# Recurrent Acute Upper Limb Ischemia in a Young Male: Case Report

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## ABSTRACT

*Although acute upper limb ischemia (AULI) is less prevalent than lower acute limb ischemia, AULI may lead to severe morbidity if not well-treated. To manage AULI appropriately, evaluation of the etiologies, risk factors, and revascularization is of importance. Here we present a case of recurrent AULI and its appropriate diagnostic and management approaches. A 27-year-old male with a chief complaint of pain and numbness in his left arm for one week. He had a history of AULI seven months before and was treated by percutaneous intra-arterial thrombolysis at left brachial and radial arteries with residual non-occlusive thrombus. Duplex ultrasound (DUS) and CT angiography revealed a new soft thrombus with occlusion at the left subclavian artery. Evaluation of comorbid risk factors and source of thrombus was performed. The patient underwent pharmacomechanical thrombectomy and angioplasty procedure. The diagnosis of AULI was established based on pain and numbness in the left arm, and the finding of soft thrombus and occlusion of the left subclavian artery on DUS and CT angiography evaluation. Although various workups have been carried out to determine the etiology of AULI in this patient, the definite cause remains unknown. In addition, pharamcomecanical thrombectomy and angioplasty were performed as the appropriate revascularization methods in this condition. Recurrent AULI is a rare vascular phenomenon leading to disabling morbidities and fatal consequences if not treated properly. Further evaluation of etiology and risk factors for recurrent AULI is mandatory for appropriate management besides revascularization.*

***Keywords****: acute upper limb ischemia, pharamcomecanical thrombectomy.*

## INTRODUCTION

Peripheral arterial disease (PAD) occurs due to the narrowing or blockage of arteries by the formation of fatty deposits/plaques (i.e., atheroma), resulting in pain and numbness in the body area supplied by the impaired arteries. The number of cases of PAD worldwide had increased from 164 million in 2000 to 202 million in 2010.[1] Acute limb ischemia (ALI), as a spectrum of PAD, is characterized by a sudden decrease in arterial perfusion of the limb which leads to a potential threat to the limb survival, requiring urgent evaluation and management. Acute upper limb ischemia (AULI) is not as common as acute lower limb ischemia, yet they share the same diagnostic strategy and treatment.[2]

## CASE ILLUSTRATION

A 27-year-old male with a chief complaint of pain and numbness in his left arm in the last week came to the outpatient clinic of Harapan Kita Hospital - National Cardiovascular Center.

Moreover, bluish, cold, and tingling of the left hand was observed. He reported difficulty in lifting his left hand in the past month. The patient then went to the nearby hospital in Pontianak, where he was hospitalized for one week and given anticoagulant injections in the abdomen, yet no improvement was seen. For this reason, the patient decided to seek further treatment at Harapan Kita Hospital - National Cardiovascular Center. He had a history of ALI in his left hand seven months before the presentation and had undergone a percutaneous intra-arterial thrombectomy (PIAT) procedure with a satisfactory outcome. At that time the patient was prescribed with simvastatin 20 mg once daily (OD), warfarin 2 mg OD, and aspilets 80 mg OD post-PIAT. Poor medication compliance was likely given that he had not taken warfarin for one month. The patient was a smoker. He denied any history of hypertension or diabetes. No family history of cardiovascular disease was reported.

Physical examination revealed the patient in a compos mentis state, heart rate of 67 bpm, respiratory rate of 16 bpm, with peripheral oxygen saturation of 97% on room air. Blood pressure was 114/57 mmHg in the left arm, 124/103 mmHg in the right arm, 129/96 mmHg in the left leg, and 133/87 mmHg in the right leg. No rales or crackles in both lungs, normal and regular S1/S2 without any murmur or gallop. Vascular examination of posterior tibial and dorsalis pedis arteries both showed a pulsation of +2 in both lower limbs, warm and free of edema. No pulsation of the radial artery of the left arm (0). There was paresthesia, poikilothermic, bluish, and pain triggered by skin contact. A dry wound and atrophy of muscle and nail beds on the left hand were observed (**Figure 1**).

