The effect of admission to intensive care unit on outcomes and complication rates after head and neck reconstruction

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The study objective *is to evaluate the utilisation and effectiveness of intensive care unit (ICU) in the postoperative period as to its potential benefits to the head and neck reconstruction services.*
Materials and methods. *This is a retrospective study on 143 consecutive patients who underwent 144 major head and neck microvascular reconstructive procedures performed by a single surgeon, that focused on perioperative management and on the relation between admission to ICU and complications/outcomes.*
Results. *Thirty-four (23.6 %) patients were admitted to ICU during the early postoperative period. Admission to ICU was not associated with lower incidence of complications compared to direct admission to the Head and Neck ward: 29.4 % vs 27.3 % (p = 0.807709).*
Conclusion. *Routinely early postoperative admission to ICU seems not to improve outcomes and/or reduce complications, and, as a consequence, ICU admission should be restricted to selected patients only.*

Key words: *head and neck cancer, microvascular free flap, elderly, intensive care unit*

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Влияние интенсивной терапии на исходы и частоту осложнений после реконструктивных операций в области головы и шеи

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Цель исследования *– оценить значение интенсивной терапии (ИТ) в послеоперационном ведении пациентов после реконструктивных операций в области головы и шеи.*
Материалы и методы. *В данное ретроспективное исследование методом сплошной выборки были включены 143 пациента, у которых были выполнены 144 микрососудистые реконструктивные операции в области головы и шеи. Все операции были проведены одним хирургом.*
Результаты. *В отделение ИТ в раннем послеоперационном периоде были переведены 34 (23.6 %) пациента. Перевод пациентов в отделение ИТ не был взаимосвязан с более низкой частотой развития осложнений по сравнению с переводом непосредственно в отделение хирургии головы и шеи: 27.3 % vs 29.4 % (p = 0.807709).*
Заключение. *Перевод в плановом порядке в отделение ИТ в раннем послеоперационном периоде не улучшает исходы и не уменьшает частоту осложнений, и, как следствие, перевод в отделение ИТ оправдан только в отдельных случаях.*

Ключевые слова: *злокачественные опухоли головы и шеи, микрососудистый свободный лоскут, пожилые пациенты, отделение интенсивной терапии*

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Introduction

Nowadays, microvascular free flap reconstruction is an essential step in the treatment of head and neck malignancies [1] because it offers the opportunity to perform an oncologic sound surgical resection associated with the immediate repair of complex 3-dimensional structures, improving patients' quality of life and survival [2]. Although patients may suffer from general surgical complications such as bleeding and/or infection, free flap failure, due to irreversible arterial or venous thrombosis, is one of the most important complications to be avoided. Close monitoring has been demonstrated successful in reducing these complications but, whether Intensive Care Unit (ICU) must be considered as an integral part of the postoperative management of the patients undergoing head and neck free flap reconstruction or not, it is still unclear [3]. The present study analysed the selection criteria and the outcomes of all consecutive patients undergoing ablative surgery followed by microvascular reconstruction for head and neck malignancies in our centre. Complications, failures and impact of the admission to ICU in the early postoperative management were investigated. Moreover, differences between elderly *vs* young patients and presence of comorbidities were assessed to identify potential contributing factors.

The aim of the study was to evaluate the utilisation and effectiveness of ICU in the postoperative period as to its potential benefits to the head and neck reconstruction services.

Materials and methods

From November 2011 till January 2017, a retrospective review was carried on a consecutive series of 143 patients who underwent 144 reconstructive microsurgical procedures performed by the same ENT head and neck surgeon (RP) in the Department of Otorhinolaryngology of a tertiary oncological Centre (Ethic Committee approval number NP/2018/895).

