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CLINICAL LETTER

Endovascular coils extrusion after internal carotid artery occlusion: From management to follow-up

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KEYWORDS

coil, embolization, internal carotid artery, pseudoaneurysm, stenting

Key points

- ICA coil extrusion (ICA-CE) occurs most frequently in the nasopharyngeal/sinonasal site.
- Evaluating the ICA coils stability, through an angiography, is of primary importance.
- ICA-CE management needs to be decided based on the patient's symptoms and general status.

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1 | INTRODUCTION

Injury of the internal carotid artery (ICA) during a surgical approach is a life-threatening complication,[1] in which goal standard of treatment is usually represented by ICA coil occlusion.[2]

As a complication of this procedure, ICA coil extrusion (ICA-CE) can occur; in the available literature, 17 case reports have been reported, with the nasopharyngeal/sinonasal site being the most represented (10 cases, 58.8%), followed by the cervical region (three cases, 17.7%), oro-/hypopharynx (three cases, 17.7%), and middle ear (one case, 5.8%). Unfortunately, no one has ever proposed a comprehensive management of this complication, thus leaving its approach open to debate.

This study aims to describe the ICA-CE management for both its intracranial and extracranial tracts.

2 | METHODS

In this multicentric study, patients affected with ICA-CE between April 2014 and January 2023 were included. The study was approved by the review boards of each hospital.

In all cases, the site of CE, cause of ICA injury, previous radiotherapy, preoperative symptoms referred by patients, diagnostic work-up, and timing between ICA occlusion and CE were analyzed. Considering the different localizations of the ICA-CE, the management of the extruded coils (complete, partial or no removal; covering with local/free

