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Management of carotid artery exposure with pectoralis major myofascial flap transfer and split-thickness skin coverage

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Abstract

The risk for post-operative exposure of the carotid artery due to skin flap necrosis after major head and neck surgery is increased after previous radiation and in severely malnourished patients. Eight patients are described who presented with an (imminent) carotid exposure one to eight weeks after surgery. Pectoralis major myofascial flap transfer with split thickness skin graft coverage was used for protection of the carotid artery. All cases were managed successfully and healed primarily in two to four weeks with acceptable cosmesis. We advocate immediate treatment in the event of an exposed carotid (or imminent exposure) by a pectoralis major myofascial flap with split-thickness skin grafting.

Key words: Carotid arteries; Pectoralis muscles; Skin; Surgical flaps

Introduction

One of the most serious and life-threatening sequelae of radical oncological surgery in the head and neck is wound breakdown with subsequent exposure of the major cervical blood vessels. If this situation is allowed to persist, especially in the case of simultaneous salivary leakage, catastrophic haemorrhage must be anticipated (Conley and Baker, 1979). Therefore, immediate management, i.e. coverage of the exposed blood vessels is of paramount importance and can be lifesaving. Although the incidence of necrosis of the skin after neck dissection, with or without opening of the food passage, is low, it occurs more frequently after salvage surgery following radiotherapy. The impact of radiotherapy not only manifests itself in the skin and subcutaneous tissues of the neck but also in the vasa vasorum of the carotid artery (Rubin and Cassaret, 1968; Moss *et al.*, 1979), thus rendering the carotid even more susceptible to bacterial flora and saliva than usual.

The optimal treatment of an exposed carotid artery should be immediate and preferably be accomplished as a one-stage procedure. Conservative treatment by debridement of necrotic material in the wound and application of saline dressings to promote secondary wound healing is time-consuming and hazardous. The method should be reliable and offer a good and well vascularized protection in an already contaminated operative field (Joseph *et al.*, 1988). Local skin and muscle flaps, therefore, are not indicated, since previous radiation therapy and surgery will have made their vascular supply less reliable.

Since its introduction, the pectoralis major flap transfer is the preferred method of reconstruction in the management of patients with carotid artery exposure as it is an extremely reliable flap and offers ample well-vascularized muscular tissue for protection. Furthermore, head and neck surgeons are generally very familiar with the technique of harvesting. We prefer to use the myofascial variant as opposed to a myocutaneous flap, because in that form the flap does not have to be twisted, and avoidance of a skin island decreases the distortion of the donor area. The undersurface can easily be skin-grafted and offers an acceptable cosmetic appearance of the receptor area (Bos *et al.*, 1991; Balm *et al.*, 1993).

We have reviewed the data over the last five years and eight cases could be identified that have been managed by this reconstructive technique and these form the basis of this analysis.

Patients

From 1989 to 1994, 272 (selective) neck dissection procedures were performed, either as a solitary procedure or as part of a composite resection. In eight patients (three per cent) an (imminent) carotid exposure developed. To outline the complicated nature of the different cases, patients' histories are

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summarized below. Relevant clinical data are listed in Table 1.

Case 1

A 63-year-old female was referred for a persistent swelling in the neck after radiation therapy (60 Gy) to the postauricular area and the neck for metastatic spread of an eccrine sweat gland tumour of the scalp, that had been treated by surgery one year before. Left-sided superficial parotidectomy and neck dissection were performed in continuity with the postauricular skin, subcutaneous tissues and the cortex of the mastoid process. A triradiate skin incision was used for the neck dissection. The defect was closed by rotation of the cervical skin flap. Histological examination revealed that the residual postauricular tumour was completely excised and no pathological lymph nodes were found. A wound infection was conservatively treated by antibiotics and the patient was discharged on post-operative Day 26.

Two months after surgery she was readmitted because of wound breakdown and exposure of the carotid bulb. The next day the neck was debrided and necrotic skin edges were excised. Reconstruction of the defect was performed by a pectoralis major myofascial flap with split-thickness skin graft (STSG) cover of the undersurface of the flap. Rapid wound healing subsequently occurred while antibiotics were continued and she was discharged from the hospital three weeks later.