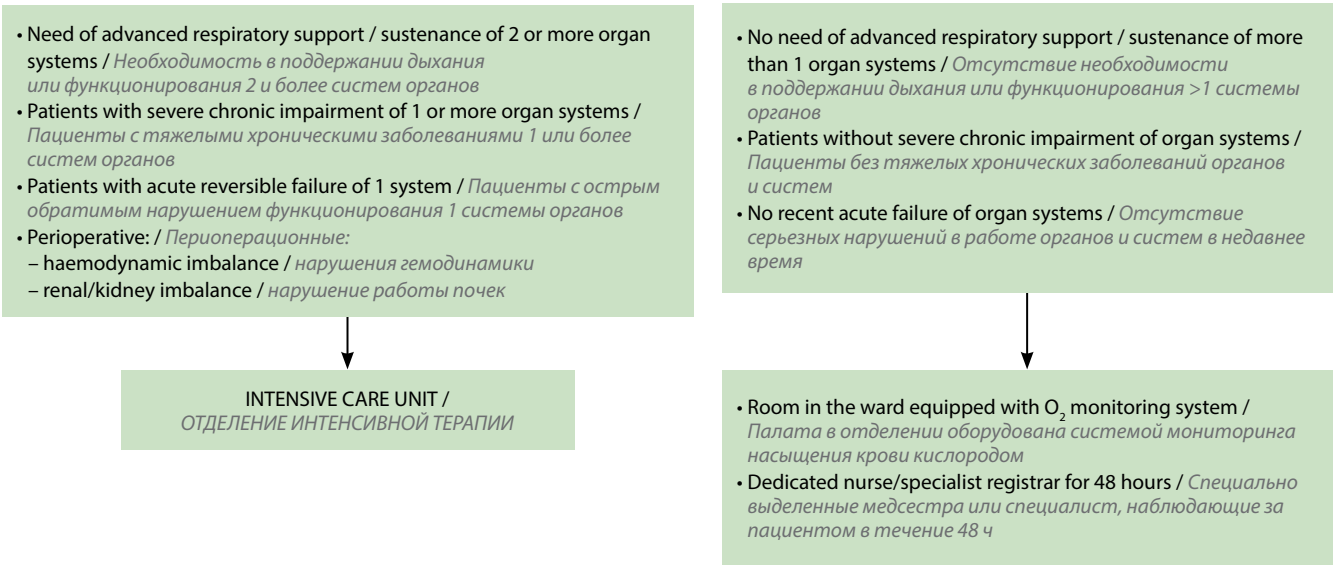
Patients were considered for free flap reconstruction during the primary treatment for head and neck malignancies at early and advanced stages, or after recurrent disease or inadequate reconstructions performed in other Centres. Previous chemotherapy and/or radiotherapy were not exclusion criteria alone, but were correlated with age and comorbidities, according to the Age Adjusted Charlson Comorbidity Index (AACCI) [4]. Fragile elderly patients with AACCI >5, were generally submitted to simpler reconstructive procedures with pedicled flaps.

Preoperative histologic diagnosis was obtained in all patients with head and neck lesions. All patients were restaged according to the 8th edition of the Union for International Cancer Control – American Joint Committee on Cancer TNM staging system [5].

Patients with head and neck malignancy underwent wide radical excision of the primary tumour with ipsilateral or bilateral neck dissection (according to the site of the tumour and the risk for nodal involvement) followed by free flap reconstruction. All patients received a single bolus of heparin sodium (1500 IU) at least 5 min before the transfer of the flap. Anastomosis was performed under microscope (ZEISS S7, focal length 250 mm); synthetic non-absorbable 8/0 or 9/0 nylon suture were used. Arterial anastomosis was performed with synthetic non-absorbable 8/0 or 9/0 nylon suture. Venous anastomosis was performed with the coupler device (Microvascular Anastomotic Coupling System, Synovis Life Technologies). Defects in the head and neck region were classified into 6 anatomical reconstructive regions: pharyngo-laryngeal, oropharyngeal, oral, mandibular, midfacial, and cutaneous. Mucosal defects included tongue, floor of mouth, oropharynx, hypopharynx, and cervical oesophagus. Oncological surgical defects of the oral cavity, base of the tongue and pharynx affecting swallowing and speech were restored with the use of thin and pliable flap. The radial forearm free flap was the first choice for intra-oral reconstruction. Sub-total or total glossectomy was reconstructed with composite rectus abdominis myocutaneous free flap, while segmental and subtotal mandibulectomies required a composite bony free flap as iliac crest or fibula flaps.

Postoperative treatment consisted of antibiotic therapy (ceftriaxone 2 g per day and metronidazole 500 mg 3 times a day for 7–10 days), low molecular weight heparin (enoxaparin sodium) in a prophylactic dosage (range of 3000–8000 IU per day) and anti-embolism stocking. Feeding tube was inserted in all patients treated for upper aero digestive tract malignancy. Temporary tracheostomy was performed to avoid postoperative respiratory distress, but its need was discussed in selected cases with facial skin reconstruction and limited neck dissection (it was avoided in 2 cases). Intraoperative and postoperative fluid balance was routinely evaluated with the goal to maintain intravascular fluid volume for optimal tissue blood flow and oxygenation.

During the first 31 procedures, patients older than 65 years or with chronic impairment of 1 or more organ systems were routinely admitted to the ICU for haemodynamic and airway monitoring. During the last 113 procedures patients were monitored in an equipped room in the ward, whilst the indication for recovery in ICU were the need of advanced respiratory support, sustenance of 2 or more organ systems, patients with chronic impairment of 1 or more organ systems sufficient to restrict daily activities, patients with acute reversible failure of 1 system, or when an extensive haemodynamic imbalance developed during surgery (see fig.).



Algorithm for postoperative intensive care unit admission
Алгоритм послеоперационной госпитализации в отделение интенсивной терапии

A trainee ENT specialist registrar and/or a head and neck experienced nurse, monitored the flap every hour during the first 2 days, and every 2 to 4 hours up to 5 postoperative days as from internal protocol. In case of doubtful flap survival, the surgeon was promptly called to evaluate the situation as to go back to theatre for exploration and flap salvage.