Electrocardiogram (ECG) showed sinus rhythm, QRS rate of 76 bpm, normal axis, normal P waves, PR interval of 0.15 sec, QRS duration of 0.11 sec, no ST-T changes, and QTc of 408 msec (**Figure 2**). Laboratory evaluation showed hemoglobin level 14.9 g/dL, hematocrit 43.5%, total leukocyte count 8420 cell/µL, platelets 312.000 cell/µL, urea 15.8 mg/dL, creatinine 1.04 mg/dL, eGFR 99 mL/min/1.73 $m^2$, random blood glucose 87 mg/dL, sodium 140 mmol/L, potassium 3.8 mmol/L, chloride 103 mmol/L, total calcium 2.45 of mmol/L, magnesium 2.1 mmol/L, D-dimer 950 mg/dL, fibrinogen 348 mg/dl, negative antinuclear antibody test (ANA) test, and normal value of protein C and S.

Duplex ultrasound of the left arm showed the left subclavian artery was completely blocked up to the left brachial artery; No radial artery collaterals but ulnar artery collaterals were observed. Positive vein flow was seen in radial and ulnar arteries (**Figure 3**). The echocardiogram showed normal left ventricular (LV) and right ventricular (RV) function, normal valves, and no intracardiac thrombus. Additional multi-slice computerized tomography (MSCT) of the upper extremities was performed and showed a total occlusion in the left subclavian artery, and positive collateral to the left brachial artery (**Figure 4**).

Diagnosis of recurrent AULI stage IIA was established based on the history, general examination, duplex ultrasound, and MSCT of the upper extremities. Intravenous anticoagulants and rehydration were given, along with statin, pentoxifylline, sodium bicarbonate, and allopurinol. Percutaneous angioplasty (PTA) with pharmacomechanical thrombectomy was

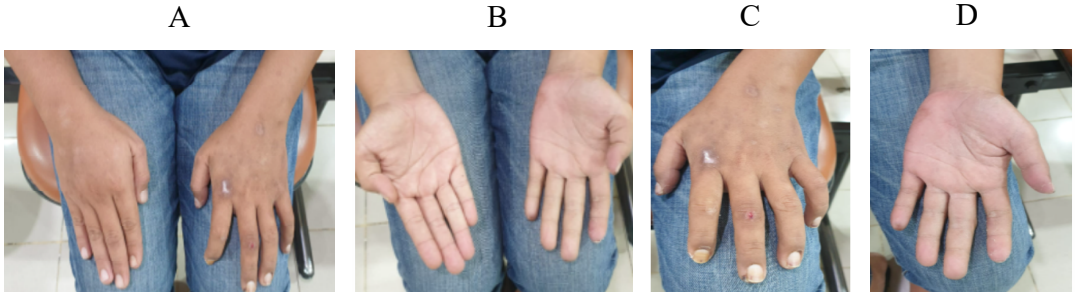


**Figure 1.** Examination of the left hand. (A) and (C) A dry wound is seen on the third finger. (B) and (D) Left hand appears pale.

