

# Endovascular repair of inadvertent subclavian artery injury during attempted internal jugular vein catheterization: A case report

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## Abstract

Inadvertent subclavian artery injury during internal jugular cannulation is a rare but potentially severe complication, resulting in the development of hematoma, hemothorax, pseudoaneurysm or arteriovenous fistula. Endovascular repair of such injuries is a safe and reasonable treatment option with lower morbidity and mortality compared to open surgical approach. Herein a case of right subclavian artery laceration resulting in massive hemothorax as a complication of the insertion of a double-lumen hemodialysis catheter into the right internal jugular vein, managed by endovascular stent-graft placement is reported.

## INTRODUCTION

Central venous cannulation is a very common catheter-based technique, widely used in daily clinical practice. The procedure is carried out on wards, in operating rooms, intensive care and high dependency units or radiology departments, providing satisfactory multiple vein access in usually critically ill patients with inadequate or nonaccessible peripheral veins, and making possible hemodynamic monitoring, fluid resuscitation, administration of vasoactive drugs, antibiotics or chemotherapy, parenteral nutritional support and hemodialysis access in renal failure patients. Central venous catheterization is effective and safe in experienced hands, but may be potentially associated with serious complications. The majority of fatal complications are insertion-related and include tension pneumothorax and arterial laceration. Arterial complications are reported in between 0,5-3,7% and may be associated with significant morbidity and mortality<sup>1</sup>. When recognized, prompt vascular consultation and intervention, usually involving angiography, are required.

There are several treatment options, ranging from open surgical approach to endovascular procedures. Endovascular repair of inadvertent arterial injuries in high risk patients, as the majority of patients undergoing central venous cannulation, is a reasonable and safe alternative with lower

morbidity and mortality compared to open surgery<sup>2,3</sup>.

Endovascular management of such injuries may be achieved using either stent-grafts or arterial closure devices, which mainly depends on whether there is removal or not of the catheter before the intervention<sup>4</sup>.

## CASE REPORT

A 82-year-old woman with a history of arterial hypertension, paroxysmal atrial fibrillation, heart failure, insulin-dependent diabetes mellitus and chronic renal failure under hemodialysis admitted in the Cardiology Department of our hospital because of acute pulmonary edema.

Inadvertent right subclavian artery catheterization took place during attempted internal jugular vein cannulation (13.5Fr silicon double-lumen hemodialysis catheter). Chest x-ray depicted catheter misplacement (Fig. 1).

**Figure 1**

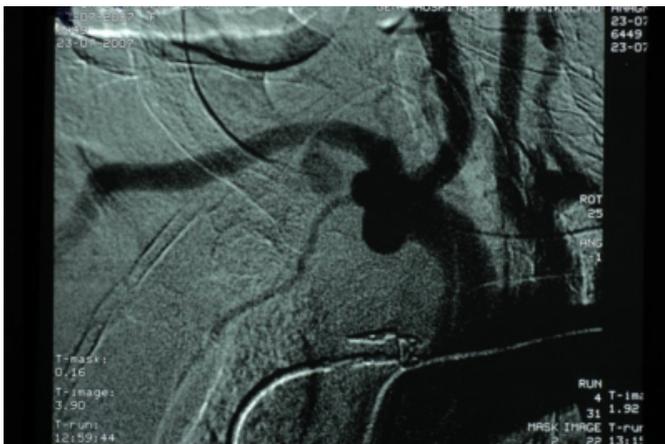
Figure 1: Chest x-ray: Misplacement of central venous catheter



The catheter was left in situ for 2 days. A decision for catheter removal was made, since the catheter was considered not to be endovascular. During its subsequent removal, there was significant bleeding and the patient rapidly developed hypovolemic shock. A massive hemothorax was documented on chest x-ray. A vascular surgeon was immediately summoned and an urgent digital subtractive angiography (DSA) of aortic arch, carotid and subclavian arteries was carried out via a common femoral approach. The angiography revealed laceration of the right subclavian artery with significant extravasation of contrast media (Fig. 2).

**Figure 2**

Figure 2: DSA: Right subclavian artery laceration with significant extravasation of contrast medium



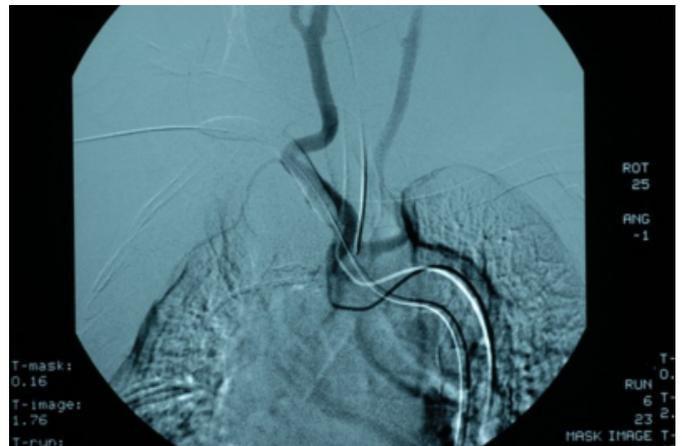
An anesthetist provided cardiocirculatory and airway support. The patient received I.V. sedation and local anesthesia, and was monitored with ECG, BP measurements and pulse oxymetry. Prophylactic I.V. antibiotic and

heparine were given.

The patient initially underwent a 10mmX8cm balloon (Optimed, Ettlingen, Germany) tamponade for temporary bleeding control from a right brachial artery approach because of technical difficulties in subclavian artery access through the aortic arch (Fig. 3). A Fluency 10mmX8cm stent-graft (Bard Angiomed, Karlsruhe, Germany) was subsequently inserted after balloon removal, resulting to occlusion of subclavian artery laceration (Fig. 4).