Outcome parameters included length of hospital stay and complications. According to E.M. Genden et al. [6] and the Clavien–Dindo system [7], complications were divided into surgical donor-site and flap complications (requiring surgical re-exploration) or non-surgical donor-site and flap complications managed with medical therapy. According to E.O. Dimovska et al., complications were also divided in early and late complications, when observed within and after the first 30 postoperative days respectively [8]. Donor-site complications include seroma, haematoma, infection, dehiscence, venous congestion and skin loss. Flap complications include partial or total flap failure, cervical hematoma, surgical site infection, wound dehiscence, fistula. Postoperative arrhythmia, myocardial infarction, pulmonary oedema, postoperative hypertension, deep vein thrombosis, pulmonary embolism, acute renal failure, respiratory failure, pneumonia and sepsis are classified as systemic complications.

Adjuvant therapy was planned for advanced T stage (pT3 or pT4), multiple positive nodes, and/or per neural/lymphatic/vascular invasion [9].

All patients were addressed for regular follow-up according to the American Head and Neck Society guidelines [10] (mean time of 3.4 years, median time of 1.8 years, range of 6 months – 7 years). A disease-free state was defined as the absence of cancer demonstrated by head and neck surgeon and imaging, and (if necessary) pathological examination following biopsy, while the definition of disease state was referred to the presence of a local, regional or loco/regional relapse and/or distant metastases.

Comorbidities were categorized retrospectively using the AACCI [4]. In the present study one of the goals was to compare complications and outcomes between elderly (≥65 years) *vs* young (<65 years) patients, between patients with AACCI ≤5 *vs* patients with AACCI >5, and between patients admitted in ICU during the early postoperative period *vs* patients treated only in the ward after surgery.

Recurrence time was assessed from the date of surgery to the date of the first recurrence. Five-year overall survival (OS), disease specific survival (DSS) and relapse-free survival (RFS) were calculated using the Kaplan–Meier method. Survival rates and univariate analysis were calculated using GraphPad Prism software (GraphPad, San Diego, CA, USA). Chi-squared analysis with Fischer's exact test was performed to determine the influence of age on complication rate, morbidity and functional outcome. Statistical significance was defined as $p < 0.05$.

Results

Overall, 143 consecutive patients underwent 144 microsurgical reconstructions after ablative surgery for head and neck cancers. Age distribution, types of cancer, site of reconstruction and the types of free flap are shown in table 1.

Seven patients were previously submitted to neoadjuvant chemotherapy; 7 patients were treated after failure of chemoradiotherapy, and 10 procedures were performed in patients with recurrent cancer surgically treated elsewhere (in 5 cases previous surgical treatments had been associated with radiotherapy). One hundred forty-two patients underwent 143 single-stage microsurgical reconstructions

Table 1. *Patients' age distribution*

Таблица 1. *Распределение пациентов по возрасту*

Parameter Показатель	Value Значение
All patients, *n* = 144 **Все пациенты, *n* = 144**	
Mean age, years Средний возраст, лет	58.3
Age range, years Диапазон возраста, лет	25–82
Younger (<65 years), abs (%) Пациенты среднего возраста (<65 лет), абс. (%)	111 (77.1)
Young old (65–74 years), abs. (%) Пациенты пожилого возраста (65–74 года), абс. (%)	21 (14.6)
Older and oldest old (≥75 years), abs. (%) Пациенты старческого возраста (≥75 лет), абс. (%)	12 (8.3)
Male, *n* = 116 (80.6 %) **Мужчины, *n* = 116 (80,6 %)**	
Mean age, years Средний возраст, лет	57.9
Age range, years Диапазон возраста, лет	25–82
Female, *n* = 28 (19.4 %) **Женщины, *n* = 28 (19,4 %)**	
Mean age, years Средний возраст, лет	60.0
Age range, years Диапазон возраста, лет	34–83

following resection of head and neck malignancies, and 1 patient underwent microsurgical reconstruction after previous failed pedicled flap reconstruction performed in different institution. Stage of patients with squamous cell carcinoma (n = 135) and all the microvascular free flap procedures reported in the present series are detailed in tables 1–4.

Harvesting of the forearm flap was performed with the use of an arm tourniquet and it included always both the cutaneous venous system (cephalic vein) and the radial deep venous system (comitantes veins).

The facial artery was chosen in 65.3 % as recipient artery (n = 94), followed by the superior thyroid artery in 26.4 % (n = 38), lingual artery in 7.6 % (n = 11) and the external carotid in 0.7 % (n = 1).