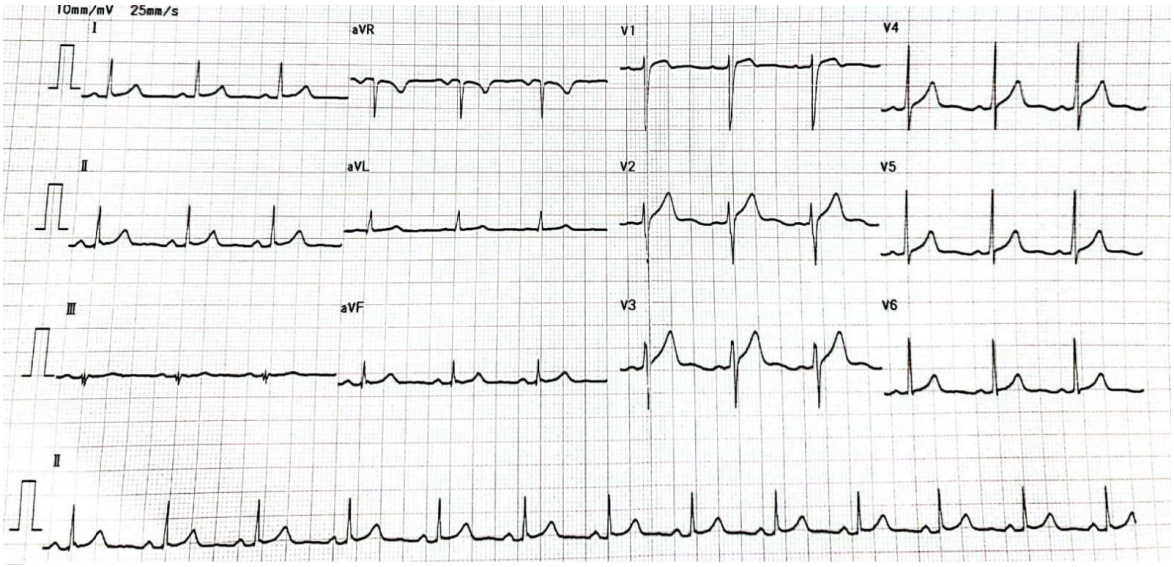


**Figure 2.** 12-lead electrocardiogram showed sinus rhythm, QRS rate of 76 beats per minute, normal axis, normal P waves, PR interval of 0.15 sec, QRS duration of 0.11 sec, no ST-T changes and QTc of 408 msec.

