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Life-threatening common carotid artery blowout: rescue treatment with a newly designed self-expanding covered nitinol stent

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ABSTRACT. Carotid blowout is a devastating complication in patients with head and neck malignancy. A covered stent offers an alternative to treatment of a carotid blowout patient thought to be at high risk for surgery or carotid occlusion. Stent placement in the common carotid artery or carotid bulb is a technical challenge because of large luminal diameter and luminal calibre discrepancy between internal carotid artery and common carotid artery. We present four patients with common carotid rupture and massive bleeding who were treated with self-expanding covered stents, among them, two cases were treated with newly designed self-expanding polytetrafluoroethylene (PTFE)-covered nitinol stents.

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Endovascular management of acute bleeding in the head and neck by occlusion of the offending vessel with coils or detachable balloons has been the alternative to surgical exploration [1]. However, these procedures have the potential for producing delayed cerebral ischaemic complications in 15–20% of patients [2]. Covered stent deployment has been developed as an effective treatment option in carotid blowout patients thought to be at high risk for surgery or carotid occlusion [2]. However, stent placement for the management of carotid blowout is not always effective in cases of head and neck malignancy involving extensive segment of the common carotid artery (CCA) with relatively large calibre or carotid bulb with luminal calibre discrepancy between internal carotid artery (ICA) and CCA.

We report four cases of CCA rupture with massive bleeding in patients with head and neck malignancies and a history of long-term radiation treatment who were treated using self-expanding covered stents. Among these patients, two cases were treated by a newly designed covered stents which have a bare area in both their proximal and distal portions.

Patients and methods

During a 5-year period between May 1999 and June 2004, we treated four patients (four males, aged 57–68 years) with common carotid rupture, who had head and neck malignancies, and who had histories of radiation therapy alone or combined with chemotherapy. The patients' characteristics are listed in Table 1. All of these patients presented with life-threatening massive neck or oral bleedings, unstable vital signs and altered mental changes. The procedures were performed under local anaesthesia with 1% lidocaine and conscious sedation with intravenously administered midazolam hydrochloride (Versed; Roche Laboratories, Nutley, NJ). A 9-F introducer sheath was positioned in the right common femoral artery. The patients did not have systemic heparinization as they were having massive bleeding. Using digital roadmap guidance, a 0.035″ hydrophilic guidewire (Terumo, Tokyo, Japan) was carefully manoeuvred into the ICA. A 4-F catheter (Terumo, Tokyo, Japan) was then advanced over the wire. After obtaining an angiogram with a 4 F catheter, a steep 0.035″ exchange length wire (Terumo, Tokyo, Japan) was introduced beyond the diseased segment into ICA. A self-expanding covered nitinol stent (NITI-S Stent; Taewoong Medical, Seoul, Korea) was then passed over the exchange guidewire and carefully positioned at the level of the bleeding site including pseudoaneurysm. The stent was then deployed across the corresponding segment of the pseudoaneurysm. 300 mg of oral clopidogrel (Plavix; Bristol Myers-Squibb, New York, NY) were given after deploying the stents to minimize the risk of stent thrombosis resulting from platelet aggregation.

Profile of PTFE covered nitinol stent

NITI-S stent is based on the longitudinal wire mesh design (Figure 1). Nitinol wire with 0.007″ in diameter

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Table 1. Summary of patients with covered stent placements in the common carotid artery

No. of cases	Age/Gender	Presentation	Underlying disease	Bleeding location	Treatment device (diameter × length)	Clinical course
Case 1	62/M	Massive bleeding at neck open wound	Oesophageal carcinoma	Mid-CCA	10 × 70 mm CS 10 × 50 mm CS	Re-bleeding after 11 days, stable for 2 months
Case 2	57/M	Massive oral bleeding	Nasopharyngeal carcinoma	Carotid bulb	10 × 70 mm CS 9.0 × 40 mm BS 10 × 50 mm CS	Re-bleeding after 6 weeks, stable for 5 months, died because of massive infarcts due to contralateral ICA invasion
Case 3	68/M	Massive oral bleeding	Laryngeal carcinoma	Distal CCA	10 × 70 mm CS	Discharged in stable condition 1 day later and lost follow-up
Case 4	61/M	Massive oral bleeding	Hypopharyngeal carcinoma	Carotid bulb	10 × 70 mm CS	Discharged in stable condition 1 day later and transferred to other hospital

