



Free Flap Reconstruction for Head and Neck Oncologic Resection: Our Experience in Pandemic Situation

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Abstract

Since cancer patients' COVID-19 outcomes are poorer and delayed cancer management leads to greater mortality, cancer treatment protocols should be reassessed. This study aims to share our experience in the pandemic's peak and suggestions for future pandemics.

Between January 2020 and November 2020, we gathered the data for 32 patients undergone free flap reconstructive surgery Imam Khomeini Hospital Complex, Tehran, Iran.

In this study, 32 free flap surgeries were done. By the day 15 after operation, we encountered total of 3 flap necroses and only one patient was infected with COVID-19 at day 4 after surgery.

This study demonstrated that in a hospital treating various patients; it is possible to manage critical patients without delays with precise considerations. These considerations aim to decrease infections and preserve equipment. The results suggest that in the presence of robust protocols and careful patient selection, major cancer surgeries may be performed safely.

Keywords: COVID-19; Free flap surgery; Head and Neck cancers; Surgical oncology

Introduction

The Coronavirus Disease 2019 (COVID-19) outbreak has inevitably led to a reassessment of cancer treatment paradigms. Several studies have indicated that cancer patients are both at higher risk for COVID-19 infection and severe adverse outcomes, due to their systemic immunosuppressive state caused by the malignancy and anticancer treatments [1-4]. However, the clinical stage at the beginning of the treatment remains one of the most important prognostic factors of cancer patient survival rate, and delay in treatment of cancer is associated with the development of metastases and higher stage of malignancy, resulting in a potential increase in preventable cancer death and treatment induced morbidity [5]. In other words, the risk of postponing necessary care for cancer patients might be more harmful than the COVID-19 infection. Perhaps one of the most paramount challenges in front of clinicians during COVID-19 pandemic is moving forward in cancer care, considering safe practices for both staff and patients, away from infection.

Tehran University of medical Sciences' Cancer Institute; the referral organization for cancer research and treatment in Iran, is a part of the Imam Khomeini Hospital Complex. This complex, as the largest educational medical center in Iran and as a referral center for complex and complicated patients, is a 235,519 square meters area consisting of 17 separate building, and has more than 300 faculty members, 4,000 administrative and clinical staff, and 1,300 active beds. Imam Khomeini Hospital Complex, is one of the first referral hospitals in the capital city of Tehran, Iran that was designated for the treatment of suspected or confirmed COVID-19 patients while at the same time, it was responsible for admitting many complex and complicated patients in the country. The hospital

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has been subjected to several modifications due to COVID-19 crisis, while attempting to maintain urgent diagnosis, therapy, and research. Some elective surgeries have also been rescheduled, postponed or even canceled with the goal of conserving limited resources, and protect patients and healthcare professionals. Treatment of cancer patients in a hospital complex where some of the buildings are dedicated totally to COVID-19 patients requires additional treatment considerations. Cancer Institute also had to change many routine operations to cope with the situation.

Advances in research, surgery, and multidisciplinary approaches do not appear to have a significant impact on the survival rates of Head and Neck Cancer (HNC), mostly due to the local recurrence of the malignancy [6,7]. Urgent radical resection and surrounding tissues with or without neck dissection is still the best treatment option available to prevent local recurrence and increase survival in patients with head and neck cancer [8,9]. The ultimate result after the satisfactory surgery would be large defects in the sensitive oral and facial area, and nowadays surgical free flaps have become the preferred reconstruction method to compensate for the severely impaired fundamental functions at this point [10]. It should be noted that any delay to perform this reconstructive surgery or failure of flap would significantly cause disruption of the resection site, which will interfere with the initiation of adjuvant treatment, which in turn worsens the prognosis and on the other hand affect patients' quality of life due to several issues including disabling and disfiguring nature, with symptoms such as discomfort and additional associated stigma.

Materials and Methods

Between January 1st, 2020 and the end of October 2020, 32 free flap reconstructive surgery have been performed on Head and Neck Cancer (HNC) patients in Tehran University of Medical Sciences Cancer Institute. A review has been carried out to find patients' details including demographics, disease characteristics and operation details. Data gathered include gender, age, comorbidities, diagnosis, cancer stage, operation detail, flap reconstruction characteristics, ventilation dependency duration, procedure duration, post-operative flap loss and COVID-related symptoms occurrence for 15 days.

