Treatment of popliteal artery aneurysm-induced emergencies

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To the Editor: Popliteal artery aneurysms (PAAs) account for nearly 70% of peripheral artery aneurysms.[1] Most PAAs are asymptomatic. Symptomatic PAAs typically present with lower extremity ischemia caused by acute or chronic thrombosis and distal embolization. Rupture of PAAs and popliteal artery pseudoaneurysms are rarely reported.[2] In this study, PAA-induced emergencies are classified as acute hemorrhagic and ischemic complications. Compared with uncomplicated PAAs with almost no limb loss and perioperative mortality, these acute complications can make management of PAAs extremely challenging, even for an experienced vascular surgeon, as evidenced by a significant risk of amputation and death in previous reports. Prompt application of appropriate diagnostic methods such as computed tomography angiogram (CTA) and angiography and careful analysis of images to establish a definitive diagnosis and timely intervention are critical to a satisfactory outcome. Although the operation indication is rather clear, there is still no consensus on the optimal management of PAA-induced emergencies. With the endovascular repair emerging as a less-invasive alternative strategy for the therapy of PAAs in recent years, the main discussion areas are focused on which modality – endovascular treatment and the open surgery – is the first choice of treatment.[3] Meanwhile, to our knowledge, the results from centers in East Asia are extremely limited, and data on of PAA patients in the mainland of China might significantly differ from those in the West. Taking these needs into account, this study aimed to provide outcomes of treatment for PAA-induced emergencies in a major vascular center in China.

Between December 2008 and December 2018, 42 PAAs in 39 patients were treated in the Department of Vascular Surgery, Zhongshan Hospital, Fudan University. As one of the leading vascular centers in China with a lot of complicated patients referred from many other cities, our center treated about four PAAs cases annually. However, compared with our counterparts in western countries, the number of patients is less than half.[4] These findings suggest that the incidence of PAAs might differ significantly among different races and ethnicities. PAA-induced emergencies were not uncommon, with an incidence rate of 18% to 39% among overall PAAs in most western studies.[5] These emergencies accounted for an even larger proportion in the current series. A total of 21 (50%; 21/42) PAA-induced emergencies in 21 patients were managed over the 10-year period: four patients with the pseudoaneurysm, two patients with ruptured PAAs, and 15 patients with acute limb ischemia. There were 14 male and seven female patients. The average patient age was 59.0 ± 12.8 years (range, 24–82 years). Two patients in the subgroup of acute thrombosis also presented with contralateral PAAs. Overall, baseline characteristics between the hemorrhagic group and ischemic group were similar.

The presentation of hemorrhagic complications was the occurrence of acute pain and swelling behind the knee, as was found in almost all our patients. Ischemic complications usually presented with acute rest pain and coolness in the leg or foot with or without deficiencies in sensation and motor strength. Because of the unfamiliarity with this rare disease, non-vascular clinicians may easily overlook or misdiagnose aneurysms, resulting in a delay in treatment. Misdiagnosis was initially made and inappropriate therapies were performed in three patients at other institutions. Patient 10 was merely diagnosed with atherosclerosis obliterans complicated with acute thrombosis and the PAA was overlooked. Mere thrombectomy was then performed, and his symptoms were not relieved after the operation. Symptoms in patient 16 were misdiagnosed as neuropathic pain, which was regarded to be a post-operative complication of his previous surgery on glioma at the left frontal lobe of the brain. Patient 19 was misdiagnosed with gout and received conservative treatment in the orthopedics department. He was then referred to our hospital emergently as his symptoms progressed rapidly. Even for vascular surgeons, relying solely on the CTA three-dimensional reconstruction performance and neglecting

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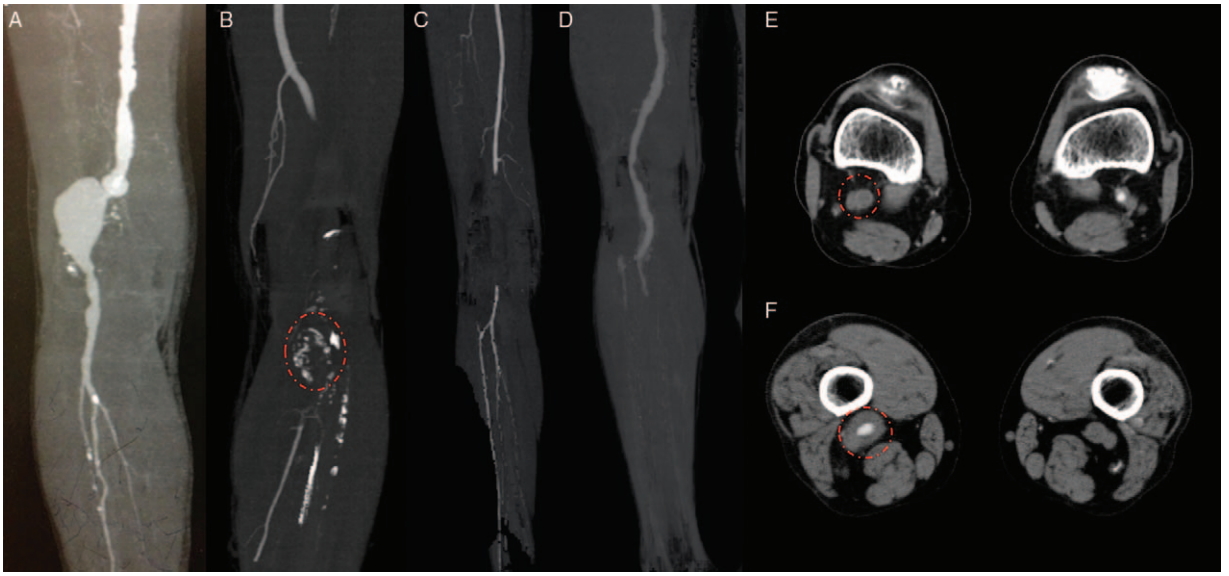