CCA, common carotid artery; CS, covered stent; BS, bare stent; ICA, internal carotid artery.

was used for the single-wire woven stent making the stent cells in the both ends closed. Three gold tip markers were attached at each end of the stent margin to enhance fluoroscopic visibility. Because the stent is adhered onto the PTFE graft by polyurethane, the stent is disposed between polyurethane at its outer surface and the PTFE sheet at its inner surface. Polyurethane would also give PTFE more durability.

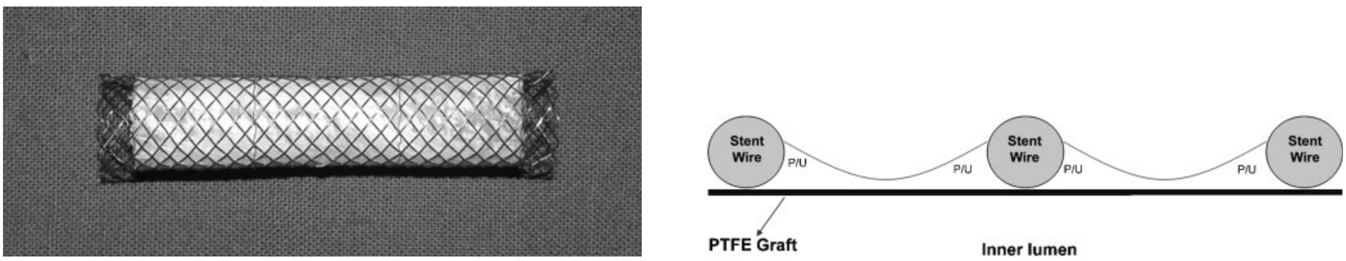
The diameters and lengths of the stents were 10 mm and 70 mm in all cases, and additional 10 mm × 50 mm stents placements were performed in cases 1 (Figure 2) and 2 (Figure 3). The 10 mm × 70 mm stent which was designed for transjugular intrahepatic portosystemic shunt (TIPS) consisted of a proximal covered area (50 mm in length) and a distal bare area (20 mm in length). The newly designed 10 mm × 50 mm stent consisted of a middle PTFE covered segment (40 mm) and a 5 mm bare segment at both proximal and distal ends (Figure 1).

Results

The stent delivery and placement were all successful. Immediately after the procedure, vital sign and neurological status of the patients became normalized and follow-up angiogram showed occlusion of pseudoaneurysm and preservation of the parent arterial flow in all cases. Re-bleeding at the proximal margin of the stented segment, suggesting extension of the disease beyond the stent margin, required another covered stent deployment in two patients (case 1 and 2). In these two patients, an additional newly designed 10 mm × 50 mm stent was placed in the lower portion of the previous stent and no recurrent haemorrhage was found on follow-up for 2 months and 5 months, respectively. Discrepancy of vessel lumen size between the ICA and the CCA required bare stenting within the covered stent in a patient with carotid bulb blowout (case 2). Treatment device, clinical course, and follow-up results for study patients were listed in Table 1.

