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Complications of Head and Neck Reconstructive Surgery Using Axial Pedicled Flap

ABSTRACT

Objectives: Axial flap surgery is associated with numerous complications. The purpose of this study is to determine the frequency of these complications, and identify possible factors contributory to their occurrence.

Methods:

Design: Cross-Sectional Study
Setting: Tertiary Public University Hospital
Subjects: Records of all patients who underwent axial pedicled flap reconstruction at the otorhinolaryngology ward of our tertiary public university hospital from January 2013 to July 2015 were retrospectively reviewed, and data consisting of age, sex, diagnosis, disease stage, smoking history, alcohol intake, co-morbidities, past operations, pre-operative hemoglobin and albumin, total operative time, total blood loss, location and total area of the surgical defect and length of hospitalization were tabulated. All complications were listed. Data were analyzed for any potential trends.

Results: A total of 38 patients underwent axial pedicled flap reconstruction in the study period. Nineteen out of 38 (50%) cases involved complications. The most common complication was infection. Most of the complications occurred in males with history of alcohol intake, advanced cancer stage, significant blood loss, recurrent tumors, low pre-operative hemoglobin and albumin levels, and a large area of surgical defect.

Conclusions: The complication rate for axial flap surgery in our series was significant at 50%. Potential risk factors identified were male gender, advanced cancer stage, tumor recurrence, alcohol intake, low pre-operative hemoglobin and albumin levels, significant blood loss, longer operative time and a larger surgical defect.

Keywords: *surgical flaps, myocutaneous flap, axial flap, complications, risk factors*

Every year 550,000 new cases of head and neck malignancies are diagnosed throughout the world.[1] In the Philippines, they comprise the 4th most common newly-diagnosed cancer, causing at least four thousand deaths annually.[2] Treatment usually involves complete surgical excision with histopathologically proven tumor-free margins. Due to poverty and / or poor health-seeking behavior, a vast majority present in advanced stages, requiring large areas of excision, and resulting in extensive surgical defects no longer suitable for primary closure.[3] However, immediate or early closure is vital in the surgical management of these cases for several reasons: it maintains alimentary tract integrity to allow feeding; ensures protection of the vital structures in the region,

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lowering the risk for life-threatening complications such as blowout of the great vessels of the neck; and allows for facial reconstruction, restoring the patient's ability to communicate by facial expression.[4] Thus, the use of flaps for reconstruction becomes necessary.

Head and neck reconstructive procedures are also indicated in various other conditions such as trauma, infection, osteoradionecrosis and congenital anomalies.[5] Although the present trend globally is to use free flaps in the reconstruction of extensive defects, this method requires both specialized expertise that is not always available in all centers, and longer operative time.[6] Because of limited experience in and lack of resources for this procedure, and the need to optimize operative time, axial pedicled flaps remain the more commonly-used flap type in our institution.

The use of axial flaps in reconstructive surgery was introduced in the country in the seventies.[7] A significant number of complications associated with these are encountered up to the present. Consolidated reports of the otorhinolaryngology department of a tertiary government institution from 2006 to 2013 showed that of an average of ten cases of axial flap surgery per year, approximately 1 in 5 developed complications.[8] Previous studies have suggested the correlation of such factors as smoking history,[9] location in the oral cavity, previous radiation therapy[10] and tumor size[11] with the occurrence of complications. To the best of our knowledge, there has been no locally - reported study on such risk factors. An extensive literature search of HERDIN NeON, MEDLINE and Google Scholar yielded no prior local study on complications of axial flap surgery. This paucity of data limits attempts to address and prevent these problems.

Thus, this study aims to determine the frequency of complications in axial pedicled flap surgery in our institution and identify potential factors that may be contributory to their occurrence.

METHODS

This is a retrospective, cross-sectional study of axial pedicled flap surgery complications. All patients who had undergone axial pedicled flap reconstruction in the public otorhinolaryngology ward of our institution from January 2013 to July 2015 were included in the study.

