46	8	CECT, Angiography	2-8 h	6 Endovascular Stents 2 embolization of the main renal artery due to extravasation of contrast medium	At follow-up 2-24 months after injury, four patients had kidney atrophy (two treated with embolization and two with stents), two had proven stent patency with functional kidneys, one was normotensive with unknown stent patency, and one was lost to follow-up. One of the patients with an occluded stent developed severe renal hypertension and required nephrectomy
9	Chabrot et al., 2016 [16]	17, M 21, M 48, M	1, U/L 2, U/R	CECT, Angiography, Doppler US, DSA	Not mentioned 6 h 3½ h	1 Endovascular stent was repeated for restenosis. 1 Endovascular stent 1 Endovascular stent and on day 1 partial stent thrombosis was seen on US. Endoluminal thromboaspiration and additional stenting were then performed	Normal blood pressure and creatinine levels 23, 26 and 30 months later, respectively
10	Lee et al., 2010 [17]	22, M	1, U/R	CECT, Angiography, DTPA Scan	Not mentioned	Endovascular stent	At the 4 month follow-up, the patient had normal BUN and creatinine levels. CT angiogram showed successful endovascular stenting in the renal artery branch. DTPA scan demonstrated mildly reduced function of the right kidney and reduced activity in the upper pole on the right side
11	Raavi et al., 2016, [18]	26, M	1, U/L	CECT, Angiography	Not mentioned	Endovascular stent	A repeat CT angiogram revealed the stent in position with good antegrade flow after 8 weeks follow-up and renal parameters were within normal limits
12	Capote et al., 2015, [19]	20, M	1, BLT	CECT, Angiography	5 h	R, Endovascular stent	The patient was discharged at three weeks with normal renal function. His renal indices and GFR were within normal limits after 3 month

BLT = bilateral, CECT = contrast-enhanced computed tomography, HT = hypertension, U/L = unilateral left, U/R = unilateral right.

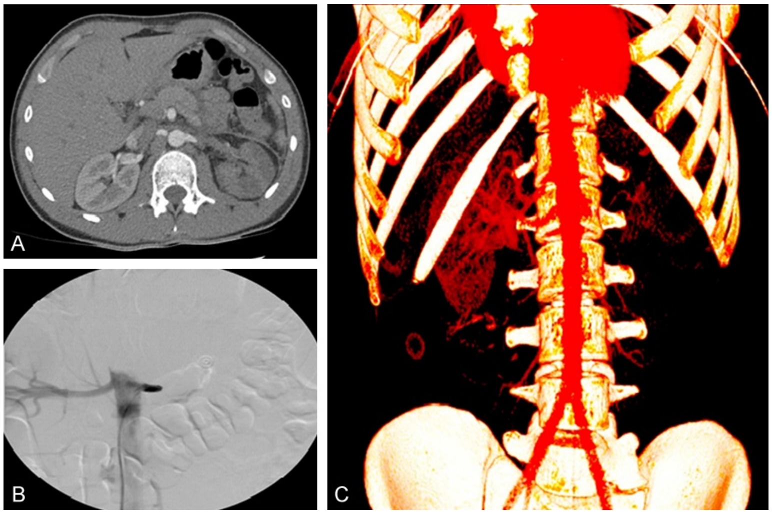

Figure 1. A. In the arterial phase of contrast enhanced thoracoabdominal CT, the presence of thrombosis and no contrast enhancement in the left renal artery was detected. B. Left renal arteriography demonstrated absence of left renal artery flow. Examination revealed occlusion in a segment of approximately 2 cm in the middle of the left renal artery. C. Volume rendered image of three-dimensional maximum intensity projection image showing no left renal artery flow.

Figure 2. Control left renal arteriography after percutaneous endovascular revascularization and tissue plasminogen activator infusion showed patent flow on left renal artery.

contrast (CECT). A renal artery thrombosis with no contrast retention in the left kidney was detected (**Figure 1A**). There was no hematuria according to urine analysis and 24-hour urine output was in normal range. CT angiography showed an occlusion of 2 cm in the middle segment of the left renal artery (**Figure 1B**, **1C**). After CT angiography, percutaneous endovascular stent replacement was planned. The thrombosed segment of left renal artery was seen via insertion through the left femoral artery. Thrombotic segment was passed with guidewires. Reperfusion of the kidney was observed and an expandable stent was placed into the renal artery. Thrombolysis was then performed with tissue plasminogen activator (tPA). Repeated angiography depicted restored blood flow of the kidney with no residual intraluminal defects. A control angiogram with contrast was done 72 hours after the trauma. Left renal artery flow was found to be patent (**Figure 2**). No complications occurred during clinical follow up and thoracotomy tubes were removed. Oral antiplatelet treatment (aspirin + plavix tablet) was administered and he was discharged as cured.