Special hospital measures

Every one entering the hospital building would be checked for fever with thermometer at the hospital entrance. Detailed information was provided about sneeze and cough hygiene, hand hygiene as well as disinfectants' usage. Our hospital also restricted any visits except family members of patients or any other person at the request of the patient in need.

The nosocomial infection control team was appointed IKCH. Patients and staff were educated about the methods of prevention and, in fact, the methods of using health guidelines and protocols; In addition, wearing medical face masks became mandatory for all. The hospital strategy for diagnosis, treatment, and research on COVID-19 virus was planned and determined throughout the hospital.

Preoperative considerations

At our institute, patients are admitted to the surgery clinic for an initial visit; patients requiring surgery are divided to emergent (Danger of imminent death) or elective groups based on the systemic situation and possibility of death in case of delay in surgery; for example, in cases of imminent danger of airway obstruction or carotid blowout, we considered the patients' situation an emergency. Elective patients are referred to anesthesia and infectious disease clinics in

cancer institute for further evaluations.

Anesthetists' role in cancer patients' management were enhanced from reporting routine comorbidities to emphasizing the risk stratification in the COVID-19 era. In preoperative anesthesia clinic, the main focus was to distinguish unsuitable patients for surgeries because of their medical conditions before their face-to-face anesthetic, surgical and preoperative work-up. Evidence shows a significant mortality risk increase during preoperative phase in case of COVID-19 infection during this time backed up by the COVID surg Collaborative study showing a 23.8% mortality rate in those infected with COVID-19 in perioperative period. Therefore, careful patient selection supported by the anesthetic is essential [11,12].

In cancer institute, preoperative patient risk assessment was done by Fellowship in Immune-compromised host and transplant and data collection was done based on standard questionnaires (Figure 1, 2). Admission to the head and neck ward was only carried out if the patients' answers to all the questions in questionnaires 1 and 2 were "NO". On the other hand, If the patients' answers to any question in questionnaires 1 and 2 were "YES", negative COVID-19 test result would make them eligible for surgery; In these cases, if the patient's signs and symptoms (based on their answers in the questionnaire or the opinion of infectious disease specialist) did not match with the negative COVID-19 test, the patient would then undergo a chest CT scan. Either way, all patients who were candidates for hospitalization were asked to follow the isolation according to the standard international protocol. In case of positive PCR swab or active chest CT scan with positive answer to questionnaires, the cases were postponed and the patients were asked to self-isolate for a further 14 days and then re-evaluated. Patients, after going through these steps, would be admitted to the head and neck ward in the hospital where patient infections were strictly controlled in order to avoid staff-patient transmission.

In COVID-19 positive patients with emergency surgery, our institutional guidelines stated that surgery should be performed in a dedicated operatory room and the postoperative hospitalization should continue in COVID-reserved department.

Major case consenting process was carried out in which patients were informed of the increased mortality rate in case of infection during the perioperative period or false negative result in preadmission screening [11,12]. This conversation was then documented on the patient consent form.

A single visitor was allowed to meet the patients in the time interval between 03.00 pm and 04.00 pm with regards for safety distances and wearing PPE (Personal Protective Equipment). These actions were aimed to minimize the population flow in the department and to reduce the number of cross-infections.

Intraoperative considerations

Our major concern at this point was to ensure staff safety, cross-infection prevention and efficient use of resources. This was considered in both the provision of theatre space and the use of full Personal Protective Equipment (PPE). Interventions, use of electrocautery and other homeostatic devices are aerosol generating [13-15]. Therefore, staff and patient safety needed to be more precise. Due to this fact, theatre list capacity was reduced. Theatre planning should be revised too. Before patient's arrival, a pre-huddle (an opportunity for the team to look at the entire day's cases, identify potential problems, and set expectations prior to beginning the

Table 1: Patient's Data.