Venous drainage was obtained with a single anastomosis in 110 (76.4 %) cases. In the majority of the cases the recipient vein was one of the branches of the thyro-lingual-facial trunk (134 procedures, 168 microanastomosis), but in 9 cases an end-to-side anastomosis to the internal jugular vein was performed, and in 1 case, the external jugular vein was used as recipient vein. In 1 case the limited pedicle's

Table 2. *Patients' distribution according to site of reconstructions and histology, n = 144*

Таблица 2. *Распределение пациентов по области реконструктивного вмешательства и гистологическому типу опухоли, n = 144*

Parameter Показатель	Number of procedures, abs. Количество процедур, абс.	Frequency, % Частота, %
Microvascular procedures **Микрососудистые процедуры**		
Oral cavity Ротовая полость	111	77.1
Oral cavity extended to the maxilla Ротовая полость с вовлечением верхней челюсти	2	1.4
Oropharynx Ротоглотка	14	9.7
Pharynx and larynx Глотка и гортань	7	4.9
Face Лицо	10	6.9
Histology **Гистологическое заключение**		
Squamous cell carcinoma Плоскоклеточная карцинома	135	93.7
Adenocarcinoma Аденокарцинома	3	2.1
Synovial sarcoma Синовиальная саркома	1	0.7
Mucoepidermoid carcinoma Мукоэпидермоидная карцинома	2	1.4
Lymphoepithelial carcinoma Лимфоэпителиальная карцинома	1	0.7
Sclerodermiform basal cell carcinoma Склеродермальная базальноклеточная карцинома	1	0.7
Previous failed reconstructions performed elsewhere Неудачные реконструктивные операции в прошлом, выполненные в других местах	1	0.7

length (rectus abdominis free flap) required the interposition of a vein graft. The anastomosis of the vein was always performed with the coupler device. Seven patients received a permanent tracheostomy (total laryngectomy) and a temporary tracheostomy was performed in 135, while 2 patients with limited neck dissection and reconstruction only of the facial skin in the parotid region did not need a tracheostomy.

Mean length of hospital stay was 23.8 days (range of 7–75 days); mean time for removal of the temporary tracheostomy was 9.9 days (range of 4–31 days); mean feeding tube permanence, when indicated (n = 126), was 22 days (range of 12–65 days).

Thirty-four (23.6 %) patients were admitted to ICU during the early postoperative period: 21 patients during the first 31 (67.7 %) procedures and 13 patients during the last 113 (11.5 %) procedures.

Thirty-nine patients experienced 40 (27.8 %) complications after the surgical procedure, requiring 35 early (n = 29) or delayed (n = 6) surgical revisions (table 5). Bleeding occurred after 16 (11.1 %) procedures. Particularly, 12 patients were taken back to theatre for evacuation of haematoma in the neck (4 of these patients needed revision of the venous anastomosis) and 4 patients underwent surgery for haematoma in the donor site region. Venous congestion of the flap was observed in 9 (6.2 %) cases: in 1 case it recovered within 12 hours after therapy with steroids, in 5 cases it was successfully managed with a revision of the venous anastomosis (range of revision of 2 hours – 2 days), and in 3 cases it was associated with flap failure (1 radial forearm flap, 1 iliac crest flap and 1 jejunum flap) and required a salvage reconstruction with pectoralis major pedicled flap (range of revision of 4–31 days). Two patients suffered loss of the skin paddle of iliac crest free flap. This last complication was observed after 10 and 15 days after surgery and was positively managed by a rotated bilateral Esser's skin flap. Three patients suffered for non-surgical complications: 2 cases of deep vein thrombosis and in 1 case of pulmonary embolism in a Clavien–Dindo grade IV patient, who needed admission to ICU.

Seven (22.5 %) early surgical complications occurred during the first 31 procedures, while 22 occurred during the last 113 (19.5 %) procedures (p = 0.701954). Nine early surgical complications (26.5 % of the procedures) were observed during the recovery in the ICU, and 20 (18.2 % of the procedures) during the recovery in the ward (p = 0.292196). No significant difference in the overall incidence of postoperative complications was observed between patients admitted to ICU *vs* patients admitted to the ward (p = 0.807709). Patients admitted to ICU in the immediate postoperative period had a longer median length of hospital stay (27 days *vs* 21 days in the non-ICU group of patients; p = 0.3). Postoperative complications were observed in 36.4 % of the elderly patients and in 25.2 % of the young patients (p = 0.171817). The most fragile patients (AACCI >5) experienced higher rate of postoperative complications: 44.4 % of the cases, while only 23.9 % of the patients with AACCI ≤5 presented post-operative complications (p = 0.03195). Young fragile patients showed a moderately higher risk to experience postoperative complications, compared to the other groups of patients (p = 0.022812). We did not find any statistical correlation between age and/or comorbidities and total/partial flap failures (p = 0.55) (table 6).

Fifty-seven (39.6 %) patients underwent adjuvant radiotherapy. During the follow-up, head and neck cancer recurred in 23 (16 %) patients; 6 (4.2 %) patients experienced a second head and neck malignancy, and 10 (6.9 %) patients developed pulmonary or cerebral metastasis. Five-year DSS, OS and RFS are shown in table 7.