Left renal artery flow was potent, the stent was open, and hypertension (HT) didn't develop as of the time of second month control. Urea and creatinine were in normal ranges, according to biochemical examination, and Tc-99m DMSA scintigraphy showed a participation of 8% for the left kidney in total renal function (**Figure 3**). According to Tc-99m DTPA scintigraphy, left kidney had decreased perfusion, concentration, and excretion function (**Figure 4**).

Discussion

Renal vascular injuries are well known. However, they are rare complications stemming from blunt abdominal injuries [1-3]. The most common injury types are RAT, laceration of artery and veins, and avulsion [3-5]. Incidence of renal artery injury due to blunt trauma was reported to be between 1-4%, in 1990. Many recent studies have reported incidence to be 0.05-0.1% [1-3]. There has been a relative increase in diagnosis with the help of advanced imaging methods, such as CT [2].

Traumatic renal artery occlusion usually occurs in the left side and mostly seen before the age

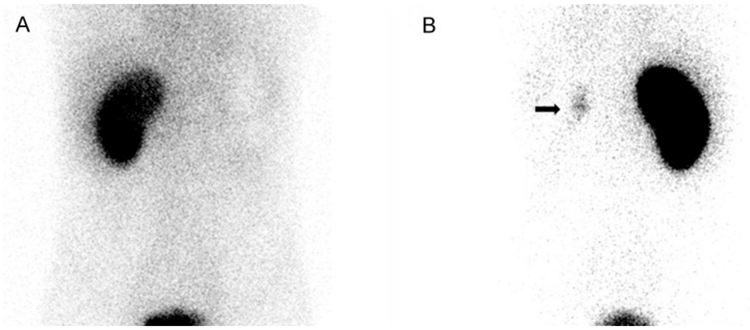

Figure 3. Tc-99m DMSA static renal scintigraphy performed 2 months after blunt abdominal injury showed (A) no activity in the left renal location in the anterior planar view, (B) minimal activity of the left kidney in the left kidney location in the posterior planar view (arrow). Total kidney function was calculated as 82% for the right kidney and 8% for the left kidney.

of 25. Bilateral occlusions are even more rare [1]. Traumatic renal injuries are explained by acceleration/deceleration mechanisms on renal vascular pedicles, which are partly fixated, and exertion of compression on renal arteries by vertebras. Because of these, thrombosis and intimal injuries may occur. Injuries may also occur because of broken ribs [1-5]. RAT after blunt trauma almost never occurs as an isolated event, usually accompanying major injuries. Clinical signs are flank or epigastric pain, due to abdominal or lumbar blunt trauma, proteinuria, and hematuria. These signs and physical examinations are not specific for diagnosis [6]. In this case, unilateral RAT of the left kidney, with no clinical or laboratory abnormalities, was detected in a young male patient.

CECT is the best technique for diagnosis and follow up after treatment. CT findings of RAT diagnosis show contrast enhancement in the parenchyma of the affected kidney and no contrast excretion [7]. Angiography is similarly effective for showing thrombosis. In addition, it may better show segmental obstruction. However, it cannot help to show accompanying organ injuries or the degree of injuries. CT angiography confirms the diagnosis and level and location of obstruction better than other examinations [8]. Scintigraphic studies and intravenous pyelography (IVP) do not provide additional information, in these cases, nor are they useful in determining the type of treatment. In this case, diagnosis was established while CT investigated additional organ injuries. Angiography was used for determining the location and degree of obstruction and therapeutic purposes. Scintigraphy was used to evaluate parenchymal function of the kidneys during follow up.

Although there is no ambiguity about treatment of renal artery avulsions and lacerations, treatment of renal arterial occlusions has not been fully elucidated and controversy remains [5]. The rarity of the disease, delayed diagnosis, accompanying organ injuries, and poor long-term outcomes after revascularization have prevented the development of an optimal treatment algorithm. Looking at the literature on this issue, it was seen that nephrectomy has been abolished and there is a tendency towards preservation of the kidneys by non-operative approaches [5]. Parallel with radiological and technological developments, revascularization procedures, previously performed under open surgery, are now performed by minimally invasive endovascular procedures for unilateral or even bilateral occlusions. However, these types of treatment options were almost always obtained through case reports.

