

Complications and outcome after free flap surgery for cancer of the head and neck

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Abstract

This study evaluated the complications following free flap surgery for cancer of the head and neck, assessed factors associated with the complications, and analyzed the impact of the complications on outcome.

This retrospective single-center study included 136 patients who underwent free flap surgery for cancer of the head and neck between 2008 and 2015. Preoperative and perioperative data and surgical and medical complications were recorded. The impact of the complications on hospital length of stay (LOS) and survival were assessed.

A total of 86/136 (63.2%) patients had complications. Compared to patients without complications, these patients had a higher rate of alcohol abuse (24.4% vs. 10.0%, $p=0.039$), longer operation time (565 [458–653] vs. 479 [418–556] min, $p<0.001$) and higher intraoperative blood loss (725 [400–1150] vs. 525 [300–800] mL, $p=0.042$). Fibular flap surgery and stage T4 were more frequent in patients with complications (26% vs. 8%, $p=0.010$; 55% vs. 34%, $p=0.015$, respectively). Patients with complications had longer hospital LOS (9 [7–12] vs. 15 [10–21] days, $p<0.001$) than those without complications. The cumulative mortality was higher for patients with late (occurred after the fourth postoperative day) complications (61.4% vs. 35.5%, $p=0.004$). In conclusion, more than half of the patients had complications that were related to alcohol abuse, a more complicated intraoperative course and fibular flap surgery. The complications were related to longer hospital LOS, and patients with late complications had higher mortality than those without.

Introduction

Postoperative complications frequently occur after major head and neck surgery with free flap repair, with the reported complication rate ranging between 34% and 85%.¹⁻⁵ Several variables are associated with an increased risk for postoperative complications in this patient group, including smoking, advanced age, ASA class (American Society of Anesthesiologists risk classification) and excessive fluid management.^{2,6-7} However, previous studies have not reported complications in detail, and there are different ways to classify complications, making it difficult to compare different studies. Moreover, the impact of postoperative complications on recovery, hospital length of stay (LOS), oncological treatment plan and outcome remains unclear.^{1,5,8-10} Because the

rate of postoperative complications in this patient group is relatively high, patient selection, prognosis and the true cost of microvascular surgery continue to be discussed.^{1,7}

Accordingly, we aimed to evaluate the onset and distribution of surgical complications and their impact on postoperative recovery and outcome in a cohort of patients who underwent major head and neck surgery with free flap repair. Specifically, we aimed to evaluate pre- and perioperative factors related to complications and their impact on hospital LOS and survival.

Materials and methods

Setting

This retrospective registry study was conducted at Oulu University Hospital, which is a university hospital that provides tertiary-level care for 750 000 inhabitants in Northern Finland. All of the analyzed data was collected for clinical or administrative purposes. The study was approved by the hospital administration and by the local ethics committee (The Regional Ethics Committee of the Northern Ostrobothnia Hospital, 95/2016).

Patients and inclusion criteria

All of the patients who underwent surgery due to cancer of the head and neck with free flap repair in 2008–2015 at Oulu University Hospital were screened for inclusion in the study by reviewing the operation records of the head and neck surgery unit. During study period, a total of 156 free flap operations were performed. Of these, 3 involved non-malignant tumors, 12 were re-operations due to flap failures, 2 patients were operated due to traumatic injury and 3 cases had inadequate data; thus, 136 patients were included in the study.

Data extraction

The data were collected from the medical records, anesthesia charts, laboratory results, radiological statements and ICU (intensive care unit) database (Centricity Critical Care Clinisoft, GE Healthcare). The data included tumor data; patient demographic information, including intraoperative variables; postoperative ICU data; and postoperative surgical ward data recorded during the hospital stay. The hospital LOS was calculated as the time from the day of surgery until discharge. The data were collected using structured forms and then digitalized. The Population Register Centre of Finland provided data concerning the dates of deaths of the non-survivors. Survival was followed until April 30, 2017.

