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Robotically Assisted Omentum Flap Harvest: A Novel, Minimally Invasive Approach for Vascularized Lymph Node Transfer

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Background: The omentum provides abundant lymphatic tissue with reliable vascular anatomy, representing an ideal donor for vascularized lymph node transfer without risk for donor site lymphedema. We describe a novel, robotically assisted approach for omental flap harvest.
Methods: All patients undergoing robotically assisted omentum harvest for vascularized lymph node transfer from 2017 to 2019 were identified. Patient demographics, intraoperative variables, and postoperative outcomes were reviewed.
Results: Five patients underwent robotically assisted omentum flap harvest for vascularized lymph node transfer. The average patient age and body mass index were 51.2 years and 29.80 kg/m^2, respectively. Indications for lymph node transfer were upper extremity lymphedema following mastectomy, radiation, and lymphadenectomy (60.0%); congenital unilateral lower extremity lymphedema (20.0%); and bilateral lower extremity/scrotal lymphedema following partial penectomy and bilateral inguinal/pelvic lymphadenectomy (20.0%). Four patients (80.0%) underwent standard robotic harvest, whereas 1 patient underwent single-port robotic harvest. The average number of port sites was 4.4. All patients underwent omentum flap transfer to 2 sites; in 2 cases, the flap was conjoined, and in 3 cases, the flap was segmented. The average overall operative time was 9:19. The average inpatient hospitalization was 5.2 days. Two patients experienced cellulitis, which is resolved with oral antibiotics. There were no major complications. All patients reported subjective improvement in swelling and softness of the affected extremity. The average follow-up was 8.8 months.
Conclusions: Robotically assisted omental harvest for vascularized lymph node transfer is a novel, safe, and viable minimally invasive approach offering improved intra-abdominal visibility and maneuverability for flap dissection. *(Plast Reconstr Surg Glob Open 2020;8:e2505; doi: 10.1097/GOX.0000000000002505; Published online 24 April 2020.)*

INTRODUCTION

The omentum is an attractive donor for vascularized lymph node transfer (VLNT), given its abundant lymphatic tissue, broad surface area, reliable vascularity, and mitigated risk of donor site lymphedema.[1–6] Further, the omentum provides sufficient tissue for simultaneous orthotopic and heterotopic transfer in a conjoined or segmented fashion via its dual pedicle supply.[1,7] Disadvantages of the omentum flap include the risk of intra-abdominal complications such as pancreatitis and ileus, along with a potential need for a laparotomy, which can be mitigated via minimally invasive approaches.[1] We, therefore, describe a novel approach for robotically assisted omentum harvest for VLNT in the treatment of lymphedema.

METHODS

All patients with lymphedema undergoing robotic-assisted omentum harvest for VLNT from 2017 to 2019

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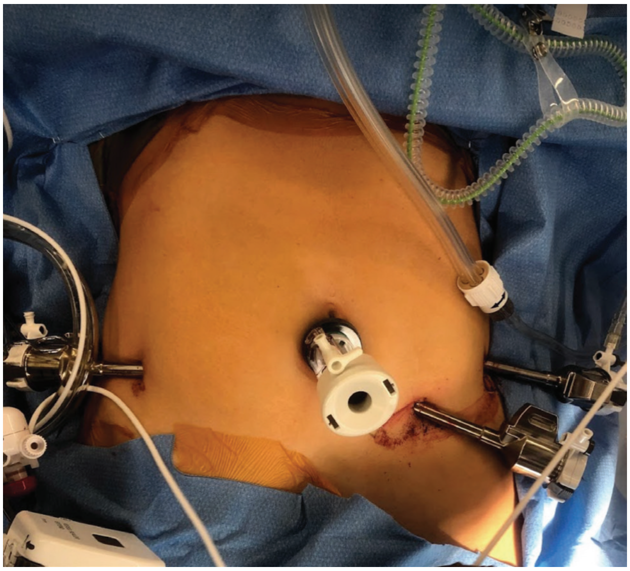

Fig. 1. Port site placement for standard robotically assisted approach for omentum harvest.

were identified. Patient demographics, intraoperative variables, and outcomes were reviewed.

TECHNIQUE

The Intuitive Xi robot (Intuitive Surgical, Sunnyvale, Calif.) is used for multiport robotic harvest. First, an 1.5-cm umbilical incision is made. A 10-mm balloon tip trocar is placed, and the abdomen is insufflated. The robotic camera is introduced, and two 8-mm ports are placed on the left. A 5-mm port is placed lateral to the umbilicus on the right, and an additional port is placed lateral to this assistant port (Fig. 1).