Records were retrospectively reviewed, and age, sex, diagnosis, stage of disease, type of disease (newly-diagnosed or recurrent), co-morbidities, history of smoking and alcohol intake were recorded. Pre-operative hemoglobin and albumin were listed. The type of operation, total operative time, total blood loss, location and size of defect and length of hospital stay were likewise determined. Complications were pre-defined as one or more of the following: infection, dehiscence, congestion and/or flap failure, and were recorded. The data were tabulated and examined for any potential trends.

Strict confidentiality was observed with all data encoded into electronic abstraction sheets using Microsoft Excel 2010 version 14 (Microsoft Corporation, WA, USA). One sheet (the correlation tool) contained the patient name, medical record number and patient study number. The patient study numbers were used in all subsequent data tables. The protocol was reviewed and approved by the ethics review board of the institution.

RESULTS

A total of 38 patients underwent pedicled axial flap surgery in our department from January 2013 to July 2015. There were 25 males (66%) and 13 females (34%), aged 23 - 81 years (mean 57 years). There were 16 (42%) nonsmokers and 22 (58%) smokers, 7 (18%) of whom had a smoking history of greater than 10 pack years. Eighteen (47%) had a history of alcoholic beverage intake. Two (5%) were diabetic, 14 (37%) were hypertensive, and 7 (14%) had pulmonary disease. Squamous cell carcinoma was the most common histopathologic diagnosis, seen in 17 patients (45%), followed by basal cell carcinoma, seen in 8 (21%), as demonstrated in *Figure 1*.

Staging according to the 2010 American Joint Committee on Cancer (AJCC) classification is listed in *Table 1*. Twenty-two patients (61%) were in stages III to IV, while 10 (28%) were in stage II. Four of the malignant cases were recurrent tumors. The 2 patients diagnosed with hemangioma, a benign disease were not assessed for stage or recurrence.

The predominant flap reconstructive technique used was the pectoralis major myocutaneous flap (PMMF). The distributions according to type of flap reconstruction are shown in *Figure 2*. The most common area of defect was in the oral cavity at 42%. The distributions according to disease localization are shown in *Figure 3*. The mean operative time was 577 minutes, mean blood loss was 992 ml and mean hospitalization period was 29 days.

Of the 38 patients who underwent pedicled axial flap surgery, 19 (50%) developed one or more flap-related complications. The most common complication was infection (11 out of 19). Other complications were dehiscence (9), congestion (7) and flap failure (2). Fourteen out of 25 males (56%) and 5 out of 13 females (38%) developed flap complications. Complications and non-complications in each age group were almost equal *(Table 2)*. In terms of flap location, those in the oral cavity and face had higher percentages of complications than those in the nasal and paranasal regions. Only 1 case involved the neck, and this developed complications *(Table 3)*.

Among the patients with malignancy as the indication for surgery, 2 out of 10 cases (20%) in stage II, 1 out of 4 cases (25%) in stage III and 13 out of 18 cases (72%) in stage IV developed flap complications.