Figure 1: Thrombosed popliteal artery aneurysms. (A) A typical popliteal artery aneurysm with patent vessels was revealed by computed tomography angiography (CTA) three-dimensional reconstruction. (B) Pre-operative CTA three-dimensional reconstruction showed only an interrupted popliteal artery and the calcified aneurysm wall (red circle) in patient 16. (C) No sign of the popliteal artery aneurysm (PAA) but an interrupted popliteal artery was revealed by pre-operative CTA three-dimensional reconstruction in patient 20. (D) No signs of the PAA, but occluded run-off vessels were revealed by pre-operative CTA three-dimensional reconstruction in patient 10. (E and F) Cross-sectional images of CTA in patient 10 showed a thrombosed PAA (red circle).

the cross-sectional images may lead to catastrophic missed diagnosis, such as in patient 10 in this study, for whom the three-dimensional reconstruction image could only demonstrate an interrupted left popliteal artery. The thrombosed PAAs could be detected only in the cross-sectional images [Figure 1]. Hence, for patients presenting acute ischemia of the lower extremities with the popliteal artery occlusion, existing PAAs would be better excluded on a regular basis.

The mean size of the aneurysms was 4.5 ± 2.1 cm (range, 2.0 cm–10.6 cm). All patients had a solitary saccular or fusiform aneurysm on the main trunk of the popliteal artery, except for patient 14, who had a beadlike aneurysm. Three run-off vessels to the ankle were all patent in the hemorrhagic group. In the ischemic setting, at least one vessel was found occluded in 12 patients (80%); nearly half of the patients (40%) had no run-off vessels patent.

Generally speaking, the treatment strategy was individualized for each patient and based on their comorbidities, characteristics of the aneurysm, the type of emergency, and physicians' preference. Operative details are presented in Supplementary Table 1, http://links.lww.com/CM9/A138 and overall were not different between the hemorrhagic group and the ischemic group, except that thrombectomy was performed significantly more often in the latter group (0 *vs.* 60%, $P = 0.01$). Two patients underwent major amputation without any surgical attempt, one in the hemorrhagic group with bleeding shock and severe infection around the ruptured PA and the other in the ischemic group with irreversible foot ischemia. For the remaining 19 patients, endovascular treatment was successfully performed in seven patients (36.8%), and the open surgery in 12 patients (63.2%). All the endovascular procedures with covered stent placement were performed in the past 5 years. Of the hemorrhagic group patients, endovascular therapy mainly referred to covered stent exclusion and has gradually been preferred over open surgery at our institution. Acute ischemia was often treatable with open surgery. Ten patients had PAAs excluded and bypasses were established, and nine also required the thrombectomy via popliteal artery cut down to improve poor outflow vessels. Only four patients were treated by endovascular means in the ischemic group. Pre-operative thrombolysis was performed in one of these four patients to establish a patent run-off vessel. The remaining three patients were treated with covered stent placement alone.

The median follow-up time was 50.0 ± 39.3 months (range, 5–119 months). No death, recurrence of the aneurysm, or wound infection occurred perioperatively or during the follow-up period. Overall, the amputation-free survival rates were 85.7%, 85.7%, and 80.9% at 30 days and 1 and 3 years, respectively. In the current series, no significant major amputation-free survival difference was observed between the hemorrhagic and ischemic group. Three-year major amputation-free survival rates were 83.3% for hemorrhagic *vs.* 80.0% for ischemic cases ($P = 0.92$). Two limbs required major amputation during follow-up. One major amputation was performed during the post-operative hospital stay in patient 19, who developed serious osteofascial compartment syndrome and refused long-term and repeated debridement and wound care. The other was performed in patient 20 at 9 months for radical re-section of leiomyosarcoma.

The overall primary patency rates were 100%, 68.7%, and 60.0%, while the secondary patency rates were 100%, 85.6%, and 75.0% at 30 days and 1 and 3 years,

respectively. In comparing the hemorrhagic and ischemic groups with respect to graft patency, no significant differences were detected ($P = 0.78$ for primary patency rate and $P = 0.41$ for secondary patency rate). For limbs in the hemorrhagic group, primary and secondary patency rates were both 75.0% at 1 and 3 years. The ischemic group had primary patency rates of 66.7% and 54.4% and secondary patency rates of 88.9% and 75.0% at 1 and 3 years, respectively. During the follow-up, four occlusions (one prosthetic bypass, one venous bypass, two covered stents) in the ischemic group required intervention again, and catheter-directed thrombolysis was successfully performed in them.

On the basis of our experience in a high-volume vascular center, the incidence of PAAs in China appeared to be remarkably lower and the proportion of PAAs requiring emergent repair might be larger than those in western countries. PAA-induced emergencies are easily misdiagnosed and lead to amputation. With reasonable and individualized strategies based on the characteristics of the lesion and the general condition of each patient, emergent repair could achieve equivalent satisfactory outcomes in both the hemorrhagic and ischemic groups.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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Conflicts of interest

None.

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