Free Jejunum Transfers in Cervical Esophagus Repair: A Series of 10 Cases

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Abstract: *Free jejunal transfer (FJT) is the preferred method for the reconstruction after cervical esophagectomy. We present 10 cases of FJT performed in our clinic within 1992. The mean (±SD) age of the patients was 55.8±12.5 years (min. 38, max. 68). Two (20%) patients were women, while eight (80%) were men. All patients were candidates for esophagus repair due to cancer. An intestinal section at sufficient length with a vascular arch was prepared. Appropriate artery and veins were made readyin the neck. The bowel was resected and placed according to the isoperistaltic direction. Suturing was done with a 3/0 absorptive material as two layers to the tongue root and distal esophagus, including the mucosa and serosa. The arterial anastomoses were performed to one common carotid (tip to side), six facial, one lingual, one superior thyroid, and one carotid artery (tip to tip). Venous anastomoses were performed on six facial, three external jugulars, and one internal jugular vein.To monitor the transfer of the cervical region, the jejunum was prepared as a large and small segment on the same pedicle. Successful results were achieved in nine patients . The median anoxic period was 84 minutes.*
We conclude that free jejunal flaps have advantages over pedicled flaps and gastric transposition. Theyare easy to apply, physiological, and ideal in the surgical reconstruction of the cervical esophagus.

I. Introduction

Among other conditions such as strictures or trauma, esophageal cancer is the most essential disease requiring esophagus repair. Its annual incidence is around 1:100,000 persons with variable geographical location and sex distributions[1].

Tumors originating from the larynx or the esophagus require mostly wide resections[2]. Thus, preservation of the pharyngo-esophageal continuity necessitates successful reconstructive procedures.Techniquessuch as a tube-shaped skin flap, stomach replacement, or colonic replacement have been employed for the reconstruction after resection[3].

Free jejunal transfer (FJT) is nowadays a commonly preferred method in the repair after cervical esophagectomy[4]. The technique started to be employed in the 1970s[5].Although other methods such as the anterolateral thigh flap were deemed as superior[6], FJT is considered safer and is practiced since many years[4,7].

Free tissue transfers are applied in our clinic since 1991. In this manuscript, we aimed to present the free jejunal transfer technique used after total laryngopharyngectomyand cervical esophagectomy.

II. Material And Methods

This descriptive case series study was carried out on patients of the department of Ear None and Throat (ENT) at Okmeydanı Teaching Hospital, Istanbul, Turkey,in1992. A total of 10 adult patients aged 38-68 years underwent free jejunum transfers in cervical esophagus repair during the given periods.

Study Design: Prospective case-series study. Study reporting was done per the CARE guideline[8].

Study Location: The study setting is a tertiary care teaching hospital with an 827-bed capacity. The hospital has 33 different medical disciplines and serves since 1971.

Study Duration: January to December1992.
Sample size: 10 patients.
Sample size calculation: No sample size calculation was done; all patients in the study period were included.
Subjects & selection method: All patients meeting the inclusion criteria were included in the study.

Inclusion criteria: Patients who underwent free jejunal transfer applied after total laryngopharyngectomy, who were above 18 years of age were included in the study. There was no sex restriction and also no exclusion criteria.

Patient information: The mean (±SD) age of the patients was 55.8±12.5 years (min. 38, max. 68). Two patients (20%) were women, while eight (80%) were men. All patients were candidates for esophagus repair due to some cancer. Localizations of the primary tumors were as follows: post-cricoid (n=1; 10%), secondary cancer after radiotherapy (n=3; 30%), piriform sinus (n=2; 20%), cervical esophagus (n=2; 20%), and posterior wall of the pharynx (n=2; 20%).

Statistical analysis

Data were presented as descriptive statistics using SPSS version 20 (SPSS Inc., Chicago, IL). The results were given as frequencies and percentages or mean and standard deviations, where applicable.