The Intuitive SP robot (Intuitive Surgical, Sunnyvale, Calif.) is used for a modified single-port approach; a 2.7-cm vertical incision through the fascia below the umbilicus is made. The single-port trocar is placed intraperitoneally under direct visualization. The single-port cannula is then

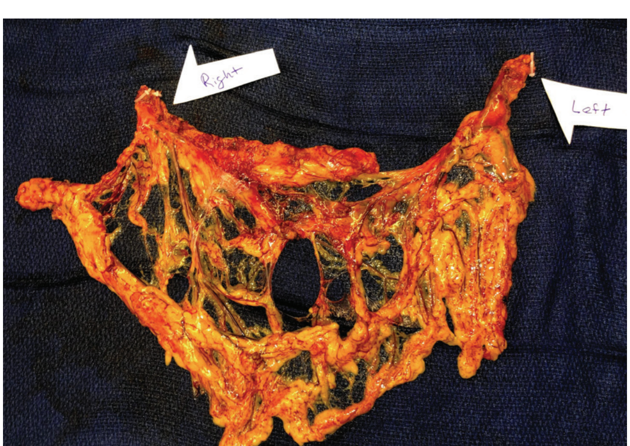

Fig. 2. Omentum shown after robotically assisted harvest and retrieval through the 10-mm trocar. The right and left gastroepiploic pedicles are labeled.

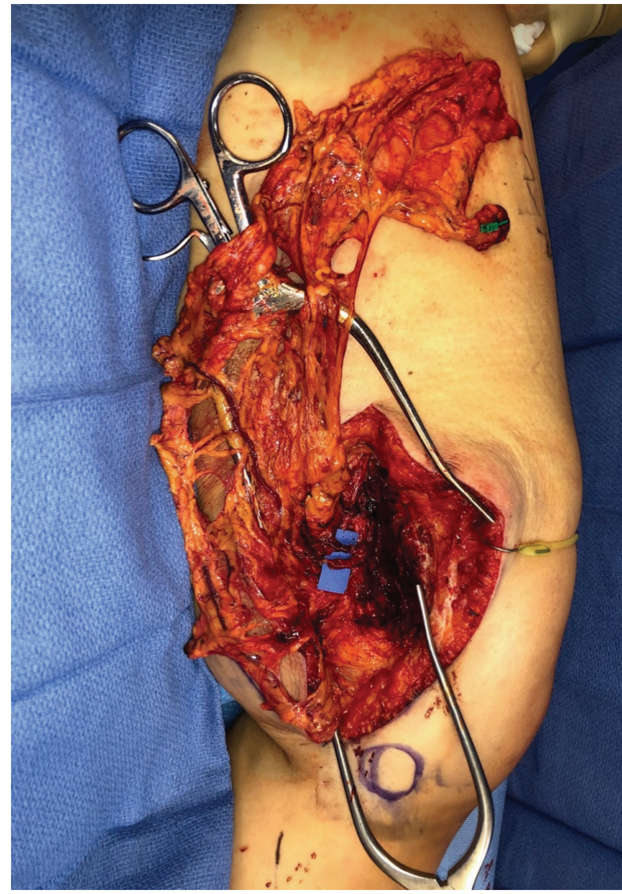

Fig. 3. Omentum perfused after anastomosis of the right gastroepiploic vessels to the descending geniculate system before segmentation of the flap for anastomosis at the second, heterotopic recipient site.

placed, and the abdomen is insufflated. A 5-mm assistant port is placed at the left lower quadrant.

Indocyanine green is locally injected into the distal omentum and examined under fluorescent angiography via the robot to identify lymph node clusters. The omentum is dissected from the transverse colon and greater curvature of the stomach while the right and left gastroepiploic arteries are isolated. Before flap harvest, the appropriate recipient site(s) are prepared. The omentum is harvested, placed in a large endobag, and retrieved (Fig. 2).

After microsurgical anastomosis at one recipient site, the flap is examined clinically and under fluorescent angiography. In cases of planned conjoined omentum transfer, the flap is tunneled subcutaneously to the second recipient site and a second set of microsurgical anastomoses are performed. In cases of segmented omentum flap transfers, the omentum is split based on the nodal distribution and/or watershed regions identified under fluorescent angiography followed by anastomosis at the second recipient site. Lipectomy and skin grafting to reduce tension from primary closure are performed as needed (Fig. 3and 4).

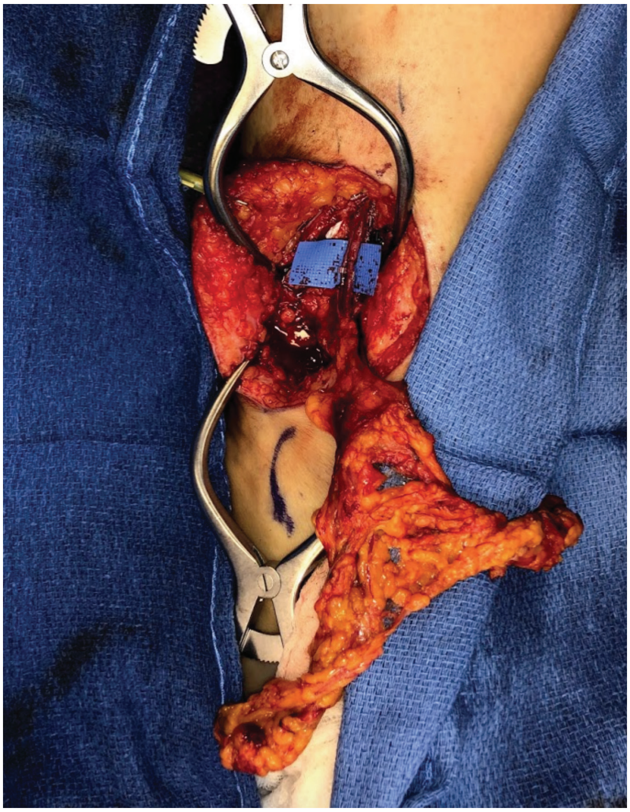

Fig. 4. Split omentum flap placed heterotopically with anastomosis performed end-to-end to the posterior tibial vessels.