Table 3. *Patients' distribution according to stages of head and neck squamous cell carcinomas (by 8th edition of the American Joint Committee on Cancer TNM staging system, n = 135)*

Таблица 3. *Распределение пациентов по стадиям плоскоклеточных карцином головы и шеи (по 8-му изданию классификации TNM Американского обьединенного комитета по изучению рака, n = 135)*

Origin Происхождение	All Все	Stage I I стадия	Stage II II стадия	Stage III III стадия	Stage IV IV стадия
Oral cavity Ротовая полость	111*	8	29*	26	48
Oropharynx Ротоглотка	11	–	4	4	3
Pharynx and larynx Глотка и гортань	6	–	–	1	5
Face Лицо	7	–	1	2	4

**One patient experienced 2 different microvascular procedures for 2 distinct metachronous squamous cell carcinomas of the oral cavity of stage II in both cases.*

**У 1 пациента были выполнены 2 разные микрососудистые процедуры по поводу 2 различных метахронных плоскоклеточных карцином полости рта II стадии.*

Discussion

Vascularized tissue transferred from a distant donor site to a recipient site to reconstruct complex head and neck defects protects vascular structures and improve wound closure and long-term aesthetic and functional restoration. In our series the microvascular radial forearm, iliac crest and the rectus abdominis free flaps were the most frequently used for the purpose.

The radial forearm free flap offers a good versatility and reliability including the presence of additional drainage pathway with the cephalic vein. There is still a debate as to which venous system (cephalic or comitantes veins) should be anastomosed, but we found the anastomosis of the cephalic vein only was reliable in 71.6 % of the cases (n = 78). This finding confirms the recent experience of S. Razzano et al. [11]. Adequate venous out-flow must be assured to guarantee the survival of free flaps. In literature a dual venous anastomosis has been related with lower failure rate

Table 4. *Microvascular free flap procedures of our series*

Таблица 4. *Микроваскулярная реконструкция с использованием свободных лоскутов*

Free flap Свободный лоскут	Number of procedures Количество процедур						
	All, abs. (%) Все, абс. (%)	in depending on the surgical procedure area в зависимости от области хирургического вмешательства					
		Oral cavity Ротовая полость	Oral cavity with maxillectomy Ротовая полость + максиллэктомия	Oral cavity with mandibulectomy Ротовая полость + мандибулоэктомия	Oropharynx Ротоглотка	Pharynx and larynx Глотка и гортань	Face Лицо
Forearm Предплечье	109 (75.7)	82	1	–	14	5	7
Rectus abdominis Прямая мышца живота	11 (7.6)	6	1	–	–	1	3
Fibula Малоберцовая кость	2 (1.4)	–	–	2	–	–	–
Iliac crest Подвздошный гребень	21 (14.6)	–	–	21	–	–	–
Jejunum Тощая кишка	1 (0.7)	–	–	–	–	1	–
Total *Всего*	*144 (100)*	*88*	*2*	*23*	*14*	*7*	*10*

Table 5. *Frequency of complications in depending on flap type*

Таблица 5. *Частота осложнений в зависимости от вида лоскута*

Complications Осложнения	Jejunum Тощая кишка	Forearm Предплечье	Iliac crest Подвздошный гребень	Rectus abdominalis Прямая мышца живота	Fibula Малоберцовая кость	All, abs. (%) Всего, абс. (%)
Flap failure Полный некроз лоскута	1	1	1	–	–	3 (2.1)
Near flap failure Частичный некроз лоскута	–	6	–	–	–	6 (4.1)
Cervical bleeding without flap sufferance Шейное кровотечение без отторжения лоскута	–	8	–	–	–	8 (5.5)
Head and neck suture dehiscence Расхождение швов в области головы и шеи	–	1	1	2	1	5 (3.5)
Delayed revision of the flap Поздняя ревизия лоскута	–	1	3	1	–	5 (3.5)
Foreign body Инородное тело	–	–	–	1	–	1 (0.7)
Donor site hematoma Гематома донорского участка	–	3	1	–	–	4 (2.8)
Donor site suture dehiscence Расхождение швов в области донорского участка	–	2	1	–	–	3 (2.1)
Salivary fistula/abscess Свищ/абсцесс слюнной железы	–	1	1	–	–	2 (1.4)
Deep vein thrombosis Тромбоз глубоких вен	–	2	–	–	–	2 (1.4)
Pulmonary embolism Легочная эмболия	–	1	–	–	–	1 (0.7)
Total *Всего*	*1*	*26*	*8*	*4*	*1*	*40 (27.8)*

Table 6. *Distribution of the complications in the different groups of patients, abs. (%)*

Таблица 6. *Распределение пациентов в зависимости от частоты осложнений в разных группах, абс. (%)*