Complications

The postoperative complications that were recorded by the treating physicians were extracted from the medical records. The analysis included all postoperative complications during the hospital stay, both surgical and medical, as well as those that occurred within the 30 days after hospital discharge.

Surgical complications included surgical site infection, surgical site hematoma, the need for reoperation, partial flap failure and total flap failure. Medical complications included pneumonia, myocardial infarction, sepsis, acute kidney injury (AKI), stroke, pulmonary embolism, deep venous thrombosis and pulmonary edema. Complication onset was determined with an accuracy of one day. Complications were categorized as early complications i.e. onset 1–4 days postoperatively or as late complications i.e. onset more than 4 days postoperatively.

Statistical analysis

The data were analyzed using SPSS for Windows (IBM Corp., 2013; IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA). Categorical variables are presented as absolute

numbers (n) and percentages (%) and were compared using the Pearson chi-square test.

Continuous variables are presented as medians with 25th and 75th percentiles [25th–75th PCT] and were analyzed using the non-parametric Mann–Whitney test. Kaplan–Meier survival curves were drawn to analyze the long-term mortality. A p-value less than 0.05 was considered statistically significant.

Results

A median of 16 (range 8–29) operations were performed annually from 2008 to 2015. The median age of the study population was 65 years, and 75 (55%) were male. The majority of patients were recorded as ASA class 3–4 (54%, n=73) and received postoperative treatment in the ICU (98%, n=133). (Table 1). The median follow-up time was 26 [14–51] months.

Complications

A total of 86 (63.2%) of the 136 patients had at least one postoperative complication. The percentage of patients with medical complications was 37.5% (n=51), and the percentage of patients with surgical complications was 47.1% (n=64); 21.3% (n=29) of the patients had both medical and surgical complications.

The most common medical complication was pneumonia (51%) and the most common surgical complication was surgical site infection (49%) (Table 2). Compared to patients without complications, patients with complications had a higher rate of alcohol abuse (24.4% vs. 10.0%, p=0.039), longer operation time (565 [458–653] vs. 479 [418–556] min, p<0.001) and higher intraoperative blood loss (725 [400–1150] vs. 525 [300–800] mL, p=0.042). Patients with complications more frequently had fibular free flaps (26% vs. 8%, p=0.010) and stage T4 tumors

(59% vs. 34%, $p=0.015$) compared to those without complications. There was no difference in the preoperative risk classification according to ASA or comorbidities (Table 1).

The procedures requiring fibula free flap were more often performed in patients with stage T4 tumor (24 of 26 vs 40 of 101, $P<0.001$). They also had higher intraoperative blood loss (1050 [560-1300]ml vs 520 [350-900]ml, $P<0.001$) and longer duration of operation (632 [575-715] min vs 493 [425-574] min, $P<0.001$).

Early complications were recorded in 69 patients (50.7%). Those with early complications had a higher rate of any late complication (44 [63.8%] vs. 14 [20.9%], $p<0.001$). Patients with early complications had a higher rate of alcohol abuse (26.1% vs. 11.9%, $p=0.036$), longer operation time (566 [451–660] vs. 495 [423–569] min, $p=0.016$), longer hospital LOS (15 [10–22] vs. 10 [8–14] days, $p<0.001$) and more often had stage T4 tumors (64.0% vs. 35%, $p=0.004$) compared to patients without early complications (Table 3).

Of the medical complications, myocardial infarction was the earliest (3 [1–8] postoperative days), while surgical site exploration (1 [0–2] postoperative days) and hematoma evacuation (2 [1–6] postoperative days) were the earliest surgical procedures that were performed because of complications. The median time for infectious complications (i.e. surgical site infection, sepsis or pneumonia) was 5 (3–9) days after the operation (Table 2). A total of 18 patients had a reoperation within 7 days and 5 of these had later a flap failure (data not shown).

