Clinical Imaging 56 (2019) 108–113

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: www.elsevier.com/locate/clinimag

Neuroradiology

Anterior spinal artery aneurysm presenting with spinal subarachnoid hemorrhage in a case of polyarteritis nodosa

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ARTICLE INFO

Keywords:
Polyarteritis nodosa
Anterior spinal artery
Aneurysm
Subarachnoid hemorrhage

ABSTRACT

Polyarteritis nodosa is characterized by presence of aneurysms in the renal, hepatic and mesenteric vasculature, and less often by vascular abnormalities in the intracranial compartment. Spinal subarachnoid hemorrhage is a rare phenomenon that can be associated with inflammatory vasculopathies such as polyarteritis nodosa, but the link between aneurysm formation and spinal subarachnoid hemorrhage in polyarteritis nodosa is unclear. We describe a case of a patient with polyarteritis nodosa and spinal subarachnoid hemorrhage following rupture of an aneurysm of the anterior spinal artery. Following operative washout and decompression of the subarachnoid hemorrhage, spinal digital subtraction angiography was performed and revealed intimal contour irregularities, stenotic changes, and multiple small aneurysms in renal, hepatic, and bronchial arteries and some proximal spinal arteries, and, most notably, a pseudoaneurysm of the anterior spinal artery supplied directly by the artery of Adamkiewicz. Polyarteritis nodosa was subsequently diagnosed in light of these findings. Though previous cases have noted spinal subarachnoid hemorrhage in of the context of polyarteritis nodosa, we found no previously documented case of a definitive aneurysm of the anterior spinal artery in a case of polyarteritis nodosa documented on angiography. This case highlights the potential importance of monitoring for aneurysms of the spinal vasculature in cases of polyarteritis nodosa and in screening for vasculitides in cases of spinal subarachnoid hemorrhage. Future studies are needed to describe patterns of the specific anatomic localization and incidence of spinal artery aneurysms in polyarteritis nodosa.

1. Introduction

Polyarteritis Nodosa (PAN) is an inflammatory vasculitis that affects small and medium-sized arteries [1,2]. Histologically, the disease is characterized by focal, pan-mural vessel inflammation with fibrinoid necrosis, and cellular infiltration primarily by polymorphonuclear cells and varying numbers of lymphocytes and eosinophils [1,3]. The skin, kidneys, peripheral nerves, and gastrointestinal tract are among the most commonly affected organs in PAN. Though less common, the central nervous system (CNS) can be affected as well, with an approximately estimated 5% of patients showing symptoms related to CNS pathology [2]. Symptoms relating to CNS affliction may include encephalopathy, seizures, aneurysms of the cerebral vessels, and multifocal hemorrhagic and ischemic cerebral infarction [2,4–10]. In rarer instances, PAN has been found associated with spinal subarachnoid hemorrhage (SAH; [11–18]).

Aneurysms are rarely the cause of spinal SAH, and description of the connection between aneurysms and SAH is present in only a sparse number of case reports, likely because cases of spinal SAH are often not diagnosed until after they become symptomatic [19,20]. Though previous cases have highlighted instances of spinal SAH in PAN [11–18,21] and have described specific cerebral arterial involvement in PAN [8,22], we found no past cases describing positive radiologic findings of spinal aneurysm as a source of SAH in PAN. We describe a case of a patient with spinal SAH following rupture of a pseudoaneurysm of the anterior spinal artery (ASA), and who was subsequently diagnosed with PAN. This case highlights the potential importance of monitoring for aneurysms of the spinal vasculature in cases of PAN and may provide guidance for diagnosis and management of PAN presenting with SAH.

