

CASE REPORT

Percutaneous Thrombin Injection: An Alternative Therapy for Iatrogenic Carotid Artery Pseudoaneurysms

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Introduction: Carotid artery pseudoaneurysm is a rare but potentially morbid complication of central venous catheter insertion. Traditionally managed by open surgical or endovascular repair, this article describes a case that used percutaneous thrombin injection. Delivered at the point of care under ultrasound guidance, it offers a less invasive and less resource dependent approach where conventional therapies are unsuccessful.

Case report: A 63 year old man re-presented to hospital with a right common carotid artery pseudoaneurysm following internal jugular vein catheterisation for a staged transcatheter aortic valve implantation. An attempt was made at coil occlusion by the neuro-interventional radiology team, but this was unsuccessful given inability to pass a delivery catheter to the pseudoaneurysm tract in the setting of a tortuous and calcified proximal circulation. Subsequently, direct percutaneous thrombin injection, administered under ultrasound guidance was undertaken as an alternative approach. Complete thrombosis was achieved with no complications and the patient was discharged on day three of admission.

Discussion: While percutaneous thrombin injection is commonly used in the treatment of femoral pseudoaneurysms, there remains a paucity of evidence regarding its use in the management of carotid pseudoaneurysms. This case demonstrates its effectiveness in treating this complication. Percutaneous thrombin injection may offer a highly effective treatment option for carotid pseudoaneurysm, particularly where more conventional therapies have been unsuccessful or are relatively contraindicated.

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INTRODUCTION

Carotid artery pseudoaneurysms (CAPs) are a rare but potentially morbid complication of central venous catheter (CVC) insertion.¹ There is a paucity of literature detailing CAP complicating internal jugular vein (IJV) catheterisation, with a limited number of case reports. Typical treatment options for iatrogenic CAP include either an endovascular or open surgical approach.² With the informed consent of the patient, this report outlines the case of a patient who developed a right common carotid pseudoaneurysm following IJV catheterisation treated successfully by percutaneous thrombin injection.

CASE REPORT

A 63 year old man presented with a 6–12 month history of Canadian Cardiovascular Society Class III angina and limited exercise tolerance. His past medical history was significant for hypertension, hyperlipidaemia, a medically managed anterior myocardial infarction, and diffuse triple vessel coronary artery disease. He also had a history of left breast carcinoma 22 years earlier that had been treated by radical mastectomy and adjuvant radiotherapy.

Deemed inappropriate for surgical intervention due to a hostile thorax and high risk of non-healing wounds, the patient underwent multivessel percutaneous coronary intervention (PCI), including left main coronary artery intervention followed by a staged transcatheter aortic valve replacement (TAVR) undertaken from a transfemoral approach. Prior to the TAVR a CVC was placed in the right IJV. His symptoms of heart failure improved significantly after the intervention; however, he re-presented to hospital 10 days after discharge with a painful, pulsatile swelling of the right neck (Fig. 1A). Ultrasound (US) demonstrated a right common carotid artery pseudoaneurysm with a long neck and a

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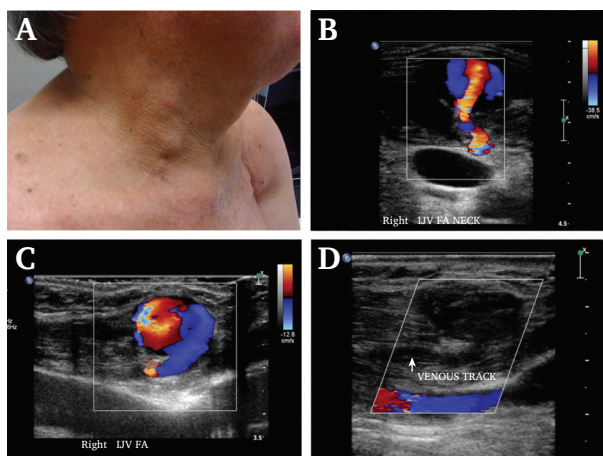


Figure 1. (A) Right neck mass. (B) Ultrasound image of the pseudoaneurysm neck. (C) Ultrasound image of the pseudoaneurysm sac. (D) Ultrasound image demonstrating no residual flow into sac or neck post-thrombin injection. IJV = internal jugular vein.

sac that measured 1×2 cm (Fig. 1B and C). The following day an attempt at coil occlusion was made by the neuro-interventional radiology team, but this was unsuccessful given inability to pass a delivery catheter to the pseudoaneurysm tract in the setting of a tortuous and calcified proximal circulation. Subsequently, direct percutaneous thrombin injection, administered under US guidance was undertaken as an alternative approach. The centre of the pseudoaneurysm sac was accessed with a 23 G needle and a normal saline filled Luer Lock Tip Syringe. Correct positioning of the needle was confirmed on two dimensional US in the transverse projection, and withdrawal of arterial blood and saline injection into the sac, as seen on Doppler flow. With the needle left *in situ*, 0.1 mL (100 units) aliquots of thrombin diluted in normal saline were administered by slow push. After administration of 600 units of thrombin complete uncomplicated defect thrombosis was achieved (Fig. 1D). A distal protection device was not used for this procedure. The patient was discharged on day three without further incident and remains asymptomatic 10 years after treatment.