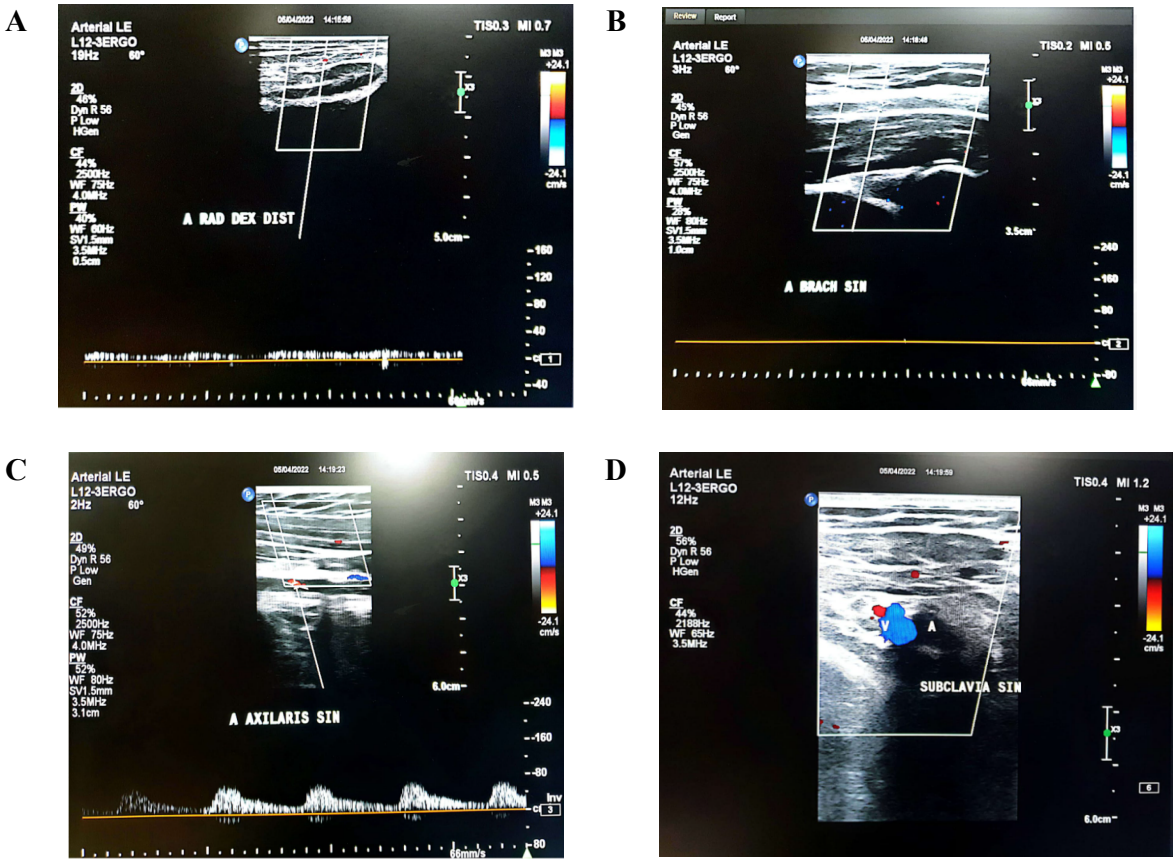


**Figure 3.** Duplex ultrasound in the left arm (subclavian – ulnar and radial area).

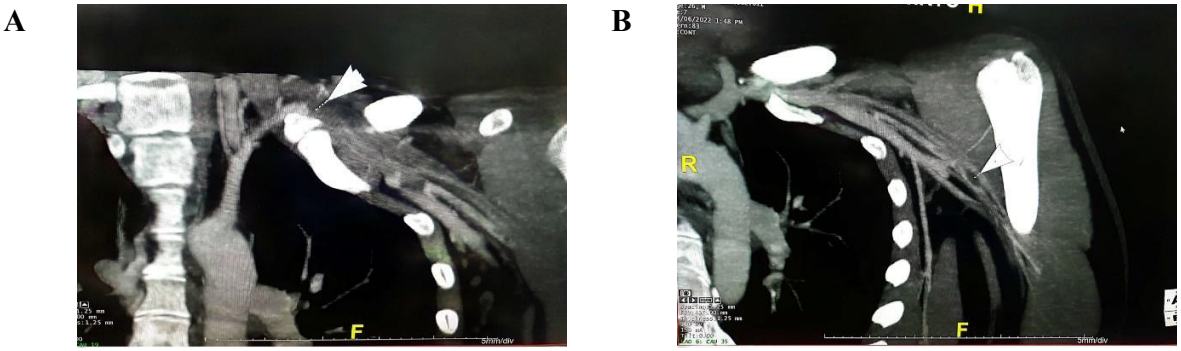


**Figure 4.** MSCT of upper extremities showed total occlusion at the left subclavian artery and collateral artery to the brachial artery, soft thrombus was detected.

performed. We also evaluated other causes of thrombosis and emboli, such as protein C and Protein S levels, rheumatoid factor, ANA, anti-dsDNA, and HbA1C.

The angiogram showed a huge thrombus in the left subclavian artery without any flow to the distal end. Intra-arterial power pulse injection of 25 mg of Alteplase was given from the left subclavian artery to the left brachial artery. Twenty minutes after the injection, thrombectomy via an Angiojet catheter system was done from the left subclavian artery to the left brachial artery. Following balloon angioplasty in the proximal left subclavian artery due to an organized thrombus, the distal left arm showed a positive flow.

## DISCUSSION

ALI is caused by an abrupt decrease of arterial perfusion in the limb. Potential causes are a progression of artery disease, cardiac embolization, aortic dissection or embolization, graft thrombosis, thrombosis of a popliteal aneurysm or cyst, popliteal artery entrapment syndrome, trauma, phlegmasia cerulea dolens, ergotism, hypercoagulable states, and iatrogenic complications related to vascular procedures. Limb viability is threatened, and hence prompt management is needed for limb salvage.[2-3]

ALI should be considered when the duration of symptoms is less than two weeks, while chronic limb ischemia is typically thought of when the duration is longer than two weeks. Clinical ALI is categorized using the Rutherford classification system.

The incidence of ALI is approximately 1.5 cases per 10,000 people per year based on epidemiological studies. ALI complications are highly prevalent. Despite early revascularization, the risk of 30–day mortality and amputation are 10 – 15%. There is no difference in ALI incidence between men and women. Yet, ALI differs by age, by which it is more likely to affect middle-aged and older adults than the younger population. ALI occurs more often in the lower extremities than in the upper extremities. Acute arm ischemia accounts on average for 16.6% of ALI cases and, by extrapolation, has an incidence rate of 1.2 to 3.5 cases per 100,000 people per year.

AULI is relatively rare. It is twofold more common among women than men. Patients with AULI are significantly older than those with acute lower limb ischemia. Nevertheless, AULI and ALI share the same risk factors, such as older age, smoking, diabetes, obesity, sedentary lifestyle, family history of vascular disease, high cholesterol, and high blood pressure.