2. Case report

A 52-year-old female with a history of hypothyroidism and pulmonary nodules was admitted to another hospital with a three-day history of back pain, ascending lower extremity weakness and sensory changes below spinal level T12. CT of the abdomen revealed increased

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https://doi.org/10.1016/j.clinimag.2019.04.008
Received 28 February 2019; Received in revised form 9 April 2019; Accepted 16 April 2019

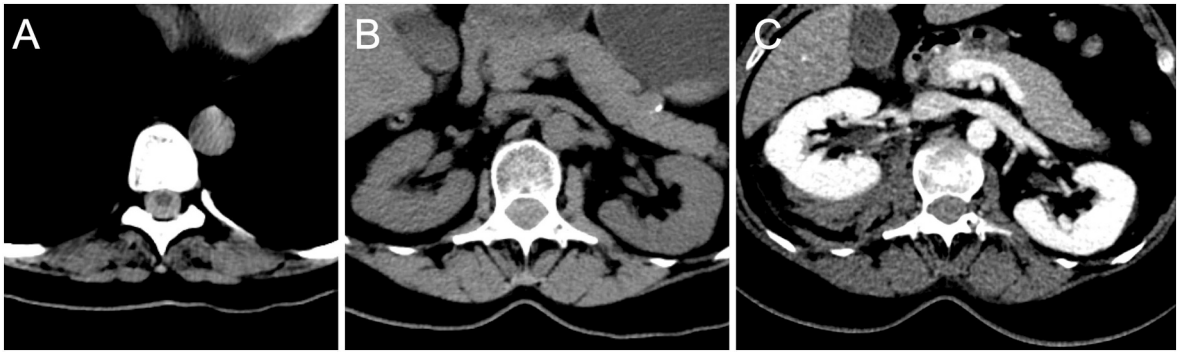

Fig. 1. Axial non-contrast CT images obtained a few hours following initial presentation from outside hospital reveals extensive subarachnoid hemorrhage in the thoracic (A) and lumbar (B) regions without perinephric hematoma. Two days later, follow-up CT revealed right sided perinephric retroperitoneal hematoma (C).