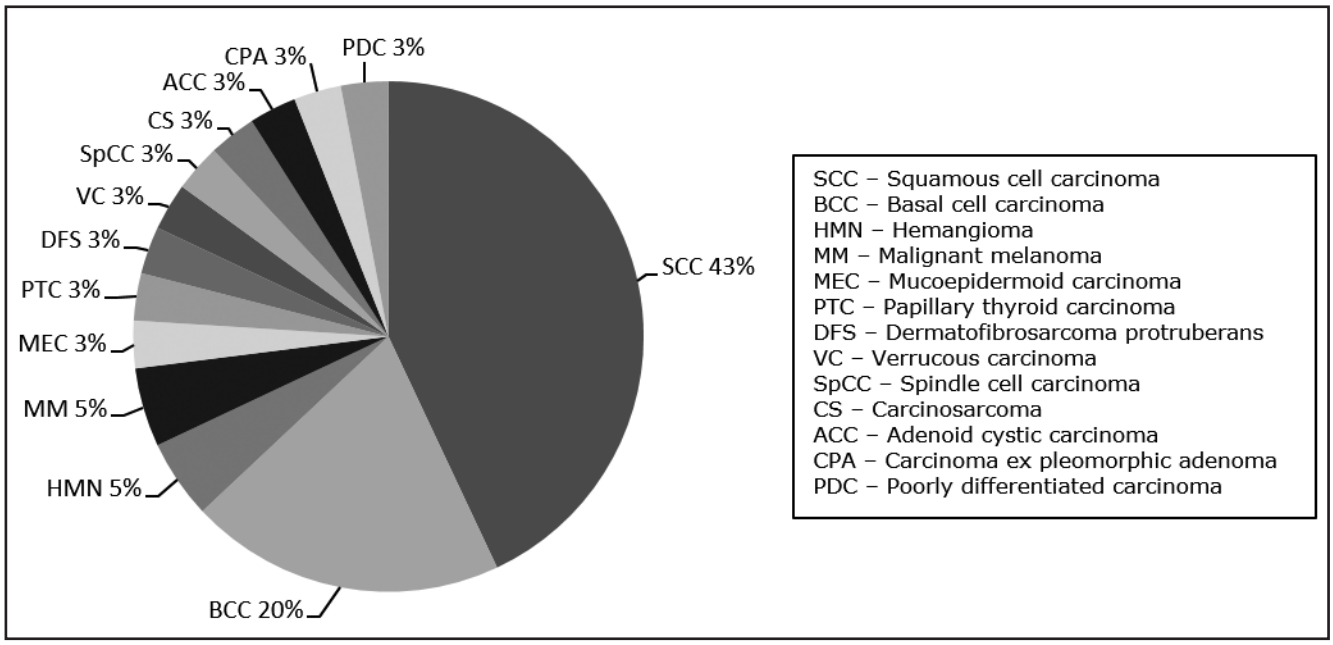

Figure 1. Distribution of patients according to histopathologic diagnoses

Table 1. Distribution of patients according to stage of malignancy and TNM classification

Stage of malignant disease (n=36)		Number (percent)
Stage I		0
Stage II		10 (28%)
Stage III		4 (11%)
Stage IV		18 (50%)
Recurrence		4 (11%)
TNM Stage (n=32)		
T	1	1 (3%)
	2	8 (25%)
	3	5 (16%)
	4	18 (56%)
N	0	14 (44%)
	1	5 (16%)
	2	13 (41%)
M	0	31 (97%)
	1	1 (3%)

Occurrences of complications in the various TNM classifications are also listed in *Table 4*. Out of the 4 cases of tumor recurrence, 3 (75%) developed complications while out of the 32 cases of non-recurrent tumor, 16 (50%) developed complications.

Occurrence of complications varied among the different pack-year ranges of smoking history *(Table 5)*. In patients with a history of alcohol intake, 12 (67%) developed complications, compared to 7 (35%) in those without history of alcohol intake. Classification of cases according to the presence of co-morbidities, particularly diabetes, hypertension, and pulmonary disease, yielded no demonstrable trend in the occurrence of complications *(Table 6)*.

Of the 20 cases that used pectoralis major myocutaneous flaps, 14 (70%) developed complications *(Table 7)*. The group that developed flap complications had a lower mean pre-operative hemoglobin of 123 g/L, compared to the group that did not develop complications with a mean pre-operative hemoglobin of 136 g/L. Likewise, the group that developed flap complications had a lower mean pre-operative serum albumin of 27 g/L, relative to the group that did not develop complications, with a mean pre-operative serum albumin of 35.3 g/L. The mean operative time for cases that resulted in flap complications was longer, lasting 653 minutes, while that for cases that did not develop flap complications was 498 minutes. Mean blood loss among flap complication cases was greater (1282 mL) than among non-complication cases (703 mL). Patients who developed flap complications had a longer mean hospital stay of 35 days, as opposed to those who did not develop flap complications, who had a mean hospital stay of 23 days. The mean area of defect in the cases that developed flap complications was greater (84 cm^2) than that in the cases that did not develop flap complications (64 cm^2). Standard deviations for each parameter are shown in *Table 8*.

DISCUSSION

A review of the compiled annual institutional reports over the last eight years showed that only approximately 20% of reconstructive pedicled axial flap surgeries developed complications.[8] However, this study showed that in the years 2013 to 2015, 19 out of 38 cases (50%) resulted in flap complications, a rate comparable to other institutions abroad.[12] This suggests that complications of axial flap surgery may have been previously underreported, possibly due to unclear and subjective definitions of what comprise complications, and incomplete documentation.