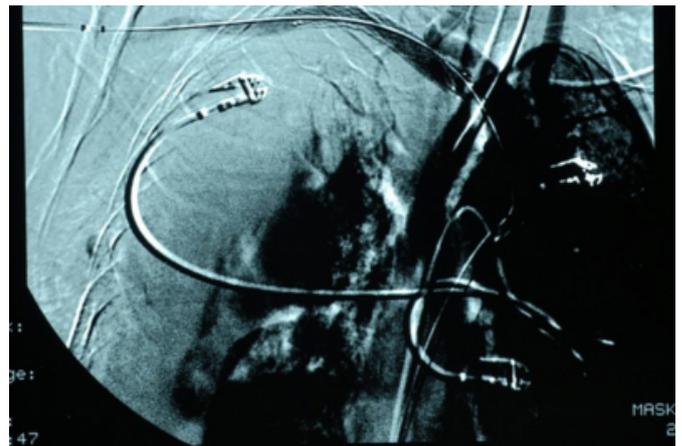
**Figure 3**

Fig. 3: Ballon tamponade for temporary bleeding control before stent-graft placement



**Figure 4**

Fig. 4: Successful stent-graft insertion from a right brachial artery approach



The whole procedure took place via the right brachial artery with no seath inserted for time saving reasons.

A closed thoracostomy tube was placed for the management of hemothorax. The blood loss during the first day was 3000ml. A bronchoscopy was attempted to remove bloody

secretions from bronchial tree. Due to continued blood draining (2300ml during the second day after tube insertion) and subsequent hematocrit decrease (20%), a new angiography was performed, which confirmed the stent-graft patency and excluded the possibility of leakage. The patient, who had already received 12 units of packed red cells and 10 units of fresh frozen plasma, underwent, after CT scan confirmation of massive hemothorax, emergency thoracotomy. Large amount of blood and clots were evacuated through a right thoracotomy and an intercostal artery puncture was recognized as the source of bleeding. The patient, 30 days after thoracotomy, remains under mechanical ventilation in ICU.

## DISCUSSION

Internal jugular vein (IJV) catheterization is a frequently performed procedure. Amongst others, IJV is increasingly being used as a temporary route for hemodialysis catheter placement in patients with renal failure, as is thought to be safer than subclavian or femoral vein sites. In the vast majority of cases, IJV cannulation is successful and uncomplicated, but some times may be associated with potentially serious traumatic complications such as inadvertent arterial puncture or laceration, pleural and mediastinal injuries, pneumothorax, hemothorax and hemomediastinum.

Arterial injury can result in the development of hematoma, hemothorax, pseudoaneurysm or arteriovenous fistula<sup>5678</sup>. These complications usually occur subsequently to arterial catheterization rather than arterial puncture alone. When identified, prompt vascular surgery and radiology consultation is required.

The most common arterial injury associated with IJV cannulation is carotid artery puncture. Complications caused by subclavian artery laceration are rare. Their actual incidence and frequency are unknown because many cases are probably underreported. Almost all subclavian artery injuries reported in the literature are right-sided. It has been supposed that this complication is a right-sided phenomenon, because of specific anatomic layout<sup>9</sup>. The typical clinical presentation of the triad of right-sided IJV cannulation, acute hypotension and x-ray evidence of hemothorax should warn for the possibility of subclavian artery injury.

Open surgical treatment of iatrogenic subclavian injuries necessitates highly invasive operative approaches

(Sternotomy or thoracotomy for injuries of intrathoracic segment / Supraclavicular incision combined in some instances with additional clavicular transection for injuries of postvertebral segment). It should be underlined that patients requiring central venous catheterization are usually critically ill or have severe comorbid conditions, and thoracotomy in such cases is associated with a high morbidity and mortality. The development of stent-grafts allowed major arterial complications to be treated percutaneously, avoiding the increased risk of open surgery. However, surgical repair of inadvertent subclavian artery injuries may be necessary if stent-grafting would cover the vertebral artery or if the common carotid artery had been punctured<sup>4</sup>.

Technically, either the femoral or brachial percutaneous approach may be used for endovascular stent-grafting, as in our case. Subclavian vessels are large and readily accessible from the femoral or brachial approach making them well suited to endovascular therapy<sup>310</sup>. Balloon tamponade may be necessary for temporary bleeding control until the preparation of stent-grafting equipment. Technical success of endovascular repair in cases of subclavian artery injuries is reported between 94-100% with procedure-related complications between 0-22%<sup>311</sup>. The risk of cerebral arteries thromboembolism should be concerned during endovascular procedures, especially for right subclavian artery injuries. It has also been recognized that rigid stents are subject to compression or fracture<sup>3</sup>. Another known disadvantage of stent-graft repair is the potential for stimulating intimal hyperplasia at the stent-graft-arterial wall junction, which results in diminished blood flow and the risk of acute thrombosis<sup>3</sup>.

In cases of suspected inadvertent subclavian artery injury during central venous access procedures, angiography is recommended before catheter removal, with the vascular surgeon and the interventional radiologist in attendance for balloon tamponade and/or stent-graft insertion.

## CONCLUSION

Inadvertent subclavian injuries during internal venous cannulation are rare but potentially devastating. Prompt vascular surgery and radiology consultation is necessary. Endovascular stent-graft repair of such injuries is a safe and reasonable treatment option, especially in high-risk patients.

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