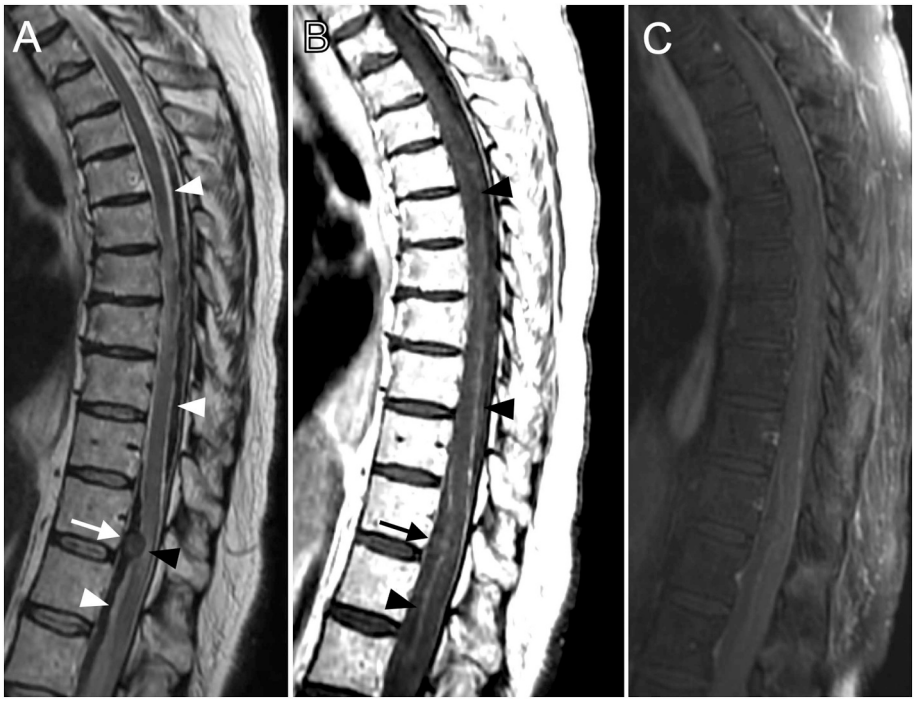

Fig. 2. MR images depicting spinal subarachnoid hemorrhage. Thoracic sagittal T2 (A), sagittal T1 (B) and post-gadolinium fat-saturated T1 (C) weighted MR images reveal abnormal signal changes in the dural sac. Significant hypointensities on T2 and iso/hypointense signal changes on T1 in the dural sac are seen consistent with subarachnoid hemorrhage (A,B, white arrowheads). No abnormal contrast enhancement is seen. Additionally, a 10 mm nodular structure in the anterior dural sac at the level of T-11 with spinal cord compression in keeping with aneurysm (A, B, arrow) and associated spinal cord edema (A, black arrowhead).

density in the subarachnoid space in the dural sac (Fig. 1). Two days later, MR obtained at the other hospital showed slightly increased T1 and decreased extensive signal changes on T2 in the dural sac around the spinal cord (Figs. 2, 3) in keeping with acute spinal SAH in the thoracolumbar region. Additionally, a nodular structure 10 mm in diameter was seen in the dural sac at the T11 level just anterior the spinal cord (Figs. 2, 3). Mild spinal cord compression and associated edema in the spinal cord also noted in this region. The lesion was hypointense on T1 and T2 and thought to be a hematoma. During this presentation the patient noted additional right-sided back pain and abdominal CT revealed large right-side perinephric hematoma. At this time the patient was negative for c-ANCA and p-ANCA, had a blood pressure of 151/90, an erythrocyte sedimentation rate of 53 mm/h (normal 0–29 mm/h), a C-reactive protein level of 144.7 mg/L (normal < 3 mg/L), a BUN of 13 mg/dL (normal 6–21 mg/dL), and a serum creatinine of 0.69 mg/dL (normal 0.38–1.02). HBV and HCV serologies were negative. She was transferred to our institution, and the patient underwent emergent T11–12 laminectomy and expansile duraplasty, and L4 laminectomy for washout of subarachnoid blood and decompression. Postoperatively, the patient underwent spinal digital subtraction angiography (DSA) and superselective angiogram of the ASA. Most notably, this revealed a pseudoaneurysm arising from the ASA supplied by the artery of Adamkiewicz which arose from the left T8 spinal artery (Fig. 4). The pseudo aneurysm occurred at about the level of T11-T12. CT scan at this time revealed no evidence of intracranial SAH or acute or chronic parenchymal ischemia.

At the time of spinal angiography, a microcatheter was not able to navigate to the ASA pseudoaneurysm due to tortuosity, and therefore endovascular embolization was not performed due to risk of spinal cord ischemia if embolization was performed from a proximal location of the ASA. Because endovascular treatment was not performed, a surgical approach was performed via bilateral L1–3 and L5 laminectomy and intradural resection of spinal intradural hematoma for washout of subarachnoid blood with expansile duraplasty. Later that day, the patient received follow-up MR imaging of the thoracic spine which revealed a focal nodule representing a pseudoaneurysm unchanged since its original appreciation during prior angiography.

Discovery of the ASA aneurysm prompted broader examination of previous spinal DSA, which was found to display luminal contour irregularities and suspicious small aneurysms in the kidney and hepatic arteries. Contour irregularities were also seen bronchial artery on the right and some proximal spinal arteries (Fig. 5). The patient was