DISCUSSION

CAPs commonly present with a painful, pulsatile neck mass, as in this case, but can also present with symptoms of stroke. If left untreated, complications such as enlargement, thrombosis, embolisation, and rupture can occur.³ In the present case, after an unsuccessful attempt at coil embolisation, a decision was made to treat by percutaneous thrombin injection under US guidance in favour of a covered stent, given the multiple previous arterial site cannulations and tortuous anatomy.

Since its introduction, percutaneous thrombin injection has demonstrated superior outcomes vs. mechanical compression in treating iatrogenic femoral artery pseudoaneurysms.⁴ The major complication associated with thrombin injection is distal thrombus embolisation. Other less common potential risks include anaphylaxis secondary

to bovine thrombin and infection (abscess formation and skin cellulitis).⁵ The risk of distal embolisation, occurring in approximately 2% of cases when treating femoral pseudoaneurysm,⁵ can be reduced with distal protection devices (including balloon occlusion) and by employing an optimal technique and minimising the thrombin volume.⁴ A neuro-protective device was not used in the described case.

Despite the favourable outcomes of percutaneous thrombin injection in treating iatrogenic peripheral pseudoaneurysms, there is a paucity of literature documenting successful treatment of CAP with this method. Of the five available case reports (Table 1),^{6–10} all CAPs developing after carotid puncture had been managed initially by direct manual pressure. In all but one case, open surgical repair was contraindicated due to patient comorbidities or haemodynamic instability and the remaining case had failed to achieve thrombosis after endovascular stent placement. In each case the operator used US guidance when administering thrombin directly into the pseudoaneurysm sac; however, a distal neuroprotection device was only used for three of the procedures. One report noted a 2 mm thrombus had been captured by the protection device during the procedure. Complete thrombosis was achieved in all cases without neurological complication.

The present case supports the safety and efficacy of the modality in treating CAP when administered in a tertiary centre, and highlights the advantages of thrombin injection being less invasive and less resource dependent. It can be delivered timely and efficiently in the critical care setting and is a lower risk alternative in the comorbid patient. The decision to manage the present patient with US guided thrombin injection followed an unsuccessful attempt at coil embolisation. Although this alternative option was supported by the cases discussed above, there are limited published clinical data and certainly no randomised or even observational reports comparing treatment options for CAP. While it is not a risk free procedure, the anatomy of the defect was thought to be favourable for percutaneous thrombin injection. It was felt that a small defect size with a relatively long tract to the carotid artery would be at lower risk of distal embolisation. Separately, there is uncertainty regarding the role of distal protection during thrombin injection (either by balloon occlusion or embolic protection device) to offset procedural stroke risk. While there are case reports to support its use, it is unclear how effective it is against thrombin micro-aggregates. Hopefully, future data will further define both the mandate and effectiveness of its use. Regardless, it was decided to proceed with thrombin therapy for the present patient without distal or proximal protection. Although considered, given multiple recent radial and bilateral femoral arterial punctures for both PCI and TAVR access, it was felt that the added risk of a repeated arterial site cannulation would potentially offset any clinical benefit of a distal neuroprotection device. Additionally, the risk of embolisation was thought to be lower due to a small defect size with long neck (Fig. 1B and C). This balanced decision was particularly reinforced by the operator's very significant experience with US guided

Table 1. Published case reports of carotid artery pseudoaneurysms managed by percutaneous thrombin injection.