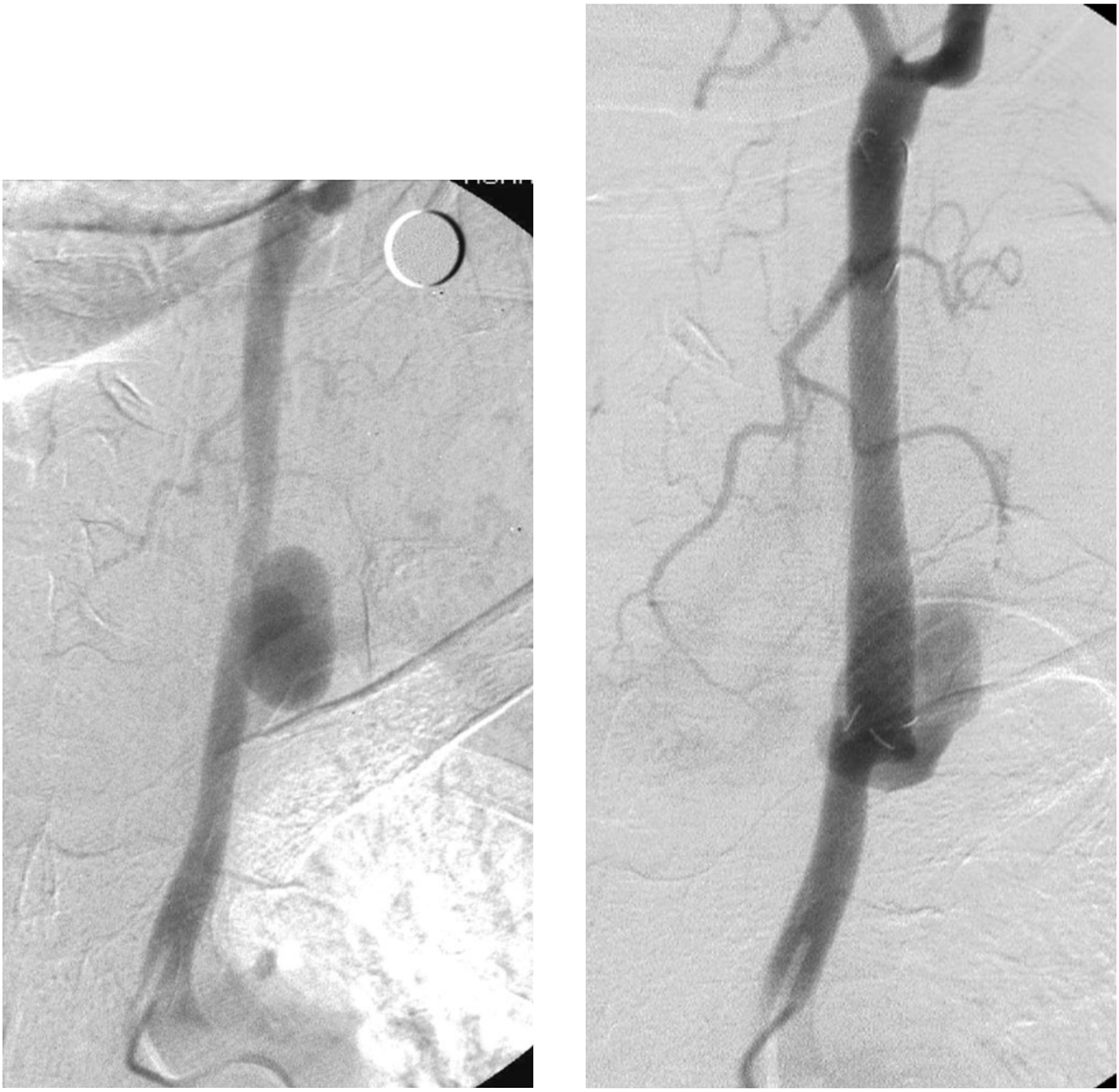
Discussion

The reported incidence of carotid rupture in patients who have had a neck dissection with or without tumour resection is 3–4% [3]. Carotid blowout is associated with approximately 60% neurological morbidity and 40% mortality in patients with associated conditions such as



(a) (b)

Figure 1. Photographs of the covered stent (Taewoong Medical, Seoul, Korea) composed of a self-expanding nitinol wire covered with PTFE. (a) The 10 mm × 50 mm stent used secondarily in cases 1 and 2 consists of proximal and distal bare segments of 5 mm and a middle covered area of 40 mm. (b) Note the structural relationship of the stent wire and PTFE graft. Outer polyurethane layer connects the stent wire and PTFE graft. Stent wire thickness is 0.007″ in size.