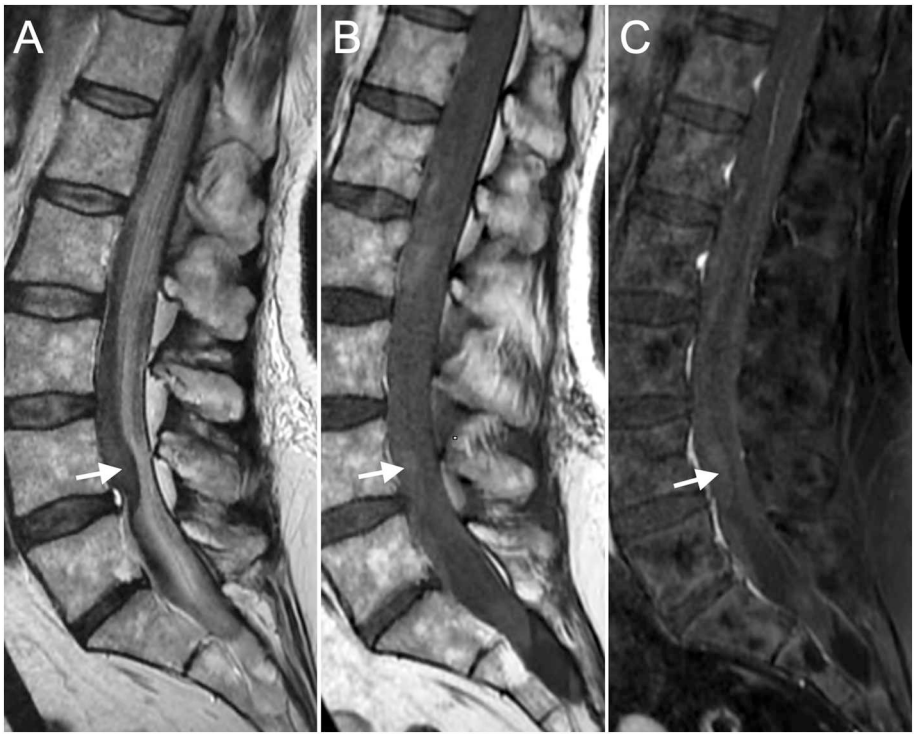

Fig. 3. MR images depicting spinal subarachnoid hemorrhage. Lumbar sagittal T2 (A), sagittal T1 (B) and post-gadolinium fat-saturated T1 (C) weighted MR images reveal abnormal signal changes in the dural sac. Significant hypointensities on T2 and iso/hyperintense signal changes on T1 in the dural sac (arrows) are seen consistent with subarachnoid hemorrhage. No abnormal contrast enhancement is seen.

diagnosed PAN based on American College of Rheumatology criteria [23], specifically for findings of hypertension, angiographic abnormalities, and weakness in lower extremity. Elevated acute phase reactants and exclusion of other causes such as infection were also consistent with a diagnosis of PAN. The patient was administered prednisone. By approximately two months following of treatment, her lower extremity weakness had significantly improved, though focal weakness and sensory deficits remained. The patient was also treated with cyclophosphamide and methotrexate for PAN. Exclusion of infection and malignancy and positive response to immunosuppressive treatment supported the diagnosis of PAN. No biopsy was performed in the patients because no skin lesion was present, renal angiographic findings are compatible with PAN, and kidney biopsy would have presented a high risk of severe bleeding in the presence of multiple aneurysms.

3. Discussion

Spinal SAH is very rare and estimated to account for < 1% of cases of SAH [24]. This incidence may be underestimated, however, due to difficulty in identifying the condition [25]. SAH can present with sudden lower back pain, lower extremity radiculopathy related to level of the lesion and severity of bleeding, or meningeal irritation causing nuchal rigidity and positive Kernig sign [25,26]. Spinal SAH is associated with trauma, lumbar puncture, arteriovenous fistula and malformation, hemorrhagic tumors, coagulopathy, aneurysms and vasculitis [11,27].

Spinal artery aneurysms are also rare, though estimates of their prevalence are unclear given that their description usually occurs within isolated case reports of symptomatic patients [20]. Incidentally, spinal SAH as a result of spinal artery aneurysm rupture is very rare as well [19,20]. A number of factors are suspected to contribute to spinal aneurysm development, including coarctation of the aorta, connective tissue disorder (e.g. Ehlers-Danlos syndrome, fibromuscular dysplasia), infections, renal transplant, pregnancy, and vasculitis [19,20,28,29]. Spinal aneurysms are most prevalent in the ASA [19,20] and occur less commonly in the posterior spinal artery [30] and Adamkiewicz artery [31]. Previous reports have suggested that ASA aneurysms more commonly occur in the context of vasculitis, whereas aneurysms of other spinal arteries do not [32,33].