Group of patients Группа пациентов	Number of procedures Количество процедур	Flap failure Полный некроз лоскута	Near flap failure Частичный некроз лоскута	Other head and neck complications Другие осложнения в области головы и шеи	Donor-site complications Осложнения на донорском участке	Non-surgical complications Нехирургические осложнения	All Всего	*p*
AACCI ≤5 elderly patients Пожилые пациенты с AACCI ≤5	23	1 (4.4)	–	5 (21.7)	1 (4.4)	2 (8.7)	9 (39.1)	Elderly *vs* young patients Между пожилыми пациентами и более молодыми 0.171817
AACCI >5 elderly patients Пожилые пациенты с AACCI >5	10	–	–	1 (10.0)	1 (10.0)	1 (10.0)	3 (30.0)	
AACCI ≤5 young patients Более молодые пациенты с AACCI ≤5	94	2 (2.1)	4 (4.2)	8 (8.5)	3 (3.2)	2 (2.1)	19 (20.2)	
AACCI>5 young patients Более молодые пациенты с AACCI >5	17	–	2 (11.8)	4 (23.5)	3 (17.6)	–	9 (52.9)	
Patients admitted in intensive care unit Пациенты, поступившие в отделение интенсивной терапии	34	2 (5.9)	1 (2.9)	6 (17.6)	1 (2.9)	–	10 (29.4)	Intensive care unit *vs* no intensive care unit Между пациентами, помещенными в отделение интенсивной терапии и помещенными в обычную палату 0.807709
Patients admitted in the ward Пациенты, помещенные в обычную палату	110	1 (0.9)	5 (4.5)	12 (10.9)	7 (6.4)	5 (4.5)	30 (27.3)	
Total (% over all series) Всего (% от всех пациентов)	144	3 (2.1)	6 (4.2)	18 (12.5)	8 (5.5)	5 (3.5)	40 (27.8)	–

Note. *AACCI – Age Adjusted Charlson Comorbidity Index.*

Примечание. *AACCI – индекс коморбидности Чарлсона с поправкой на возраст.*

(in the 1.51 % *vs* 5.03 % after single anastomosis), lower venous thrombosis rate (2.74 % *vs* 4.54 %), and lower revision rate (11.87 % *vs* 6.04 %) [12]. In our series 75.7 % patients (n = 109) received a single venous anastomosis. In the present series, the number of the anastomosis did not influence the outcomes. Although flap failures (n = 3) were observed in patients with a single venous anastomosis, these occurred during the early period of our experience, and statistical analysis did not show any significant difference (p = 0.447). After an adequate intraoperative evaluation of the venous out-flow of the flap, a single anastomosis was generally preferred to minimize operative time, simplify pedicle geometry, avoid the use of vein grafts, preserve potential recipient veins for future free flaps, make surgery technically simpler by using a single proximal large confluent vein rather than two distal smaller venae comitantes minimizing the risk for low blood velocity. According to literature, the recipient veins were generally identified among the internal jugular vein system [13]. Venous anastomosis is one of the most challenging technical aspects of microsurgery, but it can be improved by the use of an anastomotic coupler device. It is quicker and more reliable in maintaining the anastomotic site patent and it could be used also as end-to-side technique on the internal jugular vein (2 cases in our series). We routinely used silastic Penrose drainage tubes to avoid active aspiration and limit any pressure on the microvascular pedicle. The radial forearm free flap was used in 75.7 % of our microvascular procedures with a success rate of 99 %. Nevertheless, little bone reconstruction could be performed harvesting part of the radial bone with the flap (1 case in our series). Closure of the donor defect of the radial forearm flap required always a skin graft

Table 7. *Five-year disease specific survival, overall survival and relapse-free survival rates of patients with squamous cell carcinoma, n = 135*

Таблица 7. *Пятилетняя онкоспецифическая, общая и безрецидивная выживаемость пациентов с плоскоклеточным раком, n = 135*

Локализация опухоли Tumor localization	Stages Стадии	Five-year disease specific survival rate, % Пятилетняя онкоспецифическая выживаемость, %		Five-year overall survival rate, % Пятилетняя общая выживаемость, %		Five-year relapse-free survival rate, % Пятилетняя безрецидивная выживаемость, %	
Oral cavity (n = 111) Ротовая полость (n = 111)	All Все	71.6 SE 5.4		59.6 SE 5.6		67.5 SE 5.4	
	I–II	91.5 SE 5.9	Univariate analysis Однофакторный анализ p = 0.0037	74.0 SE 8.8	Univariate analysis Однофакторный анализ p = 0.0133	85.3 SE 6.9	Univariate analysis Однофакторный анализ p = 0.0067
	III–IV	61.4 SE 7.3		51.9 SE 7.1		58.3 SE 7.2	
Oropharynx (n = 11) Ротоглотка (n = 11)	All Все	72.0 SE 17.8		54.0 SE 17.3		72.0 SE 17.8	
	I–II	100.0 SE 0	Univariate analysis Однофакторный анализ p = 0.1489	75.0 SE 21.7	Univariate analysis Однофакторный анализ p = 0.3470	100.0 SE 0	Univariate analysis Однофакторный анализ p = 0.1489
	III–IV	41.7 SE 30.4		31.3 SE 24.5		41.7 SE 30.4	
Pharynx and larynx (n = 6) Глотка и гортань (n = 6)	III–IV	62.5 SE 21.9		60.0 SE 21.9		62.5 SE 21.3	
Face (n = 7) Лицо (n = 7)	All Все	100.0 SE 0		88.9 SE 10.5		72.9 SE 16.5	
All the series Всего		*72.4 SE 4.9*		*60.6 SE 5.1*		*67.5 SE 4.9*	

Note. SE – standard error.
Примечание. SE – стандартная ошибка.

although we are aware of possibility of forearm advancement-rotation flaps [14]. Two patients required a revision of the donor site defect with a further skin graft.