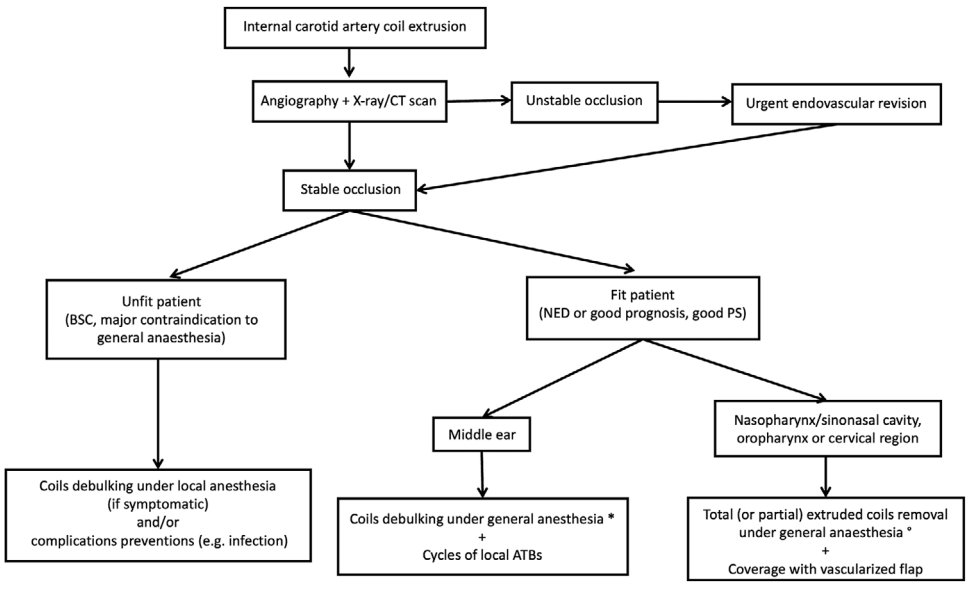

FIGURE 1 Flowchart showing the management of internal carotid artery (ICA) coil extrusion in both its intracranial and extracranial portion. Coils debulking can be performed, depending on the localization of the ICA coil extrusion, with precise instruments like sinus scissors (nasopharynx, sinonasal cavity or oropharynx), microear scissors (middle ear), or Metzenbaum scissors (cervical region). In general, considering that this noninvasive procedure has to be performed in a stable ICA occlusion, it can be done in an ambulatorial setting. °: the decision to remove totally or partially the extruded coils should be outweighed in each case. A partial removal of ICA coil extrusion (ICA-CE) was performed in one case of nasopharynx/sinonasal cavity (Pt. 4), which was sealed inside the sphenoidal sinus using a nasoseptal flap to prevent infection and symptoms recurrence. *: at the level of the middle ear ICA coil extrusion is generally associated with a membrane perforation and migration into the external ear. To treat this ICA region, it is advisable to cut the wire flush to the tympanic membrane and administrate cycles of local antibiotic therapies to avoid infection and promote the healing of the tympanic membrane. ATB, antibiotic; CT, computed tomography; BSC, best supportive care; NED, no evidence of disease; PS, performance status.

TABLE 1 Main characteristics of patients grouped by localization of extrusion site of the ICA coil.

	Age	Cause of ICA injury	Previous treatment	Type of event treated	Type of occlusion/stenting	Timing between ICA occlusion and coil extrusion	Removal of extruded coil	Application of local flap	Recurrence of extruded coils	Complications
Nasopharynx/sinonasal cavity										
Pt 1	26	Posttraumatic	–	Pseudoaneurysm	Total ICA occlusion with coils	36 months	Total	No	No	Infection
Pt 2	69	Posttreatment (nasopharyngeal SCC)	RT	ICA blow-out	Total ICA occlusion with coils	7 months	Partial[a]	No	Yes	–
Pt 3	47	Post-treatment (UCNT)	NER III + RT	Need to include the ICA in the resection	Total ICA occlusion with coils	8 months	Total	Yes (inferior turbinate flap)	No	–
Pt 4	53	Invasive mycotic infection of the sphenoidal sinus	–	Direct ICA fungal infiltration	Total ICA occlusion with coils	2 months	No	Yes (naso-septal flap)	No	–
Pt 5	31	Invasive mycotic infection of the nasopharynx	–	Direct ICA fungal infiltration	Total ICA occlusion with coils	1 month	Total	No	Yes	–
Pt 6	75	Posttreatment (sinonasal ACC)	Endoscopic endonasal resection + orbital exenteration + RT + CHT	Pseudoaneurysm	Total ICA occlusion with coils	2 months	Partial[a]	No	Yes	–
Pt 7	47	Post-treatment (sinonasal chondrosarcoma)	Endoscopic endonasal resection + proton therapy	ICA cancer encasement	Total ICA occlusion with coils	16 months	Total	Yes (nasoseptal flap)	No	–

(Continues)

TABLE 1 (Continued)

	Age	Cause of ICA injury	Previous treatment	Type of event treated	Type of occlusion/stenting	Timing between ICA occlusion and coil extrusion	Removal of extruded coil	Application of local flap	Recurrence of extruded coils	Complications
Oropharynx										
Pt 8	62	Post-treatment (oropharyngeal SCC, HPV neg)	Oropharyngectomy + RT	ICA blow-out	Total ICA occlusion with coils	6 months	Total	No	No	Infection
Middle ear										
Pt 9	38	Iatrogenic injury of aberrant tympanic ICA	–	Pseudoaneurysm	Occlusion of the pseudoaneurysm with coils + stenting	10 months	Partial	No	No	–
Cervical region										
Pt 10	57	Posttreatment (oropharyngeal SCC, HPV neg)	Neck dissection + total parotidectomy + RT	ICA blow-out	Total ICA occlusion with coils	69 months	No[a]	No	No	–

Abbreviations: ACC, adenoid cystic carcinoma; CHT, chemotherapy; ICA, internal carotid artery; NER, nasopharyngeal endoscopic resection; RT, radiotherapy; SCC, squamous cell carcinoma; UCNT, undifferentiated nasopharyngeal carcinoma.

[a]Patients in best supportive care due to a progressive pathology and not in a condition to be operated upon.

flaps or not) was studied and correlated to the number of CE recurrences and complications.