(a) (b)

Figure 2. A 62-year-old male with unresectable oesophageal carcinoma presented with massive bleeding at the neck wound site associated with deep neck infection after radiation therapy. (a) Conventional angiogram shows a large pseudoaneurysm in the mid-portion of the left common carotid artery (CCA). (b) 11 days after the first stent placement. Conventional angiography shows extension of the previous pseudoaneurysm at the lower margin of the stent. (*Continued*)

(c)

Figure 2. (*Cont.*) (c) After placement of an additional stent, angiography shows no recurrent haemorrhage.

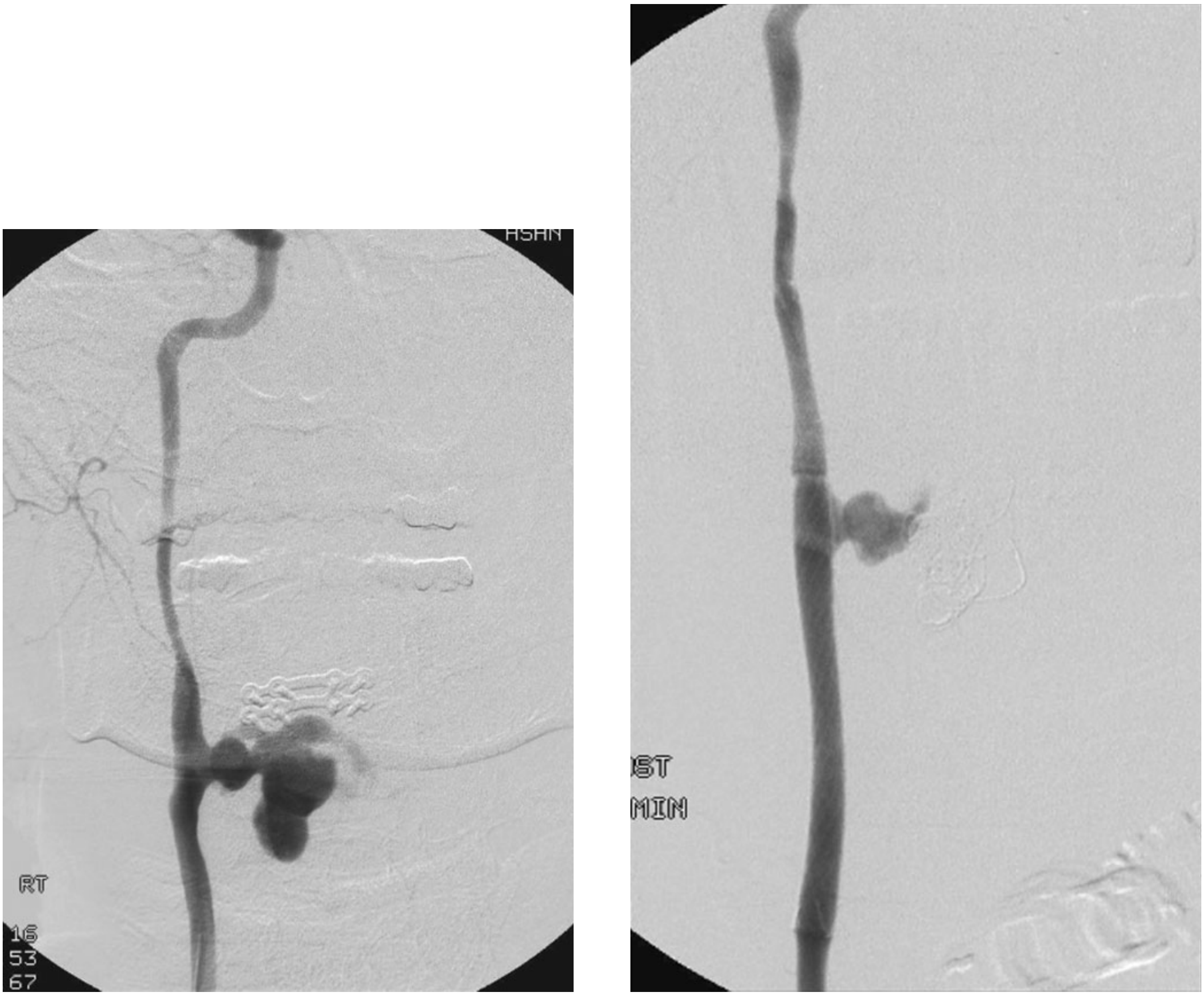
pharyngocutaneous fistula, recurrent tumour, or radiation necrosis [4]. The history of irradiation therapy adds a 7.6-fold increased risk of developing carotid blowout in patients with head and neck malignancy [5].