Microsurgical vascularised osteo-myocutaneous free flaps are very useful for reconstruction of complex defects following maxillectomy and mandibulectomy [15, 16]. Both iliac crest and fibula free flaps can be considered the best option for mandibular reconstruction [15, 16]. We preferred the use of the vascularized iliac crest flap. There are no significant differences in terms of morbidity of the donor site between iliac crest and fibula free flaps patients [17]. All patients of the present series experienced pain at the donor site, which lasted for a mean time of 1.7 months; nevertheless, a follow-up of more than 6 months showed no residual donor site morbidities. Necrosis of the cutaneous component occurred in 2 patients probably due to a scarce number of perforators, or for excessive tension or compression of the perforating vessels and muscular components during intraoral reconstruction. Complete success transfer of iliac crest free flaps in our series was 85.7 %. In our series, dental implants were not performed because of the lack of financial resources for this specific target.

Although DSS an OS are low due to loco-regional recurrence or distant metastases in total or subtotal glossectomy and despite we did not performed a quality of life assessment, the patients reconstructed with a vertical rectus abdominis muscle flap referred an improvement in the quality of life following reconstruction. Functional rehabilitation remains difficult but the use of the myocutaneous free flap has been demonstrated to deliver good outcomes [18]. In our series, the vertical rectus abdominis muscle flap was fixed anteriorly to the mandible and posteriorly to the base of tongue. The downfall of the larynx was avoided with the suspension of the hyoid bone to the mandible with non-absorbable suture. No vertical rectus abdominis muscle flap failure or visceral herniation was observed in the present series.

After adequate patient counselling, tracheostomy was considered temporarily necessary during 135 (98.5 %) of the 137 procedures performed in patients who did not undergo total laryngectomy (n = 7), in order to prevent aspiration of saliva and possible passage of massive amounts of blood in the case of post-operative haemorrhage. In our opinion, the risks correlated with massive haemorrhage of the upper aero digestive tract, which may be even fatal, justify the temporary use of a tracheotomy.

The nasogastric feeding tube was routinely preferred for the supportive feeding since it was temporary and without potential mortality and morbidity as reported for percutaneous endoscopic gastrostomy [19].

Reconstructive failure almost doubles the patient's length of stay, and is strongly associated with in-hospital mortality, since it can result in exposure of the great vessels or skull base, or the development of a pharyngo-cutaneous fistula [20]. In our series, we observed 40 (27.8 %) postoperative complications, including 3 (2.1 %) flap failures. B.H. Haughey et al. reported a 57 % rate of medical complication and a 29 % of flap complications, including a 4 % rate of complete flap failure [20].

Our patients who experienced free flap failure had a statistically significant longer hospitalization time (p <0.005) compared with the mean hospitalisation time of the whole cohort of patients (54.8 days *vs* 23.9 days respectively).

The role of anticoagulants is controversial, and includes aspirin, low-molecular-weight dextran, and subcutaneous heparin [22, 23]. Despite the increased risks of hematoma related to all the antithrombotic medicaments (most of all the aspirin) and the absence of general consensus on their efficacy in failure prevention, the morbidity represented by the loss of a free flap leaded us to systematically treat our patients with a daily dose of low-weight subcutaneous heparin and this protocol, that is also used for deep vein thrombosis prevention, appeared to be reliable [21, 22]. There are still no evidence-based guidelines for the prevention of microvascular thrombosis in the head and neck [21, 22]. Therefore, microsurgeons must evaluate carefully the clinical features of all flaps, since early detection of thrombosis is of primary importance and the chance of surgical salvage is lower after the first 48 hours of ischemia [23], as a consequence, flap monitoring should be compulsory during the first 48 postoperative hours, and clinical monitoring four times daily should be sufficient thereafter. Among microvascular surgeons, postoperative monitoring regimens vary greatly, including close observation of the flap colour (used by 79.4 % of surgeons), Doppler signal (used by 79.4 % of surgeons), hourly "flap monitoring pin prick", and bleeding rate (used by 67.6 % of surgeons), capillary refill (used by 61.8 % of surgeons), skin surface temperature (used by 11.8 % of surgeons), and implanted Doppler (used by 8.8 % of surgeons) [24], but in our opinion, clinical observation remains the simplest method of identifying vascular compromise.

In our series, we reported a percentage of surgical revision of the anastomosis of 5.5 % (8 out of 144) comparable to the data reported in literature (4.5–17.0 %) [1, 25].