Possible causes for ALI are arterial embolism (30%), arterial thrombosis due to plaque progression and complication (40%), thrombosis of a popliteal aneurysm (5%), trauma (5%) or graft thrombosis (20%). While lower limb ischemia occurs mainly as a complication of peripheral vascular disease, AULI is often caused by thromboembolic disease, trauma, or iatrogenic factors.[5]

The most common cause of AULI is thromboembolism, with cardiac thrombus as the most frequent source. Arterial occlusion in the upper extremities occurs most likely in

brachial and axillary arteries, representing 85% of embolic occlusion cases. Subclavian artery occlusion seems to be the most frequent site of occlusion in in situ thrombosis.

Diagnosis of ALI is usually established by taking the history and physical examination. The classic signs of ALI include the 6 P's: pallor, pain, paresthesia, paralysis, pulselessness, and poikilothermic. These clinical manifestations can occur anywhere distal to the occlusion. Acute embolism from the heart in the upper extremities is typically marked by acute onset of cold, pulseless, and painful upper limbs. Upper extremities vasculature is characterized by rich collateral networks. This implies that the upper extremities are unlikely to be threatened or non-viable at presentation.

The diagnosis of ALI was established in the 27-year-old male patient with complaints of discomfort, paresthesia, pulselessness, and poikilothermia in his left hand for the past week. Acute limb ischemia on the left arm was identified by the finding of a soft thrombus that obstructed the left subclavian and brachial arteries, without collateral in the radial artery. ALI in the patient was classified as type IIA based on the clinical examination and findings from CT angiography and duplex ultrasonography. Given recurrent ALI, we investigated other etiologies of ALI, such as thrombophilia, diabetes mellitus, dyslipidemia, and autoimmune disease. The results were not finished yet.

The key components of limb ischemia treatment are recognition and rapid restoration of arterial perfusion. Moreover, effective treatment depends on the type of occlusion (thrombus or embolus), location, conduit type (artery of graft), Rutherford classification, duration of ischemia, and other factors. **Figure 7** shows the management of ALI according to AHA/ACC 2016. The first line of ALI treatment is analgetic and heparin (UFH). Heparin is administered intravenously with an initial dose of 5000 IU or 70-100 IU/kg, followed by infusions at adjusted doses based on the patient's response. Activated clotting time or activated partial thromboplastin time (aPTT) is used for heparin monitoring. The purpose of the treatment is to reduce further embolism or clot propagation and to provide an anti-inflammatory effect. When the viability of the limb is threatened or symptoms of ischemia persist, revascularization is necessary. Urgent revascularization is mandatory in cases with neurological deficits.

There are some options for revascularization methods, including percutaneous catheter-directed thrombolysis, percutaneous mechanical thrombus removal or thrombo-aspiration (with or without thrombolysis), and surgical thrombectomy, bypass, and/or arterial repair. Open surgical procedure is usually preferred because it accelerates reperfusion, particularly in patients with class IIb ALI. However, this procedure is associated with a high risk of perioperative mortality. Despite advances in resuscitative care, mortality rates are still high. Percutaneous techniques offer a safer and potentially less invasive method compared to open surgical revascularization in ALI.

Nonsurgical options for AULI treatment include endovascular techniques (such as percutaneous catheter embolectomy, catheter-directed thrombolysis, and stents) and medical management (such as anticoagulation). Minimal invasive mechanical endovascular techniques have been greatly developed in recent years. They quickly remove thrombi and emboli when revascularization is urgently required, especially in frail patients. Endovascular techniques are recommended as the first-line treatment for severe ischemia.

Endovascular techniques are effective and safe for AULI. Combined multiple endovascular techniques are important for successful treatment. Among the available endovascular techniques, percutaneous aspiration thrombectomy (PAT) is recommended to be the initial procedure given the lower dosage of urokinase required and lower complication rate. In AULI, amputation and loss of function rarely occur. On the other hand, cerebral infarction and other thromboembolisms that potentially affect daily activities were observed in 38% of people with a mid-to-long-term prognosis. According to Licht et al, 3-year and 5-year survival rates of upper limb embolism were 54% and 37%, respectively. Most deaths during long-term follow-up (54% of all cases)

were due to cardiovascular and cerebrovascular causes. The incidence of recurrent AULI after treatment was estimated to be 5.7% by Miju B et al.