Follow-up visits were based on in-office evaluation associated with radiological imaging (Computed tomography (CT), Magnetic Resonance Imaging (MRI), or sinonasal X ray).

3 | RESULTS

A total of ten patients were included: seven cases experienced ICA-CE in the nasopharynx/sinonasal cavity and one case each in the oropharynx, middle ear, and cervical region (Figure 1, Table 1). In total, 60% of patients had previously received radiotherapy at the level of the extrusion site.

The ICA-CE was asymptomatic in four cases (three endonasal and one cervical), whereas two experienced foreign body sensation (one oropharyngeal and one nasopharyngeal), one ear fullness and pulsatile tinnitus (middle ear), and two nasal crusting and epistaxis (nasopharynx/sinonasal cavity).

To evaluate the stability of the ICA occlusion (potential reperfusion of the occluded ICA tract), angiography was performed in all cases; to assess the extension of the CE material, two cases underwent paranasal sinus X-ray and eight cases were explored with CT and/or MRI.

ICA-CE management is displayed in Table 1: it is noteworthy that, when a mucosal reconstruction was applied, no CE recurrence nor complications were recorded. In the case of middle ear localization (Pt. 9), the partial removal of CE resection was associated with postoperative topical antibiotic therapies.

All patients underwent clinical/radiological follow-up every 2–6 months with X-ray or CT-MRI; no further angiography was performed.

4 | DISCUSSION

When dealing with ICA-CE, our results underline that the goal of management should be threefold: (1) evaluation of the potential ICA reperfusion and assessment of the ICA coils stability, (2) resolution of symptoms caused by the CE, and (3) prevent coils infection and recurrence/further migration. Considering the potential risk of life-threatening bleeding due to endovascular coil destabilization, the immediate priority is the evaluation of potential ICA reperfusion, which is generally done with an angiography.[3] When the stability of ICA occlusion is ascertained, a radiological examination is needed to evaluate the CE extension and exclude tumor recurrence and/or infectious complications (i.e., deep abscess), usually based on CT/X-rays.

Whenever possible, the treatment of choice should be the total removal of the ICA-CE, cutting the metallic material as close as possible to the point of extrusion while preserving its intravascular portion: this procedure should be performed under general anesthesia, given the possible risk of ICA bleeding while manipulating the extruded material.[4] Indeed, these coils are tightly meshed into each other within the ICA and are prone to unravel into a single fine strand if pulled causing potential massive bleeding; on the other hand, leaving the extruded coils in a contaminated field may favor infectious complications (i.e., arteritis) or severely impact the patient quality of life. As a result, the pros and cons of a "total" removal should be evaluated case by case: in patients with a progressive disease and/or contraindications to general anesthesia, a more conservative approach should be considered, like ICA-CE debulking under local anesthesia.[5]

In some patients of our cohort, a local flap was applied and associated with fewer CE recurrences (zero vs. three cases) and complications (zero vs. two infections). This surgical solution can be applied in almost every portion of the ICA (with the exemption of the middle ear) and is used to provide vital tissue that can seal the coils inside the ICA.[6]

4.1 | Follow-up

In the first postoperative period, the recommendation is to strictly follow up the patient until a well-healed surgical field is achieved. After that, a clinical examination at 3 months, and then every 6 months associated with radiological examination of the ICA coil material is advisable.

AUTHOR CONTRIBUTIONS

A. Vinciguerra, M. Turri Zanoni, M. Ferrari, D. Mattavelli, A. Giorgianni. F. Di Pierro, E. Fazio, L. Gazzini, B. Verillaud, and V. Rampinelli made substantial contributions to conception, design and acquisition of data, drafted the article, revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; A. Schreiber, L. Calabrese, M. Bignami, P. Battaglia, P. Nicolai, P. Castelnuovo, and P. Herman made substantial contributions to conception of the data,

revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT INTERESTS STATEMENT

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