Three patients of our microsurgical series experienced a flap failure (jejunum flap, iliac crest and forearm flap). In all cases the flap was replaced with a pectoralis major pedicled flap.

Worldwide, a large number of patients undergoing microvascular free flap reconstruction are initially admitted to ICU on the premise of improved reconstructive outcomes.

In our series, admission to ICU was not associated with lower incidence of complications compared to direct admission to the head and neck ward: 29.4 % *vs* 27.3 % (p = 0.807709).

Although routine ICU care is presumed to improve postoperative care and contribute to a lower incidence of flap failure, in our analysis, flap failure was higher in patients of the ICU group (5.9 % *vs* 0.9 %), probably due to many factors, particularly the potential bias of the surgical learning curve. However, patients managed in the ward remained compliant for the examination of oral and oropharyngeal flaps and physiologic blood pressure parameters were observed routinely without a negative impact on the vascularisation of the transferred tissue.

Our results are in line with the most recent findings of the literature, confirming that protocol-driven non-ICU-based care can support successful reconstructive outcomes with comparable safety to ICU early admission routine [26]. Furthermore, avoiding ICU admission can reduce length of hospitalization and overall costs of care in both academic and community-based institutions.

In literature age alone is not a reliable prognostic factor for predicting medical complications, but it should be related with general health status, since an American Society of Anesthesiologists score of 3 is a statistically significant prognostic factor for medical complications, and diabetes mellitus, advanced atherosclerosis or other cardiovascular diseases impair the quality of the vessel wall and wound healing in general [27].

By using the AACCI, the authors characterized the impact of age and comorbidity on postoperative outcomes, and we found a not statistically significant higher surgical complication rate in the elderly group (36.4 % of the elderly patients *vs* 25.2 % in younger patients; p = 0.171817), while we observed a significant higher morbidity rate in young patients with AACCI >5 (52.9 % *vs* 20.2 % in young patients with AACCI ≤5; p = 0.022812). These data should be evaluated with caution since in our series elderly patients with poorer general conditions were reconstructed with less complex approaches to reduce postoperative risks, while young patients, even with important comorbidities, were generally treated with free flaps as to obtain better functional and aesthetic benefits.

Elderly patients admitted in ICU (n = 5) experienced higher complication rate compared to the 28 elderly patients admitted in the ward (60 % *vs* 32.1 %; p = 0.232959), and it was mainly due to the higher AACCI index of these patients (those admitted in the ICU presented AACCI >5). Patients with AACCI ≤5 admitted in the ICU (n = 12) experienced similar complication rate of the 105 patients with AACCI ≤5 admitted in the ward (16.7 % *vs* 21.9 %, p = 0.674953). ICU stay was associated with longer although not statistically significant stay in the hospital, probably as a consequence of a longer rehabilitation time due to the major in-bed stay of ICU patients.

The aim of curative surgical oncology is to remove the primary tumour with a wide margin of normal tissue, but what constitutes a sufficiently wide margin particularly in oral cancer is fundamentally unclear.

The use of microvascular free flaps improves the oncologic radicality, allowing the surgeon to repair even larger defect. Our patients with head and neck squamous cell carcinoma ($n = 135$) experienced 5-year DSS, OS and RFS rate of 72.4; 60.6 and 67.5 %, respectively, patients with oral cancer of stage I–II experienced 5-yaer DSS, OS, and RFS rate of 91.5; 74 and 85.3 % respectively, patients with oropharyngeal cancer of stage I–II experienced 5-year DSS, OS, and RFS rate of 100; 75 and 100 % respectively, and those with advanced pharyngo-laryngeal tumours experienced 5-year DSS, OS, and RFS rate of 62.5; 60 and 62.5 % respectively, patients with advanced squamous cell carcinoma of the facial skin experienced 5-year DSS, OS, and RFS rate of 100; 88.9 and 72.9 % respectively; these results show as free flaps reconstruction associated with a radical compartmental surgery allowed a positive curative in our series of patients (G. Almadori et al. reported 5-year DSS rate of 67.8 % in a series of 130 patients with oral cancer [28], F. Bussu et al. reported a 5-year DSS rate of 82 % in their series of patients with advanced malignancy of the parotid area [29], and F.T. Hall et al. reported 5-year DSS rate of 67 % for patients with cancer of the larynx and 37 % for those with cancer of the hypopharynx [30]).

Conclusion

A precise preoperative evaluation tailored to each patient on the basis of the functional age is mandatory to select the best candidates for head and neck microsurgical reconstruction. All our flap failures occurred during the first 31 cases in what could be considered our learning curve, and during the last 113 procedures we did not experience further failures. The improvement of our results leaded to an overall flap success rate of 97.9 %. Early postoperative admission to ICU seems not to improve outcomes and/or reduce complications. ICU admission should be restricted to selected patients only. More research is needed to confirm safety of post-operative treatment of head and neck free flap reconstruction without ICU admission.

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