

## Carotid bypass surgery for a persistent neck tumor after multiple treatments: a case report

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### ABSTRACT

Carotid artery involvement in head and neck cancer is challenging for surgeons and oncologists, particularly in recurrence or residual disease following multiple treatments. However, carotid artery resection and reconstruction can be safely performed in a carefully selected patient with local and regional control benefits despite the potential morbidity and high-risk complications. We presented a case of primary laryngeal cancer treated with chemoradiotherapy, modified radical neck dissection type I for residual neck node disease, and further chemotherapy. Although the primary laryngeal cancer showed a complete response, the residual neck tumor was still unresolved and even involved the carotid artery. Therefore, carotid resection with a combined saphenous vein graft and free flap reconstruction was the treatment of choice for this patient. It is effective and safe, and the risk of morbidity has been accepted.

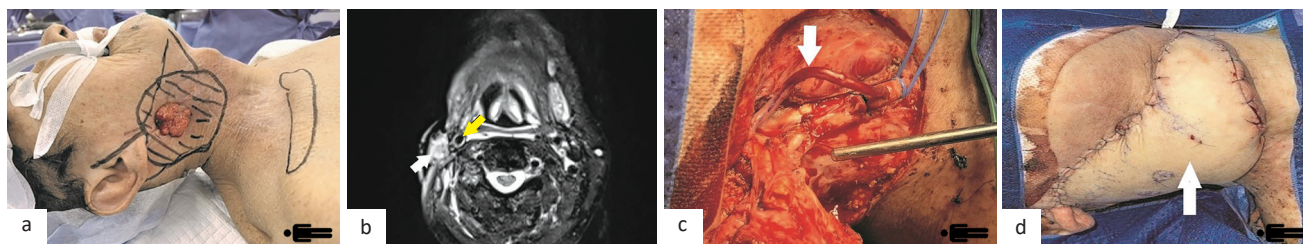
**KEYWORDS** carotid artery, neck node metastasis, reconstructive surgical procedures, squamous cell carcinoma, vascular surgical procedures

Involvement of the carotid artery in head and neck cancer poses a challenge for both surgeons and oncologists due to its high risk, particularly when it manifests following multiple treatments. Attempting surgical salvage in this population adds another layer of complexity. An aggressive surgical approach to attain oncological clearance is a challenge that head and neck surgeons must face. Radical *en bloc* resection is the aim of curative intention.

Controversies arise between the survival benefit and postoperative morbidity and mortality. A previous study indicated that in advanced squamous cell carcinoma involving the carotid artery, surgically treated patients with curative intent had improved

overall survival compared with the palliative group. However, the survival outcome was not significantly different between those treated with carotid artery resection with or without reanastomosis, curative peeling with or without adjuvant therapy, and definitive chemoradiation therapy.<sup>1</sup> Another study reported that overall survival was better in patients with carotid resection and reconstruction with low perioperative neuromorbidity and mortality rates.<sup>2–4</sup>

Although the procedure is now well known, studies about carotid artery resection and reconstruction as a part of salvage treatment are still limited. Moreover, this procedure requires careful consideration for those who have undergone radiotherapy and multiple



**Figure 1.** Pre- and intraoperative surgical site. (a) A lobulated fungating lesion protrudes from the upper third neck region before surgery; (b) an axial view of postcontrast MRI showed a nodular lesion (white arrow) to the ICA (yellow arrow); the external carotid artery and internal jugular vein were not seen; (c) saphenous vein graft (white arrow) was used to replace the resected ICA; (d) surgical defect was covered with ALT flap (white arrow). ALT=anterolateral thigh; ICA=internal carotid artery; MRI=magnetic resonance imaging

surgeries. Here we presented a carotid resection with greater saphenous vein and free flap reconstruction in a patient with a persistent neck node tumor following multiple treatments, including radiotherapy and neck dissection.

## CASE REPORT

A 69-year-old male came to the outpatient clinic of Universiti Kebangsaan Malaysia Specialist Centre, referred from another hospital with a history of transoral laser laryngeal surgery for laryngeal carcinoma *in situ* 10 years ago. He was doing well until the symptoms recurred 5 years later eventually diagnosed with laryngeal squamous cell carcinoma with neck node involvement on imaging. Although the primary tumor responded completely to chemoradiotherapy (CRT), the treatment he received seemed unable to resolve the neck lesion. He subsequently underwent a modified radical neck dissection type I (sternocleidomastoid muscle and internal jugular vein removed) but appeared to have developed wound dehiscence that gradually formed an ulcerated lesion.

After the core biopsy examination of the lesion revealed a moderately differentiated squamous cell carcinoma, he underwent another surgery at the previous hospital. However, it could not clear the disease because the tumor was found adhered and fixated to the internal carotid artery (ICA) intraoperatively. Hence, he was given another cycle of chemotherapy. Unfortunately, he could not recall or have any record of his chemotherapy regimen. He still claimed to have had no improvement after completing the treatment. He did not feel any associated symptoms such as pain or other complaints suggesting cranial nerves' involvement or

airway compromise; however, secretion and bloody discharge occasionally came out of the lesion.