Among the reconstructive axial flap surgeries performed during these years, the pectoralis major myocutaneous flap was most commonly employed. Touted as the workhorse of head and neck reconstruction, the pectoralis major muscle is the easiest to access, is technically simple to use, has an abundant vascular supply, and requires minimal specialized instrumentation and training.[12]

It is not surprising that most of the axial flap surgeries involved the oral cavity, as cancer of the oral cavity is the most common type of head and neck cancer.[13] Many of the proven risk factors for carcinogenesis – namely, smoking, alcoholism, betel nut chewing, periodontal disease and ill-fitting dentures – involve this site.[14] Furthermore, squamous cell carcinoma emerged as the most common indication for surgery among the cases reviewed, consistent with worldwide data that this cancer is the most common malignancy in the head and neck.

Comparing the complication rates of the different groups of patients classified according to the various pre-set parameters yielded some interesting findings.

The incidence of complication in males (56%) was slightly higher than that in females (38%). Review of related literature revealed that men have a statistically higher risk of developing post-operative complications possibly due to the immune-suppressive effects of high testosterone and low estradiol levels.[15]

Advanced stage of cancer appeared to be linked with increased risk of complication. Seventy-two percent of patients with stage IV malignancy developed flap-related complications, compared with 20 to 25% in the patients with lower stages of

Table 2. Age in relation to complications

Age	Complications	No complications
0 to 20	0	0
21 to 40	3	4
41 to 60	8	7
61 to 80	8	6
More than 80	0	2