III. The Surgical Methods

The interventions were performed by two surgical teams. While the head and neck team was doing the resection, another group of general surgeons prepared the jejunum graft. For this purpose, the Treitz ligament was reached via classical laparotomy, finding the second jejunal loop. The mesenteric artery was observed using transillumination. An intestinal segment at sufficient length with a vascular arch was prepared according to microvascular techniques (Picture 1). Appropriate artery and veins were made ready in the neck. The bowel was resected by placing a sign on the distal part, and set according to the isoperistaltic direction.Suturing was done with a 3/0 absorptive material as two layers to the tongue root and distal esophagus, including the mucosa and serosa. The arterial anastomoses were performed to onecommon carotid (tip to side), six facial, one lingual, onesuperior thyroid, and one carotid artery (tip to tip). Venous anastomoses were performed on six facial veins, three external jugulars, and one internal jugular vein (Picture 2).

Picture no 1: Preparation of the free jejunum graft.

Picture no 2: Appearance of the graft site after anastomosis.
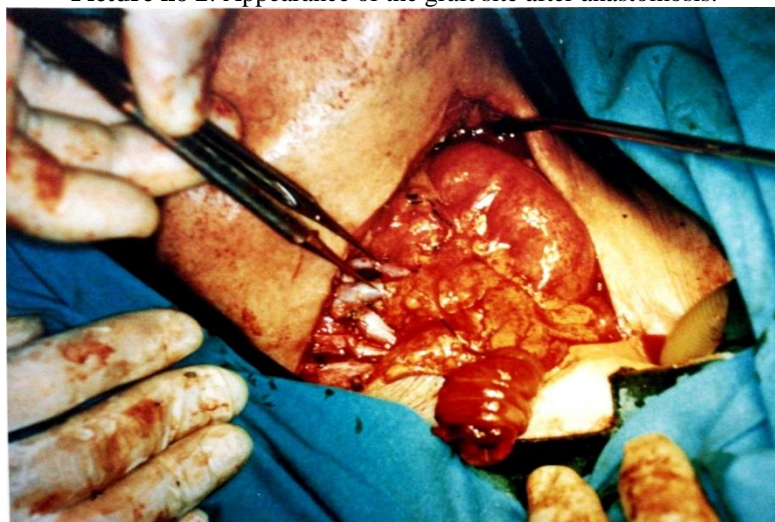
Anastomoses

Microvascular anastomoses were performed with 7/0 non-absorbing material under aZeiss Opmi-6 surgical microscope (Carl Zeiss Microscopy, Birkerød, Denmark). Systemic heparin and hypothermia were not administered. Heparin, papaverine, xylocaine, and saline were used locally in the anastomosis region. The anoxic period ranged from 65 to 115 minutes. To monitor the transfer of the cervical region, the jejunum was prepared as a large and small segment on the same pedicle. A three-cm-long distal part was fed with the same segmental mesenteric artery. The large jejunal portion was designed to be removed from the small segment neck incision while it was sutured to the cervical esophagus at the base of the tongue. The intestine part was opened on the antimesentericside. The mucosal surface was sutured outside, with the serosa remaining inside. The neck skin was covered with sterile drapes. The jejunum monitor was covered with wet dressings for seven days. Its blood supply, color, and peristalsis were observed to evaluate the perfusion of the flap. The monitor vessels were ligated and cut on day seven(Picture 3).

Picture no 3: Appearance of the monitor after skin closure.

Postoperative care

The patients were fed with a nasogastric catheter for 10 days. On the tenth day, oral feeding was started. Patients with poor general conditions were treated with a subclavian catheter using hyperalimentation one week before the operation.

Operative results

The duration of operation was between 6 and 9 hours (median 8 hours), and 11 free jejunum sections were used in 10 cases. Successful results were achieved in nine patients. The time interval between cutting the jejunal pedicle and functioning of the anastomosis was accepted as the"anoxic period." This time was 115 minutes in the first case and 65-80 minutes in the latter cases. The median anoxic period was 84 minutes.

Complications

Oral feeding was started in a female patient on the 10th day. The fistula exploration on the 25th day revealed a defect in the middle of the jejunum graft. Jejunal perfusion was healthy in the lower and upper halves. Due to the large size of the fistula, FJT reimplantation was performed. However, total necrosis was seen on the postoperative 5thday. Considering the general condition of the patient, a pharyngostoma was performed. The patient was discharged with the pharyngostoma because she did not accept another operation.