PAN is a form of necrotizing medium-sized vessel vasculitis that classically presents with fusiform or saccular microaneurysms, often with adjacent stenotic lesions, primarily in small and medium sized renal, mesenteric and hepatic arteries [2,34]. Clinical presentations of PAN are heterogenous. Presentations range from mild cutaneous vasculitis that may be self-limiting, to severe hepatic, gastrointestinal, renal, cardiac or nervous system involvement causing significant morbidity and mortality. Hypertension, renal failure, GI bleeding, stroke, arm or foot drop, and heart failure are common manifestations and accompanied with systemic symptoms such as fever, weight loss and fatigue [3]. Diagnosis may be difficult in some cases, and should be done after ruling out infections and coagulative disorders. Vasculitis may manifest with internal bleeding such as spontaneous retroperitoneal hematoma [35]. We noted this finding in our patient two days following acquisition of initial CT images (Fig. 1C). It is considered rare for arteries of the central nervous system to be affected in PAN [2,34], however the degree to which the CNS is affected in PAN is inconsistent across studies [6] and may be underestimated since patients may only present for relevant neuroimaging once CNS symptoms have become severe [8]. Early identification and treatment of the disease may also prevent CNS symptoms from becoming clinically significant [6]. PAN has been found to manifest intracranially with stenosis of the carotid artery and with cortical or subcortical infarcts or hemorrhage due to microaneurysm rupture [8,36,37]. A small number of case studies have identified intracranial aneurysms in PAN [22] within a number of different vessels including the anterior cerebral artery [38], middle cerebral artery [7,39], posterior inferior cerebellar artery [22],

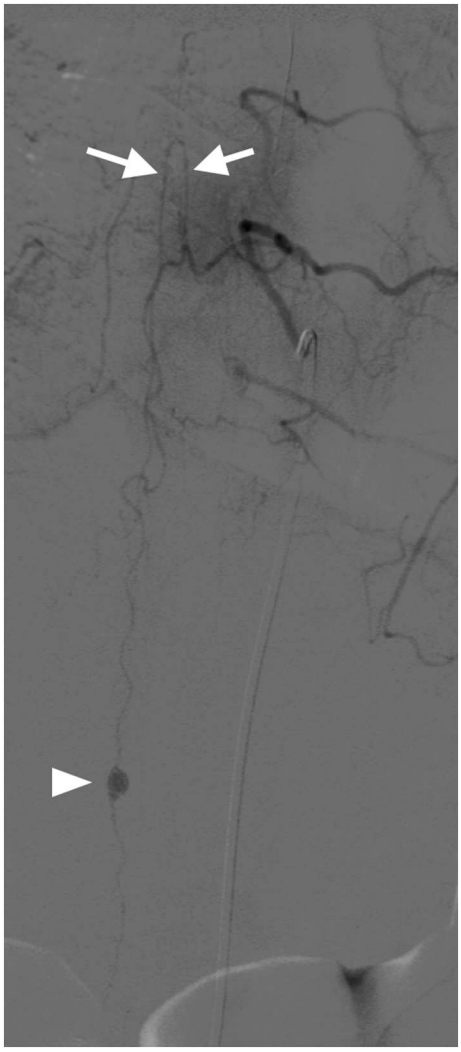

Fig. 4. Frontal digital subtraction angiography revealed a 6 × 3.5 mm pseudoaneurysm (arrowhead) at the level of T11-T12 corresponding to the nodular lesion seen on MRI. The pseudoanyeurysm arises from the distal/inferior segment of the anterior spinal artery which was supplied by the artery and Adamkiewicz originating from the T8 spinal artery. Subtle contour irregularities in the artery of Adamkiewicz and the proximal anterior spinal artery can also be seen (arrows).

superior cerebellar artery [40], internal carotid artery [39,41], and vertebral artery [41,42]. Furthermore, only a few cases exist describing spinal involvement in PAN [11], with only a subset of these reporting spinal SAH [11,13,16,17,43].