Outcome

Patients with complications had longer ICU LOS (24.0 [19.2–43.2] vs. 21.6 [19.2–24.0] hours, $p=0.022$) and longer hospital LOS (15 [10–21] vs. 9 [7–12] days, $p<0.001$) (Table 1). A total 45 (52.9%) of the patients with complications died by April 30, 2017, in contrast to 17 (35.4%, $p=0.072$) patients without complications (data not shown). Medical complications and ICU

readmissions, as well as N-stage 3, were more frequent in those who died within one year (Table 4).

Patients with late complications had higher mortality than patients without late complications (Fig. 1), but there was no difference in mortality between those with versus without early complications (data not shown).

Discussion

To our knowledge, this is the first study focusing on the impact and onset of complications on patient postoperative course and outcome in patients who underwent free flap surgery for cancer of the head and neck. The main finding of the present study was that more than half of the patients had postoperative complications. Patients with complications had a higher rate of alcohol abuse, hypoalbuminemia and T4 tumors, a more complicated intraoperative course and more frequently underwent fibular free flap reconstruction. Late complications were associated with poor long-term outcome and with significantly worse survival which were often the result of early complications.

The complication rate in our study, 63.2%, was higher than that in some previous studies, which reported complication rates between 40% and 53%. This might be explained by differences in how the complications were recorded.^{2,8,9,11} We did not categorize the complications as severe versus non-severe. Instead, we were interested in the timing of complication onset and aimed to record each complication that might possibly affect patient postoperative course and recovery. Moreover, there is a lack of standardization in the classification of postoperative complications after free flap surgery for cancer of the head and neck. The classification and the definitions of complications varies in previous studies (major vs. minor; surgical vs. medical; mild vs. moderate vs. severe); this makes it difficult to compare outcomes and risk factors for possible poor

outcomes. There is also continued debate about the use of grading systems that are commonly used for postoperative complications in other fields of surgery.^{1,2,5,8,9} In the present study, we used a simple classification for medical and surgical complications that could be reliably used in our retrospective review of medical records. The present study was performed in a low volume center, with median annual operation rate of 16. In the previous studies the annual operation rate has varied between 14-38.^{3,7,8} However, the annual complication rate cannot be explained by this due to heterogeneity of the classification of the complications. Also Klosterman et al did not find differences in complication rates between low-volume and high-volume centers.³

Previous studies have found that smoking, comorbidity and advanced age are potential risk factors for postoperative complications after free flap surgery for cancer of the head and neck.^{2,6,7} In our study, we did not find a significant correlation between these factors and complications. The high proportion of smokers (41%) in our population may explain the difficulty to show the possible impact of smoking on complications. The majority of the patients in this study were recorded as ASA 3–4, but we did not find that this had a significant effect on postoperative complications ($p=0.084$). However, the fibular free flap method was associated with complications ($p=0.010$). Further, previous studies found that free flaps with bone or composite flaps are associated with postoperative complications.^{1,18} Microvascular surgery with bone flap is a technically more demanding procedure compared to surgery with soft tissue flaps. According to our results, the duration of the operation is longer and blood loss during resection is usually higher. This is in line with the results of Mücke et al.¹⁸ Moreover, in the present study, fibula free flap was more frequent in patients with extensive disease. All these influence postoperative complications and outcome. The surgical insult of major procedures evokes an inflammatory response in patients and contributes to the development of postoperative infectious complications.¹²

In the present study, 97.8% of the patients were admitted to the ICU for immediate postoperative care. The median ICU LOS was less than 24 hours, and most of the complications were recorded after ICU discharge. There is no consensus regarding the need for postoperative management in the ICU after free flap surgery of the head and neck. In major abdominal surgery, it is essential to accurately assess the need for postoperative ICU management to ensure high-quality patient care, since this could improve outcomes.¹³ Although the high cost of routine postoperative ICU care is a concern^{14,15}, the present results still suggest that in certain cases (alcohol abuse, use of a free flap with bone, high intraoperative blood loss), planning for a longer ICU stay and better monitoring after ICU discharge could help prevent early medical complications.