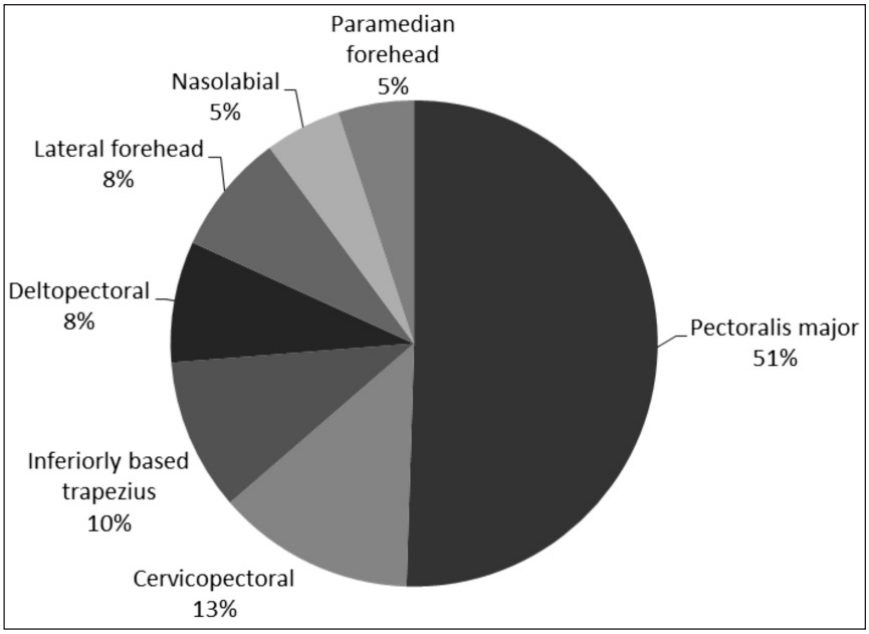

Figure 2. Distribution of patients according to type of flap reconstruction

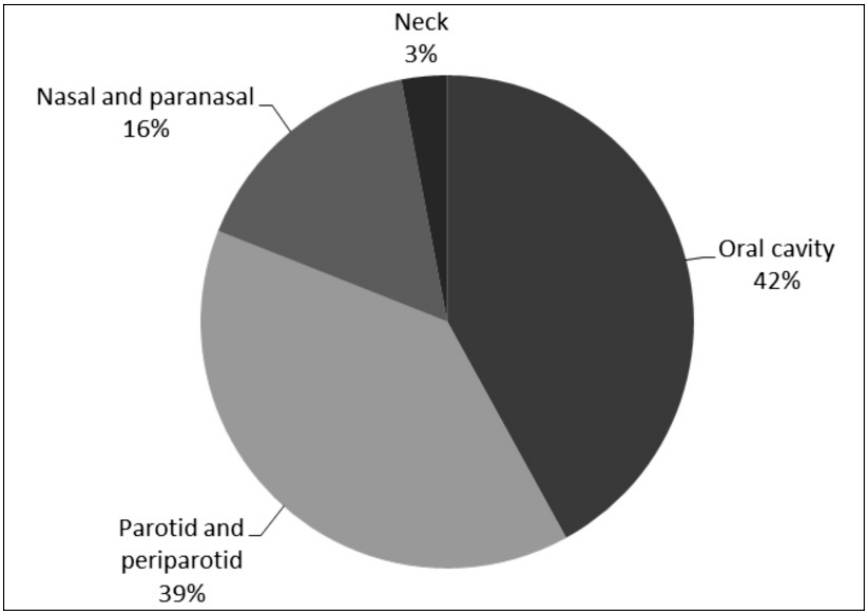

Figure 3. Distribution of patients according to location of disease

Table 3. Location of disease in relation to complications

Site of disease	Complications	No complications	Total
Oral cavity	9 (56%)	7 (44%)	16 (100%)
Parotid and periparotid	8 (53%)	7 (47%)	15 (100%)
Nasal and paranasal	1 (17%)	5 (83%)	6 (100%)
Neck	1 (100%)	0	1 (100%)

Table 4. TNM staging in relation to complications

TNM Stage (n=32)		Complications	No complications	Total
T	1	0	1 (100%)	1 (100%)
	2	1 (12%)	7 (88%)	8 (100%)
	3	1 (20%)	4 (80%)	5 (100%)
	4	14 (78%)	4 (22%)	18 (100%)
N	0	4 (29%)	10 (71%)	14 (100%)
	1	4 (80%)	1 (20%)	5 (100%)
	2	8 (62%)	5 (38%)	13 (100%)
M	0	15 (48%)	16 (52%)	31 (100%)
	1	1 (100%)	0	1 (100%)

Table 5. Smoking history in relation to complications

Smoking (pack years)	Complications	No complications	Total
0	9 (50%)	9 (50%)	18 (100%)
1-5	3 (75%)	1 (25%)	4 (100%)
6-10	2 (50%)	2 (50%)	4 (100%)
>10	2 (29%)	5 (71%)	7 (100%)
unspecified	3 (60%)	2 (40%)	5 (100%)

Table 6. Co-morbidities in relation to complications

Co-morbidities	Complications	No complications	Total
Hypertension			
Yes	7 (50%)	7 (50%)	14 (100%)
No	12 (50%)	12 (50%)	24 (100%)
Diabetes			
Yes	1 (100%)	0 (0%)	1 (100%)
No	18 (49%)	19 (51%)	37 (100%)
Pulmonary disease			
Yes	2 (29%)	5 (71%)	7 (100%)
No	17 (55%)	14 (45%)	31 (100%)

malignancy. Although association between cancer stage and operative risk has not been clearly established, and previous studies have reported no significant difference in the rate of post-operative complications among groups divided according to disease stage,[16] further study may be warranted to establish whether an association between malignancy stage and the rate of flap-related surgical complications is indeed present.

Table 7. Comparison in relation to complications

Type of Flap	Complications	No complications	Total
Pectoralis major myocutaneous	14 (70%)	6 (30%)	20 (100%)
Inferiorly based trapezius	2 (50%)	2 (50%)	4 (100%)
Cervicopectoral	1 (25%)	3 (75%)	4 (100%)
Deltopectoral	1 (33%)	2 (67%)	3 (100%)
Lateral forehead	1 (33%)	2 (67%)	3 (100%)
Nasolabial	0	2(100%)	2 (100%)
Paramedian forehead	0	2(100%)	2 (100%)