In our first case with primary laryngeal carcinoma, extensive necrosis was seen on the skin and neckafter FJT due to the former radiotherapy. There was widespread necrosis at the neck, outside the jejunum. After thorough debridement, the neck was closed with a pectoralis major myocutaneous flap.

Nevertheless, two months later, stenosis developed in the upper third of the jejunal graft, which was tried to be managed by balloon dilatation. Unable to succeed, the front wall of the jejunum was opened, and the anterior wall was repaired with a 3x4 cm full-thickness skin graft from the inguinal region. The pectoralis major was closed again. On the tenth day, aregular diet was started. Two months later, the stenosis recurred. This time, intermittent dilatations were performed with balloon esophageal dilator. At the 15[th]month, the patient was coming for regular follow-up without any problem.

In a case with pharyngeal posterior wall tumor, local recurrence was seen on the pedicle side two months after FJT. The jejunal sectionwithin the mass was removed with the vessel pedicle, and the patient underwent chemotherapy. The patient lives with the jejunal flap without a pedicle.

A passagegraph was ordered to all cases on the 10th day, and oral feeding was initiated depending on the results. Swallowing functions succeeded without any rehabilitation. Six patients underwent radiotherapy at the postoperative 3[rd]week.

In one case, a fistula was seen on the 10[th]day of postoperative radiotherapy. Nasogastric intubation was performed,and the radiotherapy was completed. During the follow-up, the fistula closed spontaneously, and the patient started oral nutrition.

In the last case, the carcinoma started from the oropharynx and extended above to the nasopharynx and below to the hypopharynx. The tumor attacked the right tonsil lodge and the right epiglottic plica. Via a transmandibular and transpalatal approach, posterior wall resection of the hypopharynx, oropharynx, and nasopharynx together with the prevertebral fascia was performed. The jejunum flap was opened at the antimesenteric side, followed by a repair of the posterior wall. Postoperative radiotherapy was completed successfully.

IV. Discussion

There are many reconstructive techniques performed after cervical esophageal resection. The pectoralis major myocutaneous (PMMC) pedicled flap, fasciocutaneous free flaps as the radial forearm and anterolateral thigh (ALT), and visceral free grafts like jejunum and gastro-omental are among the varieties[9].The multiplicity of applied techniques indicates an absence of consensus in the management of this ailment. Tumors of this region often deteriorate survival due to local expansions and distant metastases. In 1957, Morfit et al.[10]performed synthetic reconstruction of 11 cases by polyethylene tubes. The operative mortality was 9%, and the fistula rate was 45%. Seventy percent of the patients died within nine months.

Partial resections of the esophagus are highly debated. Esophageal tumors are claimed to be submucous and often multicentric.Because of these reasons, it is reliable to perform total esophagectomy followed by reconstruction[9,11].In our cases, the tumor was usually originating from the larynx or posterior pharyngeal wall. Therefore, we performed circumferential cervical esophageal resection. The resection limits were controlled with a frozen section, and none of the surgical specimens showed any suspicion in the resection margins.

Other techniques (especially pedicled flaps) besides gastric pull-ups were frequently used in our clinic. However, they had disadvantages such as distal anastomosis problems, difficulty in swallowing, challenges to shape the tube, postoperative stenosis, and salivary fistulas. On the other hand, the pectoralis major muscle is easy to prepare. Although the protection of the vascular nerve pack is a distinct advantage, it often causes swelling and cosmetic problems, and there are difficulties in preventing the torsion of the vascular pedicle. Also, the use of deltopectoral flaps starting with Bakamjian[12] has not reached the desired results.

The technique for total esophagectomy and stomach transposition, (i.e., gastric pull-ups) developed by Ong and Lee was modified and redefined by Harrison[13] in 1977. This method is still being implemented in many centers. Here, the left gastroepiploic artery and the left gastric artery are connected. The right gastroepiploic artery is preserved, and the stomach, duodenum, and esophagus are released to the level of the carina. The previously prepared pharingolarynxis pulled upward from the posterior mediastinum. The stomach is excised from the fundus and appropriately attached to the pharynx. This technique has several advantages, such as protection from multicentric tumor relapses and easy clearing of the paratracheal lymph nodes. Despite these advantages, gastric pull-ups do not appear physiological. In spite of the substantial decrease within decades, aortic stenosis, myocardial infarction, embolism, bronchopneumonia, mesenteric artery thrombosis, and graft necrosis are among the complications of this procedure[14].