In our study, complications prolonged the median hospital LOS 6 days. Alcohol abuse and pulmonary problems can lead to postoperative medical complications, which are known to be an important factor in increasing the true costs after microsurgical reconstruction for cancer of the head and neck.⁷ Early mobilization and respiratory physiotherapy intervention may be essential for reducing the high rate of postoperative pneumonia after free flap surgery.

The reported impact of postoperative complications on survival and mortality after free flap surgery for cancer of the head and neck has varied in previous studies.^{5,16,17} Unlike the present study, the recent prospective trial by McMahon et al. did not analyze the onset of complications on outcome.¹⁷ Here we reported the significant effect of late complications on mortality, which has not been analyzed before. Medical complications, more advanced cancer (N-score >2) and readmission to ICU were all associated with worsened one-year survival. Patients with complications had also significantly higher five-year mortality compared to patients without complications. Our results showed that all postoperative complications had a negative effect on outcome and survival after free flap surgery for cancer of the head and neck.

Limitations

This study had some limitations due its retrospective design and the relatively small number of patients. Alcohol abuse was more frequently found in patients with complications. Due to retrospective design we were not able to use validated methods, such as AUDIT to determine the alcohol consumption habits of the study population and alcohol abuse was retrieved from the patients' medical history. This should be noted when interpreting the results. Nevertheless, this study population represents an unselected cohort of patients with head and neck cancer who underwent resection of a malignant tumor using free flap surgery. In this study setting, we were only able to show an association of early complications with late complications, which significantly increased hospital LOS and worsened survival. Showing a robust causal effect would require a prospective study and adjustment of perioperative factors. However, we found a higher rate of late complications in patients with early complications. We were not able to analyze the medical complications as risk factors for surgical complications or vice versa due to the limited number of patients. The role of early complications should be studied in a large, prospective multicenter study to identify the origin of the complications and to determine whether they are patient- or procedure-related.

Clinical impact

The present results suggest that there should be a greater focus on preventing early complications. Careful attention should be paid to the preoperative and immediate postoperative optimization of patients who are undergoing this operation, and the most suitable surgical technique should be carefully considered. Moreover, instead of focusing on health-related risk factors such as ASA classification or chronic conditions, our results suggest that certain at-risk

populations, like those who abuse alcohol or those who are malnourished, should be identified when planning the surgery and the postoperative care. If possible, the use of less invasive reconstruction techniques and free flaps without bone should be evaluated for patients who are at high risk for postoperative complications. The present results also suggest that in the future studies the classification of the complications should include the onset of complications since it has an impact on the long-term outcome. Also, according to our results, the focus should be on tumor staging, different surgical techniques and perioperative course instead of health related risk-factors when designing studies of postoperative complications following free flap surgery of the cancer of head and neck.

Conclusion

More than half of the patients who underwent microvascular free flap reconstruction had complications that were related to alcohol abuse, a more complicated intraoperative course and reconstruction with composite free flap with bone. Most of the complications were recorded after ICU discharge, and infectious complications occurred after postoperative day 5. The complications increased hospital LOS, and late complications had a significant effect on mortality.

Legend for figure:

Figure 1. Kaplan-Meier survival curves for the 136 patients who underwent free flap surgery for cancer of the head and neck who had late complications and who had no late complications

Conflict of interest: none.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Table 1: Perioperative characteristics and postoperative outcome of 136 patients who underwent free flap surgery for cancer of the head and neck.