Case 2

A 55-year-old malnourished female underwent total glossectomy with marginal mandibulectomy, left radical neck dissection and right supra-omohyoid neck dissection for a previously untreated T_4N_{2a} squamous cell carcinoma of the oral tongue. The left-sided neck dissection was carried out using a triradiate incision. The defect was reconstructed using a latissimus dorsi musculocutaneous free flap. Pathology showed resection margins to be free and in the left neck one positive node was found with extranodal spread.

Despite administering pre-operative antibiotics, a progressive wound infection from post-operative Day 9 onwards resulted in necrosis of the skin flaps overlying the carotid artery on the left side. Debridement of the wound was carried out and a pectoralis major myofascial flap with STSG was used to resurface the neck. No connection to the pharynx was noted and the latissimus dorsi flap stayed viable. The post-operative course was uneventful and she could be discharged four weeks later.

Case 3

A 44-year-old male underwent total laryngectomy, partial pharyngectomy and right modified radical neck dissection for a T_4N_{2b} squamous cell carcinoma of the right pyriform sinus. Histopathology showed margins to be free and there were two lymph node metastases without extranodal spread. He received adjuvant radiotherapy to both the primary site and the neck up to a total dose of 54 Gy. Eight months later a left radical neck dissection had to be carried out for a contralateral nodal recurrence. This dissection appeared to be complete.

The post-operative course was uneventful. However, the patient had to be readmitted three days after discharge because of wound breakdown with carotid artery exposure. No pharyngocutaneous fistula was present. A pectoralis major myofascial flap with STSG cover was used to cover the defect after debridement of the neck and excision of non-vital tissue. Recovery was uneventful and discharge took place after 17 days.

Case 4

A 50-year-old male with a history of excision of a T_1N_0 left sided anterior tonsillar pillar carcinoma,

TABLE I

CLINICAL DATA OF PATIENTS WITH CAROTID ARTERY EXPOSURE AFTER NECK SURGERY TREATED BY PECTORALIS MAJOR MYOFASCIAL FLAP RECONSTRUCTION. ALL PATIENTS HEALED PRIMARILY

Case #/Age, (y)/Sex	Original tumour	Surgery	Predisposing factors		Interval, days	Hospital stay, days
			RT	Medical		
1/63/F	Scalp, Sweat gland	Parotidectomy, Neck diss	60Gy		60	23
2/55/F	T_4N_{2a} Tongue, SCC	Commando, Bilateral Neck diss	—	Cachexia	14	28
3/44/M	T_4N_{2b} Hypophar, SCC	LP, Neck Diss	54Gy		18	13
4/50/M	T_2N_0 Orophar, SCC	Neck diss	70Gy		21	26
5/56/M	T_3N_0 Larynx, SCC	Neck diss	66Gy		7	21
6/67/M	T_4N_1 Hypophar, SCC	Myotomy	63Gy		32	17
7/78/M	T_4N_{2c} FOM, SCC	Commando, Bilateral neck diss	—	Cachexia	14	16
8/76/M	T_4N_3 Hypophar, SCC	LP, Neck diss	—	*	17	13

RT = previous radiotherapy; F = Female; M = Male; Neck Diss = Neck dissection; Hypophar = Hypopharynx; LP = Partial pharyngectomy and total laryngectomy; Orophar = Oropharynx; FOM = Floor of mouth. *chyle leakage and pharyngocutaneous fistula.