RESULTS

Five patients underwent robotically assisted omentum flap harvest for VLNT. Average patient age and body mass index were 51.2 years and 29.80 kg/m^2, respectively. Eighty percent of patients were female.

Indications for lymph node transfer were upper extremity lymphedema following mastectomy, radiation, and lymphadenectomy in the treatment of breast cancer in 3 patients (60.0%), congenital unilateral lower extremity lymphedema in 1 patient (20.0%), and bilateral lower extremity/scrotal lymphedema following partial penectomy and bilateral inguinal/pelvic lymphadenectomy in 1 patient (20.0%). The average duration of swelling was 6.4 years; 1 patient experienced recurrent cellulitis. One patient had undergone unsuccessful lymphovenous bypass. Four patients (80.0%) underwent preoperative imaging [magnetic resonance lymphangiography (4), lymphoscintigraphy (1)], demonstrating the lack of functioning lymph nodes with delayed lymphatic transit.

Four patients (80.0%) underwent standard robotic harvest, whereas 1 patient underwent modified single-port robotic harvest. The average number of port sites was 4.4. One patient required a 5-cm upper midline laparotomy incision to retrieve the omentum. All patients underwent omentum flap transfer to 2 sites; in 2 cases, the flap was conjoined, and in 3 cases, the flap was segmented. In all upper extremity cases, anastomoses were performed in the axilla to the thoracodorsal vessels and in the upper arm to the radial recurrent vessels. In one lower extremity, one flap was transferred to the descending genicular vessels in the medial thigh, whereas one was transferred end-to-end to the posterior tibial vessels at the ankle. In the other lower extremity case, a conjoined omentum flap was transferred to the bilateral groins and perineum, with one pedicle anastomosed to the deep inferior epigastric vessels and a second vein anastomosed contralaterally. Three patients (60.0%) underwent concomitant scar release, whereas 2 patients (40.0%) each underwent lipectomy and skin grafting. The average overall operative time was 9:19.

The average inpatient hospitalization was 5.2 days. Two patients experienced cellulitis, which is resolved with oral antibiotics. There were no major complications. All patients reported subjective improvement in swelling and softness. The average follow-up was 8.8 months.

DISCUSSION

VLNT is effective in the treatment of advanced stage lymphedema through mechanisms that continue to be delineated.[8–12] The omentum represents an ideal donor for VLNT; however, its utilization has been limited by concerns for complications related to intra-abdominal manipulation and the need for laparotomy.[1–7] Laparoscopic techniques for omental flap harvest have been described but remain marred by imperfect visualization and ability for fine dissection.[2,3,13–16] Meanwhile, robotic harvest offers unique advantages.[17–23] Several studies demonstrate a shorter hospital stay, less estimated blood loss, and decreased postoperative complications in intra-abdominal procedures utilizing the surgical robot.[24–26] Further, the three dimensional/high definition scope in robotic surgery has been shown to enhance terrain visualization and improve depth perception when compared to laparoscopy.[23] Although one case of robotic omental flap harvest for wound coverage has been described, the overall experience is lacking.[17–23]

We, thus, describe our techniques for robotically assisted omentum harvest for VLNT. Robotically assisted harvest provides unparalleled visualization of the omentum for fine dissection and isolation of the pedicles while minimizing risk of damage to adjacent intra-abdominal structures due to tremor filtration and feedback, allowing better surgical ergonomy. Further, current robotic equipment offers fluorescent optics that can be utilized for identification of vascular and lymph node patterns. These represent unique advantages over laparoscopic harvest techniques, in which dissection is not as refined or precise, risking detriment to the tissues.[13–16] Intra-abdominal access is limited to[2–5] small ports, which generally permit removal of the omentum through a trocar, although in one case, a small laparotomy was necessary. Notably, length of hospital stay was 4–5 days for treating all patients except for the patient undergoing transfer to the bilateral groins for penoscrotal/bilateral lower extremity lymphedema. This patient stayed in the hospital for 7 days because his mobility was slowly increased to minimize stress on the pedicles. Although limited by a small sample size, early outcomes are promising.[1–6] Although studies comparing robotic- versus laparoscopically assisted surgery in other specialties have demonstrated longer operative times with improved equivalent morbidity, comparative analyses of outcomes, complications including small bowel obstruction, and costs between robotically assisted and other harvest methods for omental VLNT are future areas of investigation.[27–29] (**See Video [online],** which displays robotic harvest of omentum flap for VLNT in treatment of lymphedema).

Robotically assisted omentum harvest represents a novel and viable minimally invasive approach in patients undergoing VLNT in the treatment of refractory lymphedema.

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