Table 8. Surgical parameters

	Complications	No complications
Pre-op hemoglobin	123 (+/- 14)	136 (+/- 15)
Pre-op albumin	27 (+/- 6.9)	35.3 (+/- 6.5)
Mean OR Time (minutes)	653 (+/- 195)	498 (+/- 205)
Blood loss (ml)	1282 (+/- 645)	703 (+/- 507)
Hospitalization (days)	35 (+/- 22)	23 (+/- 13)
Area of defect (cm2)	84 cm^2 (+/- 52)	64cm^2 (+/- 74)

Although only 4 out of the 36 cases (11%) were classified as tumor recurrence, it is remarkable that 3 of these 4 cases developed complications. Tumor recurrence is known to signify poor prognosis even in patients who underwent salvage treatment,[17] and usually warrants palliative care.[18]

A history of alcohol intake seems to be worth investigating, as 67% of patients who reported intake of alcohol developed complications, while only 35% of those without alcohol intake developed complications. Published studies suggest that significant alcohol intake not only reduces immune capacity at the cellular level, but also causes prolonged bleeding time.[19]

Pre-operative albumin and hemoglobin levels both show a possible association with increased risk of flap complications. The patients who developed complications had a lower mean pre-operative albumin level and a lower mean pre-operative hemoglobin level than those who did not. Pre-operative albumin has been shown to be one of the most important determinants of surgical outcome, largely because hypoalbuminemia is an indicator of malnutrition and disease.[20] Studies have likewise suggested that pre-operative anemia is a significant risk factor for developing complications in various surgical cases.[21] This may be due in part to the association between anemia and the presence of

underlying co-morbid illness and low physiologic reserves.[22] Another possible reason is the detrimental effect of being in a relatively hypoxemic state.[23]

Patients who had complications had a noticeably larger mean area of defect, a longer operative time and a significantly higher amount of blood loss. It may be speculated that this is because larger areas of defect necessitate larger surgical flaps and longer, more complicated operations imposing higher demands for vascular perfusion and yielding higher risks of infection. Longer operative time usually implies a more technically difficult surgery and presents the challenge of maintaining field sterility, possibly increasing susceptibility to infection.[23] Lastly, greater blood loss denotes decreasing hemoglobin counts and consequently, relative hypoxemia, known to be unfavorable in any major surgical procedure.[24]

As could be expected, patients who developed complications had a longer hospital stay likely because more time was required to address the post-operative problems.

Surgeries employing a pectoralis major myocutaneous flap appeared to have the highest rate of complications among the various types of flap. This may be because it was the most commonly employed type of flap in the study population (50%). The number of cases employing other types of flap was likely too low to show any interesting trends. Furthermore, the pectoralis major myocutaneous flap is usually used for large surgical defects, and thus the occurrence of complications may be related to the larger defect size.

On grouping the cases according to location, complication rates were lowest in the nasal/paranasal region. This may be due in part to smaller defect size. However, due to the large variation in the number of cases in each location, further studies are needed to establish any potential association between flap location and the occurrence of complications.

Surprisingly, examination of smoking history showed no distinct pattern to suggest the possibility of an association with risk of complication. Age also did not seem to affect the complication rate in this study, likely due to the small sample size and wide distribution among groups. Finally, the presence of co-morbidities, particularly hypertension, diabetes and/or pulmonary disease showed no demonstrable effect on the rate of complications in our series.

In summary, 50% of axial pedicled flap surgeries done at the public otorhinolaryngology ward of our institution from January 2013 to July 2015 resulted in flap-related complications. The most frequent complication was infection. Factors that may contribute to the increased risk of complication are: male sex, advanced cancer stage, tumor recurrence, alcohol intake, low pre-operative hemoglobin and albumin levels, significant blood loss, longer operative time, and a larger surgical defect.

The study was limited by the retrospective design and small sample size. Information gathered depended on the recorded subjective assessments of the surgical residents-in-charge. It is recommended that further analytical, prospective research be done to determine the actual risk posed by the factors identified. The statistical differences among the variables can be computed using multiple logistic regressions to determine exact effect of each variable in future studies. Ultimately, this study may alert surgeons to perform a more thorough pre-operative evaluation, allow for possible risk-modification, and facilitate comprehensive patient education.

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