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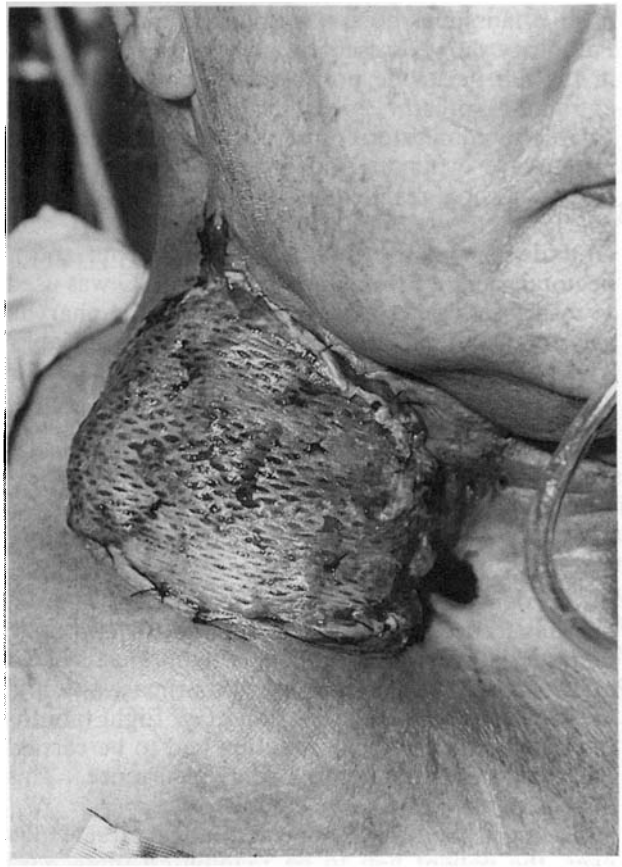

FIG. 1

Case 6 one week after transposition of the pectoralis major muscle and split skin coverage. Notice the lump of muscle in the neck.

was treated for subsequent primary tumours, i.e. a T_1N_0 carcinoma of the medial wall of the pyriform sinus and a T_2N_0 carcinoma of the vallecula and right lateral oropharyngeal wall by definitive radiation therapy. A total dose of 70 Gy was given to the primary sites and both sides of the neck received 46 Gy. Due to a neck node recurrence four months later, a right radical modified neck dissection had to be performed, utilizing a hockeystick-like incision. Two tumour masses without evidence of pre-existing lymphatic tissue were radically excised.

Twenty-one days later, 10 days after discharge, a severe infection of the neck occurred and his right neck was debrided and a pectoralis major myofascial flap with STSG cover was inserted because of wound breakdown with exposure of the carotid artery. Recovery was uneventful and he was discharged after three weeks.

Case 5

A 56-year-old male had a history of left superficial parotidectomy and radical neck dissection for nodal metastases of a squamous cell carcinoma of the nasal skin. Post-operatively, he had received radiotherapy on the operative field and both sides of the neck to a total dose of 66 Gy. Ten years later he underwent a total laryngectomy for a T_3N_0 left-sided transglottic larynx carcinoma. Nine months later a right radical neck dissection was carried out for a neck node recurrence using part of the previous incision. Fibrosis of the tissues due to the previous surgery and radiation therapy was particularly apparent. One metastasis with extranodal tumour extension into the muscle was found in the low-jugular region.

Because of wound breakdown and imminent carotid artery exposure debridement and cover with a pectoralis major myofascial flap with STSG had to be performed one week later. Wound healing was uncomplicated and he was discharged three weeks later.

Case 6

A 67-year-old male underwent surgery for a T_4N_1 right pyriform sinus carcinoma. Total laryngectomy and partial pharyngectomy were performed in continuity with a right radical neck dissection. The pharynx was reconstructed primarily. A Provox™ voice prosthesis was inserted and unilateral neurectomy of the pharyngeal plexus was done. Pathology showed a radical excision and four positive nodes with extranodal spread. A course of adjuvant radiotherapy was given using an accelerated fractionation scheme to a total dose of 63 Gy in 36 days. Because of speech and swallowing problems a videofluoroscopy was done and spasm of the inferior constrictor could be demonstrated.

After seven months pharyngeal myotomy was performed using part of the previous incision. During this procedure a small perforation of the mucosa occurred which was oversewn. Oral diet was resumed nine days later. His speech improved considerably and became fluent and easily intelligible.