There have been major developments in the repair of esophageal defects with free tissue transfers. Radial forearm, lateral thigh, jejunum, ileum, and gastric mucosa have been frequently used in the repair of this area by microvascular techniques. The pedicle of the forearm flap is easy to prepare[15]. However, morbidity in the donor area is high. Additionally, late stenosis is possible. On the other hand, the lateral thigh free flap has minimal donor site morbidity[16].It can be easily closed with primary suturing.

Jejunum seems to be suitable for the pharyngo-esophageal region with its ease in both preparation and ready tube shape for esophageal passage. Here, a high rate of success is achieved by applying proper techniques. Besides, stenosis is much less than in skin flaps. Hence, we consider this method more physiological than gastric pull-ups. It does not require multi-session interventions as in the pectoralis major myocutaneous flap. Additionally, due to continuing mucus activity, it is resistant to radiotherapy, no extra rehabilitation is required for swallowing, there are no problems such as regurgitation in gastric pull-ups, and in case of failure, reimplantation is possible without life-threatening conditions[2,3,11].

No method has been found to match the ideal definition of postoperative free flap monitoring[17,18]. Flap monitoring is performed by direct or indirect methods. Doppler or superficial heat probes are used for this purpose. Salvage rates in decreasing frequency of monitoring techniques are 85% with near-infrared spectroscopy, 81% with implantable Doppler, and 61.5% with conventional monitoring[17].There are several methods for direct observation of the flap. In appropriate cases, the flap is observed directly from the oropharynx. Laryngoscopy and flexible endoscopy are used for follow-up. However, the flap remains buried under the neck. This type of follow-up has some disadvantages. First, postoperative edema greatly disrupts the vision. Also, these procedures are inconvenient for the patient, continuous monitoring is not possible, and it is not possible to be administered by an assistant medical staff. For all these reasons, endoscopes are not practical and reliable.

For the first time, Katsaros[19] used a small jejunal segment as a monitor. He removed a two-cm-long jejunum from the large segment while retaining terminal branches, and moved it out of the skin. This segment of the neck was observed directly for five days. At day five, the veins were cut.In 1989, Urken et al.[20] Modified this technique. They cut the intestine from the anti-mesenteric side and revealed the mucosa. To prevent contamination of the neck, the serosa was sutured to the edges of the skin. They followed the flap for color, capillary filling, or by sticking a needle to the open jejunal mucosa.

We applied the Katsaros-technique in one case. We moved the small jejunum segment out of the incision and stitched it to the skin of the neck. With this method, only the mucosa and flap perfusion at the ends of the jejunum segment can be evaluated. The serosa of the jejunal flap remains outside. Thus, the exposure of the serosa causes drying, leading to a risk of infection. The mucosal surface to be used in the main follow-up remains inside. However, the mucosa remains wet with mucus activity even when it is outside, and it is more resistant to infections than the serosa. Therefore, we found it appropriate to reverse the outermost jejunum segment for monitor purposes in later cases. This practice is similar to the modification of Urken et al.[20]They reversed the intestine, closing both ends with staples, leaving the long side exposed, and suturing the serosa to the skin edges. In this technique, the long side of the monitor is exposed. The monitor is fed with the small terminal branches of the jejunum pedicle. The nutrition deteriorates as with distance from the main pedicle. Exposing the edges of the wound causes malnutrition in this area. A possibleinterruption in the perfusion may cause flap necrosis and lead to unnecessary exploration.

Therefore, instead of leaving the edges of the mucosa open as described by Urken, a different approach was used by stitching them together. The exposure of the mucosal surface of the jejunum facilitates monitoring of the perfusion. On the other hand, in the intestinal segment, which is cut from the antimesenteric side, suturing the edges together is mutually supportive of the nutrition ofboth edges. This is a cheap and objective technique. The monitor status can be observed continuously and easily by any health personnel.