A soft lobulated fungating lesion was discovered on physical examination in the upper third region of the irradiated right neck (Figure 1a). There were no other palpable neck nodes. Magnetic resonance imaging (MRI) of the neck revealed a nodular lesion measuring  $2.2 \times 1.3 \times 2.6 \text{ cm}^3$  in the right posterior submandibular region up to level C3, with no evidence of invasion of the ICA. In addition, there was no evidence of the internal jugular vein or external carotid artery. The lesion was slightly smaller than the previous scan performed before chemotherapy (Figure 1b).

A preoperative balloon test occlusion of the right ICA was performed as a precautionary measure to assess crossflow supply to the contralateral ICA. The result showed adequate filling of the contralateral blood supply, and the risk of cerebral infarction was low. He was scheduled for salvage surgery that consisted of wide excision of the tumor, carotid



**Figure 2.** Clinical appearance of the patient 7 months after surgery without significant morbidity. The anterolateral thigh (ALT) flap was healing well

resection, and reconstruction with a saphenous vein graft. An anterolateral thigh (ALT) flap was harvested to reconstruct the defect in the neck. The surgery was done by head and neck as well as plastic reconstructive surgeons with curative intent. Intraoperatively, the lesion was discovered to have adhered and fixated to the ICA, with no discernible demarcated plane but not encasing it. The external carotid artery and internal jugular vein were not found, most likely because they were resected during the previous surgery.

The saphenous vein graft and ALT flap were harvested concurrently with the excision of the tumor to minimize surgical time. Before clamping the carotid artery, the entire tumor mass was mobilized. Once a sufficient length of greater saphenous vein was harvested, heparin was administered, clamps were applied, and the tumor mass and the affected portion of the carotid artery were removed *en bloc*. Microvascular anastomosis was performed under a microscope with end-to-end anastomosis at the cephalic and end-to-side at the caudal end (Figure 1c). The raw surfaces of surgical fields and transplanted grafts were covered with the ALT flap (Figure 1d). The ALT flap's end-to-end arterial and venous anastomosis was done to the contralateral superior thyroid artery and internal jugular vein. Intraoperative Doppler sonography was done to check the flow of anastomoses before closing the wound.

The postoperative period was relatively uneventful. The patient continued to be treated in the intensive care unit until the following day and required 7 days of hospitalization. During this time, the flap was monitored with surface Doppler periodically, and the mean arterial pressure was maintained at 80–90 mmHg. If any potential sign of vascular compromise was detected, the patient must return to the operating room for emergent exploration and revision. Antibiotics and supportive therapies were given routinely after surgery. He had no neurological complications such as peri- and postoperative stroke or myocardial infarction. In addition, he demonstrated excellent motor function postoperatively, with only minor dysphagia complaints resolving.

His histopathological examination revealed a well-differentiated squamous cell carcinoma with a free surgical margin. However, lymphatic permeation was noted in the specimen. During the follow-up MRI examination, a poorly defined irregular lesion was enhanced heterogeneously at the posterior aspect

of the right parotid gland extending into the right postauricular region, which was outside our previous surgical field, measuring 1.9 × 2.2 cm. Despite having recurrences, to date, at 7 months postoperative carotid resection and reconstruction, he has no significant complications from the operation and is currently undergoing palliative care (Figure 2). Written informed consent was obtained from the patients for the publication of this report and any accompanying images.

## DISCUSSION

Primary concurrent CRT is a known treatment strategy for preserving larynx function for locally advanced laryngeal malignancies. However, 25% of individuals with primary CRT may develop residual neck disease. A study showed a decrease of 35% in neck control in patients with N2 or greater regional disease in those who received CRT without neck dissection compared to those with neck dissection.<sup>5</sup>

Carotid artery invasion in advanced squamous cell carcinoma can be tough to predict, even with preoperative computed tomography (CT) or MRI. Thus, if bulky disease or carotid encasement is not present, the surgeon still must consider the possibility of invasion. A previous study reported that preoperative MRI provided a sensitivity of 100% for ICA involvement in head and neck cancer, while CT scans had a sensitivity of 75%. On the other hand, MRI had a specificity of 88%, while CT scans were 100%.<sup>6</sup> Preoperative imaging can be beneficial in predicting a tumor resection. However, the final decision to sacrifice the ICA is typically made intraoperatively after thoroughly examining the tumor and its relationship to the artery.

Salvage surgery is a fundamental treatment of recurrent or residual nodal disease. The goal of treatment is to achieve tumor-free margins, a principle of oncologic resection. As a result, a complete, and when feasible, *en bloc* removal of the disease is required. A complete resection involves the removal of the affected structures. When the invasion of the carotid artery is associated with recurrent neck cancer, the surgical challenge becomes more significant due to scarring of the tissues.