S. No	Sex	Age	Comorbidity	Diagnosis	Stage	Operation Details	Operation Duration	Ventilator Need	Flap Failure Up to Day 15 post-Op	COVID-19 Infection Up to Day 15 post-Op
1	M	42	Allergy	Mandible Osteosarcoma	T1N0	Mandibulectomy+ Fibular Free Flap	10 Hours	2 Days	No	No
2	M	72	HTN	Maxilla SCC Recurrence	T2N0	Maxillectomy+ Orbital Base Resection + Iliac Graft for Reconstruction of Orbit+ ALT Repair	10 Hours	1 Day	No	No
3	F	65	Hypothyroidism	Tongue SCC	T2N1	Glossectomy+ Lymph Node Dissection + ALT Repair	13 Hours	1 Day	Flap Necrosis Due to Jugular Vein Thrombosis	No
4	M	60	None	Mandible SCC	T4N0	Mandibulectomy+ Bilateral prophylactic Neck Dissection+ Fibular Free Flap	12 Hours	6 Days	No	No
5	F	59	HTN & CVA	Tongue SCC	T3N2	Mandibulectomy+ Bilateral Neck Dissection+ Subtotal Glossectomy+ ALT Flap	10 Hours	3 Days	No	No
6	M	61	HTN & IHD	Mandible SCC	T4N0	Mandibulectomy+ prophylactic Lymph Node Dissection+ Fibular Free Flap	10 Hours	1 Day	No	No
7	M	59	DM & HTN	Face (Parotid site) Merkel Cell Recurrence	T4N0	Parotidectomy+ Zygomatic Arch Resection+ALT Repair	10 Hours	1 Day	No	No
8	F	57	None	Tongue SCC	T2N0	Partial Glossectomy+ prophylactic Lymph Node Dissection+ ALT Repair	10 hours	1 Day	No	No
9	M	35	None	Tongue SCC	T3N1	Glossectomy+ floor of mouth Resection+ Lymph Node Dissection + ALT Repair	11 hours	1 day	No	No
10	M	30	None	Facial dermatofibrosarcoma protuberans	Stage 1	Facial Tumor Radical Resection+ALT Repair	10 hours	1 day	No	No
11	F	73	DM & IHD	floor of mouth SCC	T4N2	floor of mouth + Submandibular Gland Resection+Lymph Node Dissection+free Radial Forearm Flap Reconstruction	10 hours	2 days	No	No
12	M	47	None	Maxilla Sarcoma	T4bN0	Radical Maxillectomy+ Eye Enucleation+ Sphenoid Sinus Resection+ALT Flap Repair	9 hours	2 days	No	No
13	M	22	None	Mandible malignant Ameloblastoma	stage 2	Mandibulectomy+ Fibular Free Flap	9 hours	2 days	No	No
14	M	56	None	Tongue SCC Recurrence	T1N2	Total glossectomy+ Floor of Mouth Resection + neck dissection Mandibulectomy+Fibular Free Flap	12 hours	1 day	No	No
15	M	64	IHD	Orbital BCC Recurrence	T2N0	Mass Excision+ Zygomatic Arch Excision + ALT Flap Repair	11 hours	1 day	No	No
16	F	33	None	Mandible Osteosarcoma	T1N0G2 (stage 2a)	Mandibulectomy+ Fibular Free Flap	9 hours	1 day	No	No
17	F	53	HTN	Mandible SCC	T4N2	Mandibulectomy+ Lymph Node Dissection + Fibular Free Flap	9 hours	1 day	No	No