Moreover, Katsaros and Urken cut the monitor on the 5th postoperative day. However, we observed that the edema in the jejunal transfers decreased after 7 days in both the main part and on the monitor. For this reason, we continued monitoring until the postoperative 7thday. In addition, it is claimed that the jejunum may get necrosed even after years if there is no neovascularization in the free jejunum after cutting the pedicle. In one of our cases, we did not observe necrosis after cutting the pedicle two months later.

Hester et al.[21] reported that they applied microvascular techniques withan ischemic time less than 90 minutes. Prophylactic antibiotics are suggested. The nasogastric tube is removed on day 7-10, followed by an examination of the passage with barium. If there is no fistula, oral feeding is started. Liquid food intake is initiated on the same day. Usually, on the 13thday, oral nutrition is started in jejunum transfers[22].

Complications in free jejunum interposition surgery are graft necrosis, stenosis, salivary fistula, and hypoparathyroidism[2,3]. Factors leading to necrosis in jejunum include venous thrombosis, infection, sepsis, and fistula. In cases of failure, repair with asecond jejunum graft (reimplant) is possible. We performed reimplantation in one case. Our complication rates are quite low compared to the literature[23]. In our case series, most complications were collected in one particular patient. According to our estimation, the general condition of the patient was the reason. We believe that the complications will decrease with the careful selection of patients.

Three patients had received previous radiotherapy. Although their neck vascularization was affected, anastomotic problems were not observed in these patients; neither was any fistula formation. Besides,

postoperative radiotherapy was performed in six patients. One patient had a fistula; spontaneous closure ensued on the 10[th]day, followed by successful oral feeding.

Stenosis is much less compared to other techniques in patients with free jejunal flap[24]. This complication is treated with intermittent dilatations. We experienced stenosis in one case. A balloon dilator was used initially every second day, then, after day 10, once-a-week, and monthly after one month.Postoperative radiotherapy did not cause stenosis. We considered that the continuation of mucus secretion prevented from the complications of radiotherapy.

Wide resection and total thyroidectomy are often required in esophagus tumors. Therefore, postoperative hypoparathyroidism may be encountered. We performed total thyroidectomy in one case, whereas six patients underwent hemithyroidectomy. The patient with total thyroidectomy received thyroid replacement therapy and calcium supplementation.

The swallowing rehabilitation was straightforward because tongue movements were normal, and, thus, the swallowing function was quite good in these patients. Besides, the jejunum is compatible with lower esophageal motility and lower esophageal sphincter. For these reasons, no reflux or regurgitation was observed.

McConnel et al.[25]achieved 85% success in free jejunum transfers for cervical esophagus repair. Coleman[26] reported the success of 86.5% in 111 free jejunal flaps. Wang et al.[27] reported successful results in nine out of 10 cases (90%). Also, we have achieved successful results in nineout of 10 cases (90%). We did not encounter any early or late donor site morbidities in any of our cases.

V. Conclusion

Cervical esophageal reconstruction is one of the most challenging areas of head and neck surgery. There are many different techniques applied in the restoration of this region. Although pedicled flaps showed high morbidity, successful applications were performed. The reconstruction with gastric transpositions by total esophagectomy appears to be more oncologic with the broader range of resection margins and easy paratracheal lymph node dissections. This technique, which shows high mortality and morbidity, does not seem physiological in our opinion. We believe that partial resections will be sufficientin larynx or hypopharynx carcinomas with spread to the cervical esophagus. We consider the frozen section as enough in deciding on the resection boundaries of tumors confined to the cervical region. We conclude that free jejunal flaps have advantages over pedicled ones and gastric transposition. It is an essential advantage for patients to start oral nutrition and receive radiotherapy in the early period. In addition, donor site morbidity is low. Compared to other techniques, the relatively long operation time is getting shorter with the success of the teams and the increased coordination. For the post-operative follow-up of the jejunum, we advise the monitoring that we have modified from the Urken technique. Free jejunal flaps are easy to apply, physiological, and ideal in the surgical reconstruction of the cervical esophagus.

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