Characteristic	All patients n=136	Patients with no complications n=50	Patients with complications n=86	p-value
Gender, m/f	75/61 (55.1/44.9)	23 (46.0)/27 (54.0)	52 (60.5)/34 (39.5)	0.10
Age, years	65 [59–74]	65 [57–71]	66 [59–74]	0.43
ASA classification, 3–4	73 (53.7)	22 (44.0)	51 (59.3)	0.084
BMI	23.3 [20.2–26.2]	22.6 [20.5–26.5]	23.6 [19.7–26.0]	0.83
Smoking	56 (41.2)	21 (42.0)	35 (40.7)	0.88
Alcohol abuse	26 (19.1)	5 (10.0)	21 (24.4)	0.039
Comorbidity	95 (69.9)	32 (64.0)	63 (73.3)	0.26
Charlson Comorbidity Index				
CCI >0	54 (39.7)	19 (38.0)	35 (40.7)	0.76
Medication	85 (62.5)	30 (60.0)	55 (64.0)	0.65
Preoperative laboratory results				
Hemoglobin, g/L	132 [121–143]	134 [127–145]	131 [118–141]	0.15
Creatinine, µmol/L	63 [55–72]	61 [54–69]	65 [55–73]	0.38
Hypoalbuminemia (alb <36)	8 (5.9)	0 (0.0)	8 (9.3)	0.027
Tumor site				
Oral cavity/tongue	57 (41.9)	24 (48.0)	33 (38.4)	0.51
Maxilla	12 (8.8)	3 (6.0)	9 (10.5)	
Mandibula	23 (16.9)	7 (14.0)	16 (18.6)	
Larynx/pharynx	12 (8.8)	3 (6.0)	9 (10.5)	
Cutaneous	10 (7.4)	4 (8.0)	6 (7.0)	
Palatal	10 (7.4)	6 (12.0)	4 (4.7)	
Buccal mucosa	8 (5.9)	3 (6.0)	5 (5.8)	
Other	4 (2.9)	0 (0.0)	4 (4.7)	
Tumor staging	n=127	n=47	n=80	
T-score T1	5 (3.9)	2 (4.2)	3 (3.8)	0.015
T2	31 (24.4)	12 (25.5)	19 (23.8)	
T3	28 (22.0)	17 (36.2)	11 (13.8)	
T4	63 (49.6)	16 (34.0)	47 (58.8)	
N-score N0	80 (63.0)	35 (74.5)	45 (56.3)	0.14
N1	19 (15.0)	6 (12.8)	13 (16.3)	
N2	26 (20.5)	5 (10.6)	21 (26.3)	
N3	2 (1.6)	1 (2.1)	1 (1.3)	
Preoperative radiotherapy				
No need	96 (70.6)	35 (70.0)	61 (70.9)	