Some case reports document spinal artery aneurysms in the context of vasculitis [12,33,44–46], but we could find no previous reports that confirmed a spinal aneurysm in a case PAN angiographically. Rengachary et al. [12] described a 50-year-old woman with spinal SAH who was found on spinal angiogram to possess a aneurysm of the radiculomedullary branch of the 12th spinal root. Pathology of the aneurysm in this case revealed intimal and medial fibroblastic proliferation with foamy macrophages and acute inflammatory infiltrate. The authors suspected acute inflammatory arthritis, possibly PAN. However, diagnostic test for autoimmune disease were negative in this patient, and no definitive diagnosis of PAN was made. One other study performed spinal angiography in a case of PAN with SAH but did not identify any associated vascular abnormalities, including aneurysm [11], though it is unclear how comprehensive the angiography was in this particular case. Angiography in our case revealed a pseudoaneurysm in the ASA at a site inferior to the site of anastomosis between the ASA and the artery of Adamkiewicz, small aneurysms in the renal and hepatic arteries, and contour irregularities in the right bronchial artery and some proximal spinal arteries (Fig. 5). A right-sided perinephric hematoma was also appreciated on MR imaging before the patient's initial laminectomy; this likely resulted from rupture of a renal aneurysm at some point after her initial imaging at an outside hospital. These findings prompted an early suspicion of vasculitis that was later confirmed to be PAN, highlighting the importance of angiographic exploration of extra-spinal vessels such as bronchial arteries, distal spinal arteries, renal arteries and hepatic arteries. To our knowledge, our case provides the first documented evidence on angiography of an aneurysmal source of SAH in a case of PAN. Given the rarity of isolated spinal artery aneurysms, and the association between vasculitis and aneurysm development [19,20], it is likely that the ASA aneurysm in the present case was a consequence of the patient's PAN, particularly given the occurrence of microaneurysms within the patients' hepatic and renal vasculature and proximal spinal arteries (Fig. 5). This case may represent the potential cause of past reported SAH in cases of PAN that did not identify any specific source of aneurysm [11,13,16,17,43].

Previous reports have described mostly positive outcomes of surgical and endovascular treatment for spinal artery aneurysms [20,28], though these reports mostly feature cases of isolated aneurysms occurring outside the context of vasculitis. The best treatment modality for spinal aneurysm may depend on the underlying cause. Vasculitis is more likely to cause pseudoaneurysm due to weakening of the vessel integrity [19], and past reports have noted spinal artery aneurysms regression following immune modulation or antibiotic therapy [42,45,46]. Treatment of vasculitis including PAN based on steroid and immunosuppressives. In mild disease, steroids may be enough. However, in cases of severe organ involvement, immunosuppressive treatment is necessary [47]. Clinical findings of our patient improved after prednisone therapy. Later on, our patient was treated with cyclophosphamide and methotrexate. Medical treatment may thus be a suitable treatment option for spinal aneurysm in some cases, though larger studies are needed to understand how treatment outcomes differ based on spinal aneurysm etiology. In our case, endovascular treatment by microcatheter was ineffective due to inability to navigate the catheter around the hairpin turn occurring in the artery of Adamkiewicz before it anastomoses with the ASA. If the ASA is more commonly affected in PAN, this may suggest that intravascular approaches would not be beneficial to manage ASA aneurysms as a source of SAH in PAN. Though no subsequent angiography was performed on our patient to allow for monitoring aneurysm regression, she reported good functional outcome approximately one year following SAH, noting that she is able to walk two miles per day unsupported. No recurrent disease SAH.