18	M	66	IHD	Maxillary SCC Recurrence	T4N0	Maxillectomy+ Partial Mandibulectomy+ Para-pharynx Resection+ALT Flap Repair	12 hours	1 day	No	No
19	M	70	HTN	Larynx SCC Recurrence	T4N2	laryngo esophagectomy and Right Para-pharynx Resection+neck Dissection+neopharynx Reconstruction with ALT Flap	11 hours	2 days	Necrotic	No
20	F	33	None	Submandibular Mucoepidermoid Carcinoma Recurrence	T2N0	Mandibulectomy+ floor of mouth and Submandibular Gland Resection+Fibular Free Flap	11 hours	1 day	No	No
21	M	56	None	Mandible SCC	T4N2	Mandibulectomy+ floor of mouth Resection + Lymph Node Dissection + Pectoral Flap+ALT Flap Repair	8 hours	1 day	No	No
22	F	29	None	Mandible Ameloblastoma	Stage 1	Mandibulectomy+ Fibular Free Flap	13 hours	1 day	Flap Necrosis in Day 5	No
23	M	63	None	Mandible Clear Cell carcinoma	T4N0	Mandibulectomy+ Superficial Parathyroidectomy + Fibular Free Flap	11 hours	1 day	No	No
24	M	21	None	Mandible Fibromyxoma	5 CM	Mandibulectomy+Fibular Free Flap	12 hours	1 day	No	No
25	F	33	None (lung metastasis)	Mandible osteo Sarcoma	T2N0M1	Mandibulectomy+ Partial Maxillectomy+ floor of tongue Resection + Pectoral Flap+Fibular Free Flap	9 hours	1 day	No	No
26	M	74	HTN	Mandible SCC	T3N2M0	Mandibulectomy +Neck Dissection Fibular Free Flap	14 hours	1 day	No	Day 8 CT scan Involvement
27	M	66	Nephrectomy	Maxillary SCC	T3N0M0	Maxillectomy+ ALT Flap Repair	12 hours	1 day	No	No
28	M	45	None	Buccal SCC (lip SCC recurrence)	T4N0M0	Total Mandibulectomy and lip resection+ALT Flap Repair	14 hours	1 day	No	No
29	F	24	Seizure	Mandible Ameloblastoma	Stage 1	Mandibulectomy+ Fibular Free Flap	10 hours	1 day	No	No
30	M	72	IHD	Lip SCC Recurrence	T4N0M0	Lip and Hard Palate Resection+ALT Flap Repair	9 hours	1 day	No	No
31	M	59	None	Lip SCC Recurrence	T2N0M0	Lip and Mandible Resection+prophylactic Bilateral Dissection+ Fibular Free Flap	12 hours	2 days	Flap Necrosis in Day 12	No
32	M	87	(HTN), (IHD)	Maxillary SCC	T4N0M0	Maxillectomy+ ALT Flap Repair	9 hours	2 days	No	No

day's cases) was used outside the operating room including all team members. All necessary equipment is rechecked so that circulating nurses do not have to leave the theatre. Full PPE is worn by the staff anytime an Aerosol Generating Procedure (AGP) is performed [16,17]. Another challenge for the team was working in full PPE. For this matter, considerations have been given to limit the potential time spent in full PPE and to minimize the number of staff present during AGPs. For this purpose, we divided the process of resection and reconstructive surgery into high-risk (highly probability of aerosol production) and low-risk (Low probability of aerosol production) procedures.

High risk: Tumor resection, neck dissection, flap harvesting.

Low risk: Flap in setting, microvascular anastomosis, Closing facial and neck incisions.

In high-risk situations, essential staff was only present to undertake the task and full PPE had to be worn.

In low-risk situations, full theatre team was present, standard surgical protective equipment was worn and an occlusive dressing was placed on mouth and nose.

Postoperative considerations

Key focus points in this stage are reduction of potential exposure to everyone in the hospital and conservation of PPE. Different measures have been considered for this matter. Staff members were required to change in to clean surgical scrubs to minimize the potential transmission of COVID-19 in addition to routine temperature checking in arrival.

Careful considerations have been made in order to reduce the number of healthcare staff in patients' bed side. Due to this fact, a lot of consults such as nutrition consults were done *via* telephone. Free flap transfer reconstruction patients were taken care of in a special unit managed by nursing staff expert in flap monitoring and tracheostomy care. We tried to extubate the patient in the operating

Have you experienced any of the following symptoms of COVID-19 within the last 48 hours?		
• Fever or chills	Yes	No
• Cough	Yes	No
• Shortness of breath or difficulty breathing	Yes	No
• Fatigue	Yes	No
• Muscle or body aches	Yes	No
• Headache	Yes	No
• New loss of taste or smell	Yes	No
• Sore throat	Yes	No
• Congestion or runny nose	Yes	No
• Nausea or vomiting	Yes	No
• Diarrhea	Yes	No

Figure 1: Standard COVID-19 infection screening questionnaire part 1.