0–3 months before operation	2 (1.5)	0 (0.0)	2 (2.3)	0.69
3–12 m before operation	9 (6.6)	3 (6.0)	6 (7.0)	
>12 m before operation	29 (21.3)	12 (24.0)	17 (19.8)	
Free flap				
RFA	42 (30.9)	22 (44.0)	20 (23.3)	0.011
ALT	39 (28.7)	15 (30.0)	24 (27.9)	0.80
LD	3 (2.2)	0 (0.0)	3 (3.5)	–
Scapula	7 (5.1)	2 (4.0)	5 (5.8)	0.64
Fibula	26 (19.1)	4 (8.0)	22 (25.6)	0.010
Lateral arm	9 (6.6)	4 (8.0)	5 (5.8)	0.62
Other	10 (7.4)	3 (6.0)	7 (8.1)	0.65
Tracheostomy	111 (81.6)	40 (80.0)	71 (82.6)	0.44
Neck dissection bilateral	28 (20.6)	8 (16.0)	20 (23.3)	0.51
Time in operation room, min	613 [540–707]	561 [500–614]	647 [561–733]	<0.001
Duration of operation, min	527 [437–625]	479 [418–556]	565 [458–653]	0.001
Total fluids received, mL	6460 [5400–8420]	6310 [4600–8200]	6940 [5400–8820]	0.096
Red blood cells received, mL	260 [0–520]	0 [0–520]	260 [0–520]	0.025
Blood loss, mL	600 [385–1000]	525 [300–800]	725 [400–1150]	0.042
Antibiotic treatment >48 h	105 (77.2)	28 (56.0)	77 (89.5)	<0.001
Postoperative ventilator support, h	13.7 [9.6–17.0]	12 [7.2–14.4]	14.4 [9.6–19.2]	0.009
Postoperative sedation, h	11.5 [5.5–15.8]	9.6 [4.8–14.4]	12.0 [7.2–16.8]	0.065
Hos LOS, days	13 [9–17]	9 [7–12]	15 [10–21]	<0.001
ICU LOS, hours	21.6 [19.2–41.3]	21.6 [19.2–21.6]	24.0 [19.2–43.2]	0.022
Discharge disposition home	82 (60.3)	37 (74.0)	45 (52.3)	0.003
Oncologic treatment				
No need	39 (28.7)	5 (10.0)	34 (38.4)	0.49
Curative treatment	69 (50.7)	27 (54.0)	42 (50.0)	
Palliative treatment	18 (13.2)	8 (16.0)	10 (11.6)	
Onset of assessment for oncologic treatment, days	44 [29–75]	44 [35–67]	44 [28–72]	0.97
Discharge disposition home	82 (60.3)	37 (74.0)	45 (52.3)	0.070
30-day mortality	1 (0.7)	0 (0.0)	1 (1.2)	0.44
90-day mortality	3 (2.2)	0 (0.0)	3 (3.5)	0.18
180-day mortality	8 (5.9)	1 (2.0)	7 (8.1)	0.14
1-year mortality	27 (19.9)	9 (18.0)	18 (20.9)	0.68
2-year mortality	48/121 (39.7)	14/46 (30.4)	34/75 (45.3)	0.10
5-year mortality	60/87 (69.0)	16/29 (55.2)	44/58 (75.9)	0.049

ASA: American Society of Anaesthesiologists; BMI: body mass index; RFA: radial forearm; ALT: anterolateral thigh; LD: latissimus dorsi; Hosp LOS: hospital length of stay; ICU LOS: intensive care length of stay

Complications	Frequency, %	Onset of complications, days
Medical complications	70	7 [3–9]
Pneumonia	36 (51.4)	5 [3–7]
Sepsis	9 (12.9)	8 [7.5–11.5]
Myocardial infarction	7 (10.0)	3 [1–8]
Pulmonary edema	13 (18.6)	7 [5–9]
Pulmonary embolism	1 (1.4)	13
Deep venous thrombosis	2 (2.9)	9 & 11
Stroke	1 (1.4)	2
Acute kidney injury	1 (1.4)	23
Surgical complications	73	5 [2–10]
Surgical site infection	36 (49.3)	6 [3–11]
Surgical site hematoma	22 (30.1)	6 [1–9]
Partial flap failure	5 (6.8)	10 [3–14]
Total flap failure	10 (13.7)	
Need for reoperation	72	9 [1–15]
Surgical site revision	20 (27.8)	14 [9–18]
Surgical site exploration	18 (25.0)	1 [0–2]
Evacuation of hematoma	17 (23.6)	2 [1–6]
New free flap	10 (13.9)	14 [9–22]
New other flap	7 (9.7)	14 [8–21]
ICU readmission	8	7 [4–17]

Table 2
The 143 complications and their onset in 136 patients who underwent free flap surgery for cancer of the head and neck

Table 3**Differences between patients who underwent free flap surgery for cancer of the head and neck who did or did not have early onset complications**