Treatment of extracranial carotid artery pseudoaneurysm has been open surgery with resection and reconstruction or carotid artery ligation. However, this condition often makes patient haemodynamically unstable and causes significantly decreased cerebral perfusion. Pseudoaneurysm is composed only of fibrous tissue and contains no normal vessel wall elements: neither do these aneurysms have a real neck. Therefore, the dissection and preparation of the aneurysmal sac for clipping involves an extremely high risk of perioperative rupture [6].

The advent of various endovascular treatments including permanent balloon occlusion or coil embolisation has expanded the therapeutic options for patient with rupture and pseudoaneurysm of ICA or CCA [3]. However, as many as 15–20% of patients whose carotid blowout is managed with permanent balloon occlusion may develop immediate or delayed cerebral ischaemia [2]. In all of our patients, as their vital signs and mental status were unstable and the examinations for the cerebral perfusion before the procedure such as the balloon occlusion test were impossible, it was not known whether the occlusion procedure of the CCA would have further compromised cerebral perfusion. Thus, endovascular sacrifice of the CCA was not reliable. The choice of endovascular carotid stent placement combined with Guglielmi detachable coils (GDC) has been reported [7]. However, long-term radiation therapy in patients with head and neck cancer could injure normal head and neck structures, thus, the surrounding radiation induced soft tissue changes cannot offer enough support to the parent artery and to the pseudoaneurysmal sac. In case 2, the patient was initially treated with coil embolisation because stent placement was considered difficult due to a discrepancy in the size of vessel lumen between the ICA and the CCA. However, as coil embolisation alone did not occlude the pseudoaneurysm of the CCA, additional stent placement was then performed. Kiyosue et al, reported dispersion and migration of coils in carotid blowout patient treated by parent-artery occlusion with coils [8].