Four weeks later he was readmitted for a pharyngocutaneous fistula to the neck with exposure of the carotid artery to saliva. The same day the fistula was explored and a 3 cm defect in the pharynx was noted with the carotid being at risk. After removing devitalized tissue a pectoralis major myofascial flap was used to close the defect in the food passage and the pectoral fascia on the pedicle of the flap was covered by STSG (Figures 1 and 2). The

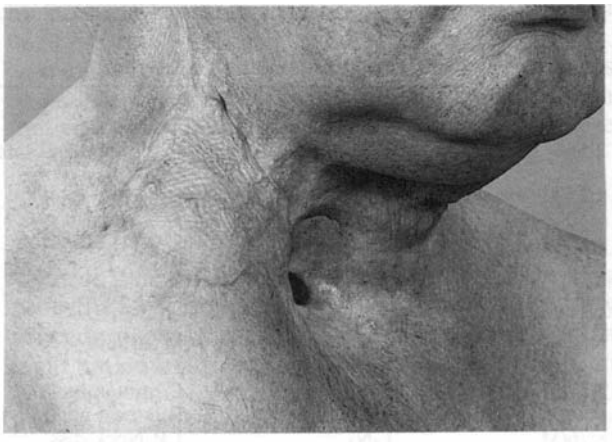

FIG. 2

Case 6 one year post-operatively with a better soft tissue contour in the neck after partial atrophy of the denervated pectoralis major muscle.

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wound healed and he was discharged on Day 17 after normal diet was recommended. The flap did not affect the functioning of the pharynx.

Case 7

A 78-year-old male presented with a T_4N_{2c} squamous cell carcinoma of the floor of the mouth. He had a history of malnutrition and 10 per cent weight loss in the previous months. He had undergone a right hemicolectomy seven years previously for an adenocarcinoma of the caecum. Excision of the primary tumour with marginal mandibulectomy and en-bloc bilateral neck dissections were performed. The right internal jugular vein and sternomastoid muscle were preserved while these structures were sacrificed on the left side. The defect was reconstructed with a sensate radial forearm free flap with the microvascular anastomoses in the right neck. Histopathology showed margins to be free and in both neck dissection specimens multiple positive nodes with extranodal spread were found.

The immediate post-operative course was uneventful but on Day 14 an orocutaneous fistula to the left neck was noted exposing the carotid artery to saliva. The same day the neck was explored and debrided. The free flap was viable and the defect was closed with a pectoralis major myofascial flap covering the carotid artery and closing the defect in the floor of the mouth. The defect in the neck was covered with a STSG on the pectoralis major muscle pedicle. Wound healing was rapid and on Day 16 oral food intake could be resumed.

Case 8

A 76-year-old male who presented with a T_4N_3 squamous cell carcinoma of the lateral hypopharyngeal wall underwent partial pharyngectomy, total laryngectomy and left radical neck dissection. The metastasis could only be removed by sacrificing the external carotid artery and hypoglossal nerve. Histopathology showed margins to be close and an extensive extranodal tumour mass in the neck. The defect in the pharynx was reconstructed with a pectoralis major myocutaneous flap.

The immediate post-operative course was complicated by chyle leakage and a pharyngocutaneous fistula was noted on Day 14. Because of exposure of the carotid artery re-exploration of the left neck was performed. Devitalized tissue was removed and the carotid artery could be covered by mobilizing the pectoralis major muscle pedicle which was completely vital. At the same time the chylous leak was closed by transposing another part of the pedicle using fibrin glue to seal the leak. The skin defect was covered by a STSG. Oral intake could be recommenced after 13 days and the chyle leakage stopped after 19 days.