Treatment options include early surgical revascularization, early/prophylactic or delayed nephrectomy, and non-operative conservative treatments. The role of early elective nephrectomy, in patients with RAT initially followed non-operatively, is unclear. Some authors have suggested nephrectomy to prevent infections and septic complications of infectious kidneys and to prevent delayed HT development. However, Bruce et al. [6] reported that only 1 of 16 patients with non-operative follow up developed delayed HT. It is more appropriate to perform nephrectomy if kidney-related complications develop (such as abscess or HT). Since intervention is easy when HT develops and there is possibility of spontaneous improvement of renal function and kidneys have beneficial endocrine and hemopoetic effects [9].

Selective nonoperative treatment is considered the safest and most appropriate treatment option in the majority of patients. Abscess formation and HT development are not more frequent than in patients undergoing surgical revascularization. Jawas [4] and Haas [9] advo-

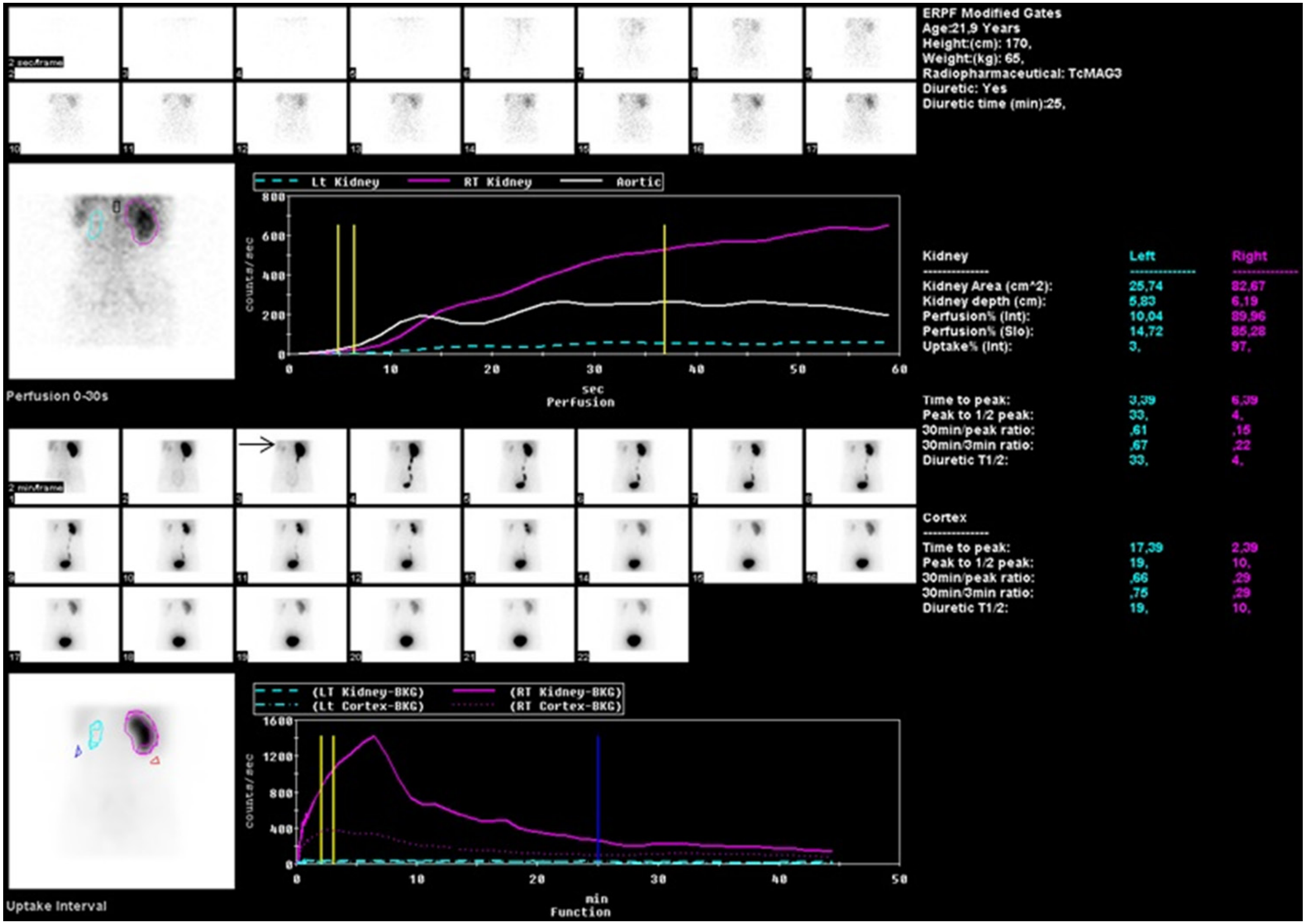

Figure 4. Tc-99m DTPA dynamic kidney scintigraphy performed 2 months after blunt abdominal injury: the left kidney was observed at normal localization, size smaller than normal (arrow). Left kidney perfusion, concentration and excretion functions decreased significantly.