Have you tested positive for COVID-19 in the past 10 days?	Yes	No
Are you currently awaiting results from a COVID-19 test?	Yes	No
Have you been diagnosed with COVID-19 by a licensed healthcare provider (for example, a doctor, nurse, pharmacist, or other) in the past 10 days?	Yes	No
Have you been told that you are suspected to have COVID-19 by a licensed healthcare provider in the past 10 days?	Yes	No

Figure 2: Standard COVID-19 infection screening questionnaire part 2.

room and not leave it to the ICU; In other words, patients were transferred to the ICU when they did not need ventilator support. Also, patients should wake up as soon as possible to be detached from the ventilator to reduce additional procedures such as suctioning and to also reduce the risk of pneumonia. If a tracheostomy is required, we used a double-walled tube tracheostomy as soon as possible to reduce the need for frequent suctioning. Patients should be moved out of the ICU as soon as possible in order to reduce potential exposure to COVID-19 patients receiving ICU level care.

For these reasons, in IKHC Cancer Institute, oncologic surgery requiring ICU level postoperative care and prolonged hospitalization was relocated to COVID-19 free institutions. By the time of departure, we provided patients with the necessary training about COVID-19 symptoms to contact us if needed.

Results

Patient data are presented in (Table 1). There were 32 patients (22 males and 10 females) who underwent surgery; the mean age was 52.7 years (range 21 to 87 years). Most seen comorbidities were Hypertension (HTN) (8 patient) and Ischemic Heart Disease (IHD) (6 patient). Squamous cell carcinoma of tongue, maxilla, and mandible were more frequent among those who underwent free flap reconstructive surgery. The average duration of the surgeries was 10.65 ± 2.38 h. 31.2% (10 patient) of undergoing operations were due to previous cancer recurrence. Partial or total mandibulectomy was performed on more than half of the patient population (18 patient) followed by reconstruction using a free fibula or Anterolateral Thigh Flap (ALT). We encountered total of 3 (9.4%) flap necrosis where all of them was reconstructed with local flap. Six patients were hospitalized for less than 15 days after surgery. Among total of 32, only one patient with stage T3N2M0 of squamous cell carcinoma of

mandible, who had undergone mandibulectomy and primary fibular free flap reconstruction was infected with COVID-19 between days 4 to 8 after surgery. This was one of 3 patients with flap necrosis. Mortality rate of surgery our population was 3.1%; one patient died due to myocardial infarction.

Discussion

Head and neck oncologic surgery should be scheduled timely due to increase in tumor volume within 1 to 3 months, potential of airway compromise and risk of severe bleeding and most importantly, delay in management may result in disease progression (the risk of becoming inoperable and distant metastasis occurrence) which will reduce the chance of survival in patients [18,19].

The COVID-19 global pandemic continues to present an enormous challenge to our healthcare system, which has witnessed major restructured changes to adapt and continue to provide safe care to patients. Major surgery involving the head and neck represents a high-risk field both to patients and involved healthcare professionals, with information regarding transmission and outcomes evolving on a daily basis.

As mentioned earlier Imam Khomeini Hospital complex is a referral center in Iran. Our hospital was one of the first referral hospitals in the capital city of Tehran, Iran that was designated for the treatment of suspected or confirmed COVID-19 patients while at the same time, it was responsible for admitting many complex and complicated patients in the country as it had done for many years. Also, In the time period of our study, none of the medical staff and patient were vaccinated. Despite the fact that our institute was responsible for complex and complicated patient care, our data shows that we were able to carry out our free flap surgeries with minimal changes and COVID-19 infections. Despite difficulties that can be encountered

in this period, with due precautions/regulations we showed that surgical activity can be carried out, even facing an increase of activity for Cancer Centers. Our Unit has tried not to reduce therapies of cancer patients and at the same time respect the procedures aimed to contain the COVID-19 infection. Such preventive procedures seem effective, not slowing down inpatient surgical activity nor impacting an increased demand for procedures.

We recommend close attention to clinical signs and symptoms and the combination of preoperative throat swabs at 72 h and 24 h and chest CT to enhance the quality of screening for COVID-19, improve planning of services and potentially maximize the efficiency of vital resources.

This pandemic will hopefully be over sooner or later but the lessons that we learn from it should be considered for future upcoming pandemics. Considering future pandemics, our institutional experience also suggests that in the presence of a robust perioperative protocol and careful patient selection, major surgery to the head and neck, including reconstruction with free tissue transfer may be performed safely. Thus, in the absence of obvious clinical indicators, clinicians may safely undertake their usual reconstructive flap option without the need to downgrade to a less complex alternative.

Author Contributions

1,2,4,7 Designed the Study. 3,4,5,6 Provided the Data. 2,7 Analyzed the Manuscript Data.

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