Discussion

Carotid artery exposure and haemorrhage is a dreaded complication of head and neck surgery. Patients who undergo carotid ligation have a high chance of suffering a stroke or dying (Moore *et al.*, 1969). Although infrequent, awareness of its catastrophic nature should lead to rapid intervention to prevent its occurrence. Several factors predispose to necrosis of neck wounds with exposure of the carotid artery. Pre-operative radiation therapy and salivary contamination of the neck are the most significant factors in this respect. Also malnutrition and cachexia increase the risk of post-operative complications, such as infection and necrosis of skin flaps. As demonstrated, exposure of the carotid artery is not always an early event and may even become apparent after 60 days post-surgery. Protection of an exposed carotid artery begins with the initial surgery. Preservation of the adventitia is important in preventing wound breakdown and subsequent desiccation of the carotid artery. Also, modern reconstructive techniques such as muscle or myocutaneous flaps, should be applied without hesitation either to fortify a mucosal suture line or to replace resected mucosa.

Management of an exposed carotid artery has evolved over the last decades and the techniques used have followed the introduction of new reconstructive techniques. Conley (1953) described the use of non-irradiated regional skin flaps to cover the neck defect, while others proposed levator scapulae muscle flaps (Staley, 1961). Later Conley (1962) advocated rotation of the carotid bulb into a muscle pocket. Cheek and Rise (1967) used prevertebral fascia or fascia lata for protection of the artery. Buried dermal grafts were popularized by Corso and Gerold (1963), and Reed and Halsey (1975). All of these methods, however, failed to provide reliable coverage of the carotid artery in the majority of cases (Shumrick, 1973).

Since the introduction of the pectoralis major myocutaneous flap (Ariyan, 1979; Baek *et al.*, 1979; Ariyan and Cuono, 1980) for reconstruction of major defects in the head and neck, the use of this flap has been extended to secondary coverage of necrotic neck wounds (Gardiner *et al.*, 1983; Coleman, 1985; Price *et al.*, 1985; Goldstein *et al.*, 1988; Joseph *et al.*, 1988).

Although planned pre-operative radiotherapy in head and neck cancer has not been applied frequently by us to date, salvage surgery and increasing incidences of second primary tumours in the head and neck after successful treatment of the first tumour ensure a substantial proportion of patients who have been previously irradiated. Even when preventative measures have been taken in high risk patients such as perioperative administration of broadspectrum antibiotics, optimal nutrition and careful planning of skin incisions, we will occasionally be confronted with exposure of the carotid artery.

We have adopted the use of the pectoralis major flap in the management of these patients as it is an extremely reliable flap and offers ample well-vascularized muscular tissue for protection. The independent blood supply assists tissue perfusion with antibiotics, cellular and humoral factors impor-

tant in infection control and wound healing (Hanel, 1989). We prefer to use the myofascial modification (Moloy, 1989; Shindo *et al.,* 1992) as opposed to a myocutaneous flap because in that form the flap does not have to be twisted and harvesting results in no distortion of the donor area. The undersurface can easily be skin-grafted and offers a good cosmetic appearance after atrophy of the denervated muscle (Balm *et al.,* 1993). A full thickness pectoralis major myocutaneous flap transposition is too bulky, especially in women, and the skin colour doesn't match well.

In the present series of eight patients, who were at risk for carotid artery haemorrhage, the predisposing factors were previous radiotherapy in five and malnutrition in two cases. One patient had a pharyngocutaneous fistula with chyle leakage resulting in necrosis of the neck wound with subsequent exposure of the artery. The five patients who had had previous radiotherapy received 54–70 Gy, four months to 11 years prior to surgery of the neck. In three cases a regional recurrence after initial successful treatment of the primary tumour was the indication for surgery of the neck. One patient had surgery of the pharyngo-oesophageal segment because of speech and deglutition problems after laryngopharyngectomy with primary mucosal closure and neck dissection. All patients could leave the hospital within four weeks (13–28 days) after debridement and pectoralis major myofascial flap coverage.

Conclusion

Early recognition of disturbances of wound healing is crucial in the event of prevention of carotid exposure. Experienced nursing staff will certainly be helpful in alerting the surgeon to the danger of wound healing problems. In case of carotid exposure or even imminent wound breakdown at the carotid site, immediate transposition of pedicled pectoralis major muscle with STSG is reliable and a rapid method for the prevention of carotid blow out.

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