Case	Cause	Symptoms	Treatment	Adjuncts	Outcome
Moller et al. ⁶	IJV catheterisation without US guidance	<ul style="list-style-type: none"> • Arterial puncture recognised immediately • 2.3 cm pseudoaneurysm with 8 mm neck 	<ul style="list-style-type: none"> • Manual compression (unsuccessful) • Thrombin injection (75 units) 	A neuroprotective device was not used	Complete thrombosis was achieved with no neurological complications
Holder et al. ⁷	IJV catheterisation without US guidance	<ul style="list-style-type: none"> • Increasing pain, bruising • Pulsatile mass noted after 72 h • 3.5 cm pseudoaneurysm 	<ul style="list-style-type: none"> • US guided compression (unsuccessful) • Thrombin injection (250 units) 	8.5 mm occlusive balloon positioned at level of pseudoaneurysm neck (inflated for 10 s)	Complete thrombosis was achieved with no neurological complications
Lee et al. ⁸	IJV catheterisation without US guidance	<ul style="list-style-type: none"> • Arterial puncture noticed on routine blood draw • Neck swelling at puncture site • 5 cm pseudoaneurysm 	<ul style="list-style-type: none"> • Manual compression (unsuccessful) • Thrombin injection (200 units) 	6.5 mm embolic protection device was deployed distal to the pseudoaneurysm neck	<ul style="list-style-type: none"> • Complete thrombosis was achieved with no neurological complications • A 2 mm thrombus was retrieved from the embolic protection device post-procedure
Randazzo et al. ⁹	Carotid endarterectomy	<ul style="list-style-type: none"> • A large pulsatile neck mass noted at two week follow up • 3 cm pseudoaneurysm with a 1 × 2.3 mm neck 	<ul style="list-style-type: none"> • Thrombin injection (125 units) 	A neuroprotective device was not used	<ul style="list-style-type: none"> • Complete thrombosis was achieved with no neurological complications
Sablani et al. ¹⁰	Not described	<ul style="list-style-type: none"> • Symptoms not described • 6.8 × 6.1 × 4.5 cm pseudoaneurysm 	<ul style="list-style-type: none"> • Placement of six coils in the external carotid artery • Placement of three covered stents followed by balloon dilatation over two staged procedures • Thrombin injection (500 units) 	Balloon inflation in the right internal carotid artery (inflated for 2 min)	<ul style="list-style-type: none"> • Complete thrombosis was achieved with no neurological complications

IJV = internal jugular vein; US = ultrasound.

thrombin injection in treating iatrogenic femoral pseudoaneurysms with a well established institutional protocol and technique associated with high procedural efficacy and safety.⁴ Intra-procedural neurological monitoring such as transcranial Doppler may be considered as it offers real time assessment and allows for early detection of micro-emboli and cerebral hypoperfusion.¹¹

In the years following this case, TAVR programmes have matured with advanced computed tomography guided pre-procedural planning, improved prosthesis technology, and increased clinical experience. Whereas invasive lines were once common practice, the procedure is now done with

local anaesthesia and conscious sedation. Although the use of CVCs has fallen, the case highlights thrombin injection as a viable option in the management of CAP after failed conventional approach with coiling and high operative risk.

Conclusion

CAP, a rare but potentially morbid complication of CVC insertion, has been traditionally managed by an open surgical or endovascular approach. However, as the present case illustrates, percutaneous thrombin injection may offer a highly effective treatment option with an apparently low

complication rate particularly where more conventional therapies have been unsuccessful or are relatively contraindicated.

CONFLICT OF INTEREST

None.

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REFERENCES

- 1 Golden LR. Incidence and management of large-bore introducer sheath puncture of the carotid artery. *J Cardiothorac Vasc Anesth* 1995;**9**:425–8.
- 2 Cafasso D, Meadows JM, Wolfe SQ, Katras T, Kellicut DC, Golarz SR. Endovascular treatment of bilateral carotid artery pseudoaneurysms after blunt carotid injury. *Ann Vasc Surg* 2014;**28**:263.
- 3 Yi AC, Palmer E, Luh GY, Jacobson JP, Smith DC. Endovascular treatment of carotid and vertebral pseudoaneurysms with covered stents. *Am J Neuroradiol* 2008;**29**:983–7.
- 4 Chen DH, Sammel AM, Jain P, Jepson NS. Cardiologist operated ultrasound guided thrombin injection as a safe and efficacious first line treatment for iatrogenic femoral artery pseudoaneurysms. *Heart Lung Circ* 2015;**24**:165–72.
- 5 Morgan R, Belli AM. Current treatment methods for post-catheterization pseudoaneurysms. *J Vasc Interv Radiol* 2003;**14**:697–710.
- 6 Moller SM, Logason K, Karason S, Thorisson HM. Percutaneous thrombin injection of common carotid artery pseudoaneurysm without cerebral protection. *Tex Heart Inst J* 2012;**39**:696–8.
- 7 Holder R, Hilton D, Martin J, Harris PL, Rowlands PC, McWilliams RG. Percutaneous thrombin injection of carotid artery pseudoaneurysm. *J Endovasc Ther* 2002;**9**:25–8.
- 8 Lee JH, Tseng IK, Siegel RL, Roychowdhury S. Percutaneous thrombin injection with a distal embolic protection device for treatment of a common carotid artery pseudoaneurysm. *Interv Neuroradiol* 2013;**19**:235–9.
- 9 Randazzo MA, Onye AC, Khariton K, Singh K. Ultrasound-guided percutaneous thrombin injection of common carotid pseudoaneurysm following carotid endarterectomy is possible. *J Vasc Ultrasound* 2016;**40**:35–7.
- 10 Sablani N, Jain G, Hasan MM, Sivakumar K, Feuerwerker S, Arcot K, et al. A novel approach to the management of carotid blowout syndrome: the use of thrombin in a case of failed covered stenting. *BMJ Case Rep* 2016;**2016**:bcr2015012121.
- 11 Ali MFA. Transcranial Doppler ultrasonography (uses, limitations, and potentials): a review article. *Egypt J Neurosurg* 2021;**36**:20.