In conclusion, spinal SAH is a rare phenomenon that may be precipitated by vasculitis and spinal artery aneurysm such as may occur in PAN. We described a case that to our knowledge represents the first definitive example of PAN-related spinal SAH due to rupture of an aneurysm definitively identified on spinal imaging, including CT, MR and DSA. This case also highlights the potential importance of conducting thorough spinal angiography following suspicion of SAH, as extra-spinal angiographic findings (e.g. in kidneys, mesentery and liver) may facilitate discovery of an appropriate diagnosis. Future studies in broader patient populations are needed to describe patterns of the specific anatomic localization and incidence of spinal artery aneurysms in PAN as well as the pathologic contributors to these aneurysms.

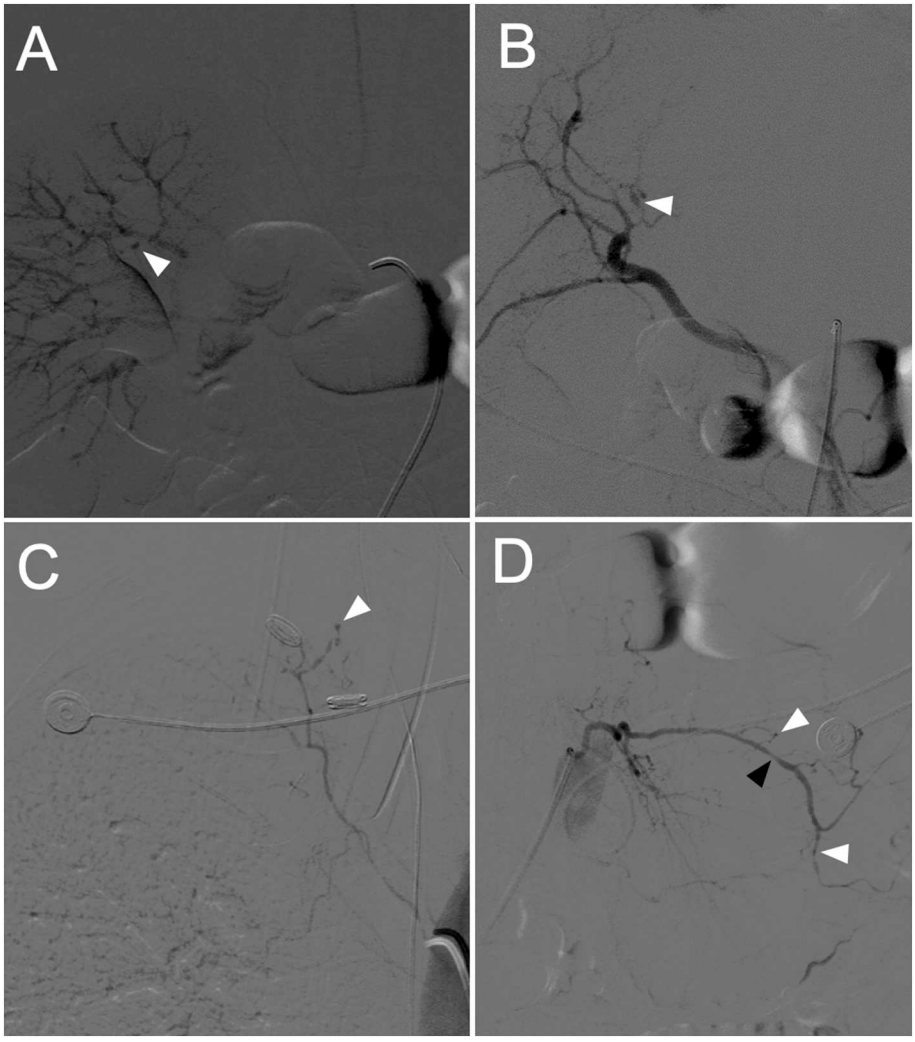

Fig. 5. DSA angiogram also reveals multiple small aneurysms (white arrowheads) in the right renal artery (A), hepatic artery (B), right bronchial artery (C), and left lumbar spinal arteries (D). Subtle contour luminal irregularities are also seen in the lumbar spinal artery at the level of L3 (D; black arrowhead).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgments

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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