cated conservative methods in unilateral cases and surgical revascularization in the case of bilateral occlusions or solitary kidneys. In their review of 159 cases, Haas and Spirnak [9] stated that 16 of 20 patients, with bilateral thrombosis, had undergone surgical revascularization with 9 patients achieving success. A total of 34 patients with unilateral thrombosis underwent surgical revascularization and 9 were successful. The success of surgical revascularization in unilateral thrombosis was lower than bilateral trombosis. For this reason, they have recommended conservative treatment for unilateral thrombosis. In a recent study conducted by Sangthong and colleagues [2], 517 of 945,326 blunt trauma patients had renal artery injuries and 45 of these patients underwent surgical revascularization. Based on these results, they concluded that non-operative treatment is acceptable.

Surgical revascularization of occluded arteries is recommended for selected patients. It has been aggressively stated to be indicated in bilateral renal artery occlusions or bilateral occlusions with a single kidney [10-12]. However, it has been suggested that endovascular revascularization be tried in optimal patients who have had a very short period of ischemia. In recent years, occlusions, which have been treated with methods such as open surgical thrombectomy in the past, have reportedly been treated using percutaneous endovascular techniques, which are minimally invasive. However, these studies do not have large a series and long-term results are not available. The efficacy of different revascularization techniques for RAT, after blunt trauma, is unknown.

An important problem in patients treated with endovascular revascularization is the development of HT and impaired renal function. For this reason, it is necessary to follow up with scintigraphy. Renovascular HT develops in the first year in 25-50% of these patients [1-5] and delayed nephrectomy is needed. Haas and Spirnak [9] reported that, in long-term results of arterial endovascular revascularization after thrombosis, 67% of unilateral cases had decreased renal function and 12% developed HT. The rate of delayed nephrectomy was 12-35% in patients undergoing endovascular revascularization. In this case, HT was not developed in the early period and nephrectomy was not necessary.

The time to pass over the renal artery occlusion for successful revascularization is also uncertain. Most authors agree that if revascularization is to be performed it should be within 4 hours after trauma [8, 13]. On the other hand, some authors state that it may also be done before 20 hours of warm ischemia. However, some cases have been reported in which revascularization was performed for longer periods or even 2-7 days after occlusion. Therefore, it should be considered that, in situations where the renal artery is not completely obstructed or with collateral circulation, kidneys can tolerate ischemia for longer periods [12].

Stent patency may not be achieved without anticoagulation or antiplatelet therapy. A current report provided evidence that endovascular renal artery stents placed for trauma can thrombose when not anticoagulated, resulting in kidney loss [10].

Limiting reasoning for surgical revascularization is the indication that if the other kidney is normal and it is 4 hours past trauma, surgical revascularization does not have a high protective effect on kidney function. Therefore, percutaneous endovascular revascularization with minimal invasiveness and low morbidity can be used instead of surgical vascularization [14, 15]. In the present case, percutaneous revascularization was successfully performed and it was observed that HT did not develop, with the kidney partially functioning during short-term follow up. The main reason for revascularization in unilateral renal occlusion is to prevent renal replacement therapy, preserve renal function, and prevent future renal HT [16-19]. For this reason, it is recommended that young patients with late-onset trauma be treated with minimally invasive procedures, despite the possibility of poor kidney function. Nevertheless, to demonstrate the RAT treatment algorithm, studies comparing percutaneous revascularization with nonoperative conservative management are necessary in terms of treatment choice and long-term outcomes. Long-term post-procedure antiplatelet prophylaxis of late stent occlusion seems to be reasonable but no guidelines are available.

Conclusion

This study recommends that young patients with late-onset trauma be treated with minimally invasive procedures to protect renal function and prevent renal HT, despite the possibility of poor kidney function. Percutaneous endovascular revascularization can be substituted for surgical vascularization due to minimal invasiveness and less morbidity.

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Informed consent was obtained from the patient for publication of this case report and any accompanying images.

Disclosure of conflict of interest

None.

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