Additionally, patients exposed to radiation may have weakened arterial walls due to adventitial fibrosis, arterial elastic tissue destruction, and accelerated atherosclerosis.<sup>2</sup> Peeling off the tumor from the

ICA's adventitial layer will weaken the arterial wall, predisposing it to postoperative complications such as arteritis, luminal obstruction, arterial aneurysm, and further wall weakening. These can lead to arterial rupture risk, resulting in life-threatening consequences such as a carotid artery blowout. Moreover, a "clean" resection may not be possible. Histopathological examination of carotid artery specimens following the tumor peeling technique reveals microscopic disease within the arterial wall of the carotid artery. This likely contributes to the low survival outcomes, making this treatment the least favorable option.<sup>2</sup> Therefore, the carotid artery must be sacrificed at times. However, it must be remembered that the risks of stroke and death involved with sacrificing the carotid artery are still significant. The overall risk of carotid sacrifice without revascularization includes a mortality rate of 7% and morbidity rate of 17%, which is higher than the inherent risks associated with bypass procedures (no mortality and a 3–7% morbidity rate).<sup>7</sup> To decrease the overall morbidity and mortality rates associated with carotid artery sacrifice, revascularization may be performed.<sup>8</sup> In our case, deciding to provide the best treatment with the optimal outcome for the patient was critical. Thus, meticulous planning and thorough discussion were essential before deciding on the procedure with the patient.

A preoperative screening helps determine which patients can tolerate the resection with minimal chances of postoperative complications, especially a cerebrovascular event. The balloon occlusion test is an angiographic test performed to evaluate cerebral ischemic tolerance in patients undergoing therapeutic ICA ligation and bypass surgery.<sup>9,10</sup> Although the balloon occlusion test has a false negative risk of 3.3–10.0% when the complication rate is compared between those who undergo ICA occlusion without and with balloon occlusion tests, the number reaches 26% with a 12% mortality rate related to cerebral infarction. These complications are reduced to 13% when balloon occlusion tests are performed.<sup>9</sup> Therefore, patients who require vascular resection or occlusion during head and neck cancer surgery may benefit from a preoperative balloon occlusion test.

Mourad et al<sup>2</sup> reported that out of 51 patients undergoing carotid reconstruction, two patients (3.9%) had a cerebral vascular accident in the immediate postoperative period. One patient developed residual upper extremity weakness, while the second patient

had profound hemiplegia. Another study reported a trend toward poor outcomes following carotid bypass surgery (16.7% complication rate, including subdural hematoma associated with blindness, stroke, and asymptomatic bypass occlusion).<sup>8</sup> Meanwhile, another study demonstrated a favorable median survival, with only one incidence of perioperative complication (carotid artery blowout) led to stroke.<sup>1</sup>

Mourad et al<sup>2</sup> documented an overall 2-year survival of 82% in the setting of low perioperative neurologic morbidity and mortality rates. Illuminati et al<sup>11</sup> reported a disease-specific survival at 2 and 5 years was 56% and 49%, respectively. In our case, despite the newly grown tumor at a different site during follow-up, which occurs most likely due to lymphatic invasion, the patient maintained a favorable quality of life until the present day (7 months after carotid resection and reconstruction). Furthermore, there were no neurologic complications; he was ambulatory and could care for most of his personal needs. Hence, carotid bypass surgery can be performed without significantly increasing morbidity if patients are carefully selected and preoperative preparation is carried out effectively.

However, consideration needs to be made regarding the nature of the disease. Although the pathologist reported that the surgery achieved free margin, recurrence still occurred in this case. In head and neck squamous cell carcinoma, occult neck node metastasis in the form of micrometastasis and isolated tumor cells (ITC) is often undetected during a routine pathological examination. According to the American Joint Committee on Cancer cancer staging manual, 6th edition, ITC are classified as pN0 metastatic lesions measuring less than 0.2 mm in diameter. On the other hand, micrometastasis is defined as metastatic lesions of 0.2 to 2.0 mm and classified as pN1mi.<sup>12</sup> Detecting this occult metastasis can be done using serial sectioning and immunohistochemistry with a pan-cytokeratin marker.<sup>13</sup> Further examinations should be considered for these micrometastases and the ITC when dealing with recurrences or residual tumors.

The management of patients with residual or recurrent neck disease involving the carotid artery is controversial despite evidence of the benefits of carotid artery resection and reconstruction. As indicated in this case, salvage surgery with carotid artery reconstruction may benefit the patient with the result of accepted morbidity. Nevertheless, due to the disease's nature, the procedure's technical feasibility

must be weighed against its morbidity, the functional consequences of organ resection, and the likelihood of successful salvage.

#### Conflict of Interest

The authors affirm no conflict of interest in this study.

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