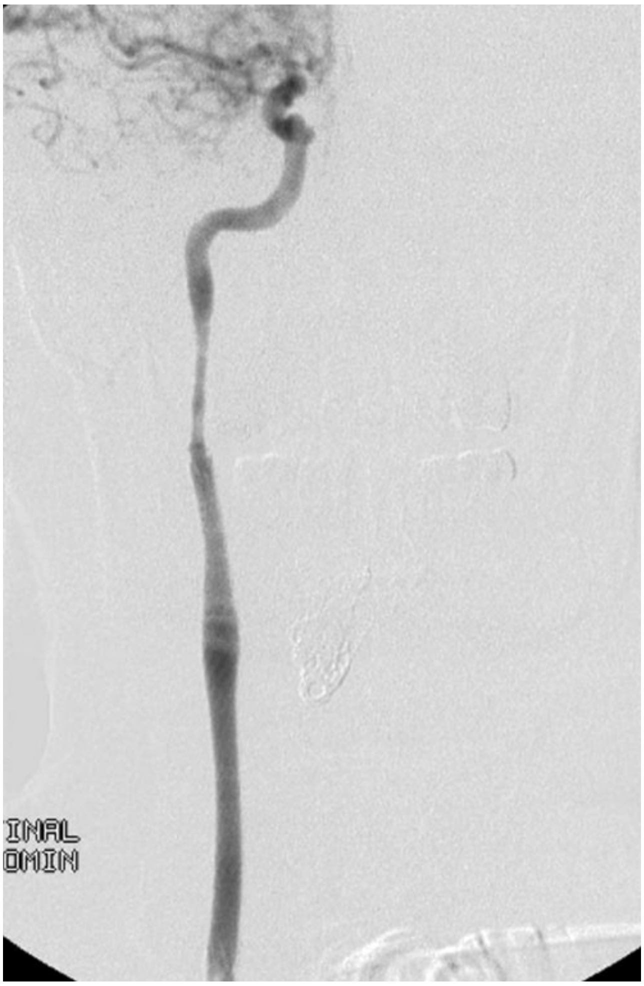
Covered stents are already in clinical use for treating occlusive, aneurysmal, and traumatic peripheral arterial disease, for repairing aortic aneurysm, and in transjugular portosystemic shunting [9]. In several previous reports, covered stents had been used in the treatment of ICA pseudoaneurysm [10–12]. However, the stent placement for the management of carotid blowout is not always effective in case of head and neck malignancy involving extensive segment of the CCA with relatively large calibre or carotid bulb with luminal calibre discrepancy between the ICA and the CCA. In general treatment of ICA and CCA pseudoaneurysm, either 5 mm or 7 mm diameter stents consistent with the CCA or ICA lumen were usually used as well as 9-F arterial sheaths to accommodate the outer diameter as its delivery system. In our cases, we used large-bore 10 mm diameter self-expanding stents via exchange guidewire through a 9-F arterial sheath as its delivery system. With these methods on the realtime roadmap fluoroscopy, there was no difficulty in exact positioning and deployment.

Additional pseudoaneurysm formation at the lower end of the covered stented margin of the CCA can be due to the radiation-induced surrounding soft tissue weakness or due to the rigid lower end of the covered stent structure because the covered stent used at the initial attempt in our patients did not have a bare portion at the lower end. The newly designed 10 mm $\times$ 50 mm stents were used in cases 1 and 2. It consisted of a covered segment (40 mm) and 5 mm bare segments at proximal and distal ends. Although the long-term patency rates of these stents and their risk of thromboembolic or other complications in the treatment of the CCA rupture and pseudoaneurysm formation are unknown, the vital signs and neurological status of these patients became stable after these procedures and there were no complications



(a) (b)

Figure 3. A 57-year-old man with inoperable nasopharyngeal carcinoma treated with radical neck dissection and radiation therapy presented with massive oral bleeding. (a) The right common carotid arteriogram shows a pseudoaneurysm formation and contrast leakage into pharynx and oral cavity near the carotid bulb. (b) Immediate angiography after stent placement and coil embolisation revealed a small contrast leakage out of the distal portion of the covered stent due to luminal diameter discrepancy between the proximal internal carotid artery (ICA) and the covered stent caused by the transitional lumen size of the carotid bulb. (*Continued*)



(c)

Figure 3. (*Cont.*) (c) Final angiography shows no further leakage of the contrast agent after deployment of another self-expanding stent crossing the distal end of the covered stent. The patient became stable immediately after procedure.

leading to any neurological deficits during the short-term follow-up periods.

Because of the limited follow-up periods in this series, the long-term patency rates of these stents and their risk of thromboembolic or other complications in the treatment of the CCA pseudoaneurysm are unknown. However, in all of our cases, there were no complications during the short-term follow-up periods, and the causes of death were not associated with stent complications or bleeding pseudoaneurysms. The vital signs and neurological status of these patients were dramatically improved after these procedures.

In summary, the newly designed self-expanding covered nitinol stent may be a safe and useful tool for the endovascular occlusion of the CCA pseudoaneurysms. Delivering this 10 mm diameter stent via a 9-F arterial sheath is easy. Although long-term follow-up and larger series are required in order to evaluate the stent efficacy, these four cases highlight the usefulness and versatility of this covered stent for rescue treatment of life-threatening bleeding pseudoaneurysm of the CCA.)

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