Variable	Early complications n=69	No early complications n=67	p-value
ASA classification 3–4	36 (52.2)	37 (55.2)	0.72
APACHEII	13 [10–15]	12 [11–15]	>0.9
SOFA admission	3 [2–4]	3 [2–4]	0.40
Charlson Comorbidity Index>0	26 (37.7)	28 (41.8)	0.62
Smoking	28 (40.6)	28 (41.8)	0.89
Tumor staging			
T-score T1	2	17	0.004
T2	14	17	
T3	7	21	
T4	41	22	
N-score N0	36	44	0.45
N1	11	8	
N2	16	10	
N3	1	1	
Alcohol abuse	18 (26.1)	8 (11.9)	0.036
Preoperative radiotherapy			
No need	49 (71.0)	47 (70.1)	0.49
0–3 months before operation	2 (2.9)	0 (0)	
3–12 months before operation	5 (7.2)	4 (6.0)	
>12 months before operation	13 (18.9)	16 (23.9)	
Free flap with bone	21 (30.4)	12 (17.9)	0.088
Perioperative blood loss	750 [400–1150]	530 [350–898]	0.079
Length of operation	566 [451–660]	495 [423–569]	0.016
Postoperative ventilator time	0.60 [0.43–0.76]	0.54 [0.30–0.67]	0.037
Hosp LOS, days	15 [10–22]	10 [8–14]	<0.001
ICU LOS, hours	1.1 [0.8–1.8]	0.9 [0.8–1.6]	0.089
Any late complication	44 (63.8)	14 (20.9)	<0.001
Late surgical site infection	22 (31.9)	0 (0.0)	<0.001
Late surgical site hematoma	12 (17.4)	1 (1.5)	0.002
Late partial flap failure	4 (5.8)	0 (0.0)	0.045
Late total flap failure	6 (8.7)	0 (0.0)	0.014
Late evacuation of hematoma	8 (11.6)	0 (0.0)	0.004

Late surgical site revision	18 (26.1)	2 (3.0)	<0.001
Late surgical site exploration	0 (0.0)	1 (1.5)	0.31
Late new free flap	10 (14.5)	0 (0.0)	0.001
Late new other flap	7 (10.1)	0 (0.0)	0.007
Late pneumonia	15 (21.7)	7 (10.4)	0.074
Late sepsis	6 (8.7)	2 (3.0)	0.16
Late pulmonary edema	7 (10.1)	5 (7.5)	0.58
Late myocardial infarction	2 (2.9)	1 (1.5)	0.58

SOFA: Sequential Organ Failure Assessment; APACHEII: Acute Physiology and Chronic Health Evaluation; Hosp LOS: hospital length of stay; ICU LOS: intensive care unit length of stay.

Table 4

Characteristics of the 136 patients who underwent free flap surgery for cancer of the head and neck according to their one-year survival status

	Alive one year after surgery n=109	Not alive one year after surgery n=27	p-value
Age <65 y	51 (46.8)	13 (48.1)	0.56
65–75 y	38 (34.9)	7 (25.9)	
>75 y	20 (18.3)	7 (25.9)	
Tumor staging	n=102	n=25	0.28
T-score T1	4 (3.7)	1 (3.7)	
T2	27 (24.8)	4 (14.8)	
T3	19 (17.4)	9 (33.3)	
T4	52 (47.7)	11 (40.7)	0.034
N-score N0	64 (58.7)	16 (59.3)	
N1	16 (14.7)	3 (11.1)	
N2	22 (20.2)	4 (14.8)	
N3	0 (0.0)	2 (7.4)	
Early complications	57 (52.3)	12 (44.4)	0.47
Late complications	44 (40.4)	14 (51.9)	0.28
Surgical complications	54 (39.7)	10 (37.0)	0.24
Medical complications	36 (33.3)	15 (55.6)	0.030
Reoperation	43 (39.4)	10 (37.0)	0.82
Readmission to ICU	4 (3.7)	4 (14.8)	0.028
Fibular flap	22 (20.2)	4 (14.8)	0.53
Alcohol abuse	19 (17.4)	4 (14.8)	0.32

Fig.1. Kaplan-Meier survival curves for the 136 patients who underwent free flap surgery for cancer of the head and neck who had late complications and who had no late complications