Systemic anticoagulant therapy is used to treat both upper and lower limb ischemia in recurrent ALI. Other treatments include intravenous (IV) fluid, oxygen, and medical optimization. Comorbid risk factor assessment and revascularization are compulsory to be performed. The most common causes of AULI are embolism, thrombosis, and iatrogenic. Recurrent AULI can be prevented by long-term anticoagulants. One-third of patients without anticoagulants and 10% of patients on anticoagulants experience recurrent embolization, mostly due to persistent atrial fibrillation. The overall risk for ALI recurrence was 3.6% according to Silva et al. ALI recurrence was observed in 12.2% of patients who were on inadequate anticoagulant treatment and 1.3% of those who received adequate anticoagulant treatment.

Other comorbid factors were assessed, in addition to medication and revascularization by pharmacomechanical thrombectomy with angioplasty. Unfortunately, some of the test results remained unavailable until this case was reported.

## CONCLUSION

We presented a case of a young male with recurrent AULI. To determine the cause of recurrent limb ischemia, the comorbid risk factor was evaluated, and the embolism source was identified. The patient received pharmacotherapy and underwent revascularization with PAT.

## AUTHOR CONTRIBUTIONS

The study was conceptualized by Widya Safitri. Data analysis was performed by Widya Safitri, Suci Indriani and Suko Adiarto. The manuscript was written and edited by Widya Safitri and Suci Indriani. All authors read and approved the final manuscript.

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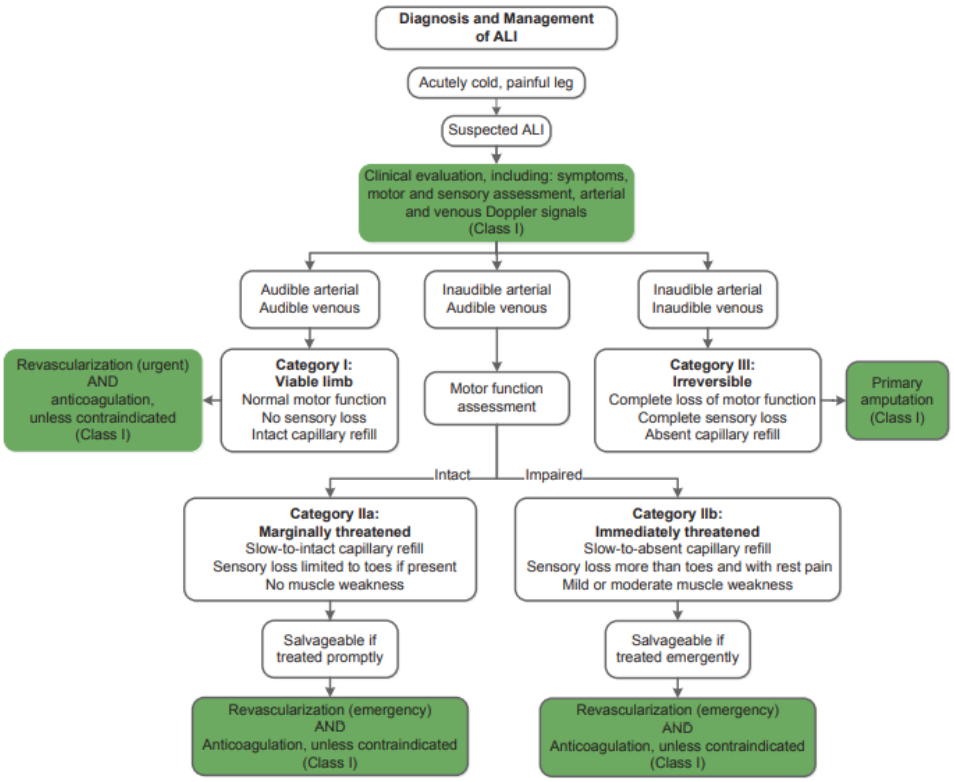


**Figure 6.** Management of acute limb ischemia[8]

## ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

This is a case report of a hospitalized patient who did not undergo additional or experimental procedures/measures. The patient received standard therapy in our hospital. Due to the nature of this study, the Hospital team did not require ethical clearance.

## CONSENT FOR PUBLICATION

Informed consent for publication is obtained from the patient and the patient's confidentiality is protected.

## COMPETING INTERESTS

The authors declare that no known competing financial interest or personal relationship that could have appeared to influence the work reported in this paper.

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