

described in the experimental section. Figure 7 shows the position of the cannulas and laparoscopic instruments. Using a 25-mm cannula, the omentum was identified and exteriorized by making a 8-cm incision in the right upper quadrant. The omentum was mobilized into the incision and the greater curvature of the stomach identified (Fig. 8). The right gastro-epiploic vessels were identified and four branches between the greater curvature of the stomach and the main vessels were ligated and divided. A large segment of omentum was isolated based on the gastro-epiploic vessels. The omentum was wrapped with warm moist saline pads until the donor site and vessels were ready for transfer. At that time the proximal part of the gastro-epiploic artery and vein were ligated and divided, and the vascularized pedicle of omentum was transferred to the reconstructive team for revascularization. The stomach and omentum were returned to the abdomen and laparoscopically inspected for bleeding. The right upper quadrant incision was closed with a running absorbable suture and the skin closed with staples. The laparoscope was removed and the umbilical incision closed with a single absorbable suture.

The reconstructive team debrided the wound and isolated the popliteal artery and vein. An end-to-side microvascular anastomosis was performed using 9-0 nonabsorbable sutures. The omental arteries had a doppler signal as well as palpable pulses. The omentum was secured to the edges of the defect with absorbable sutures and inset into the wound (Fig. 9). A dressing was applied and the extremity was immobilized with a posterior splint. A window was made in the dressings to monitor the viability of the omentum by visual checks and Doppler signal. On the third postoperative day a skin graft was placed on the granulating omental bed.

The patient had a nasogastric tube removed the day of operation and was on a regular diet on the second postoperative day. The skin graft healed well and he was discharged on the eighth postoperative day. The most recent follow-up was in November, 1992, and at 10 months the area was healed and he was ambulatory (Fig. 10).

## DISCUSSION

The use of the omentum in reconstructive surgery was first described by Jobet and Lambell in 1926<sup>3</sup> for the treatment of intestinal wounds. Durmond and Morsion used the omentum as a free graft in the treatment of ascites in 1914,<sup>3</sup> after excising a large thoracic tumor. Kiricuta<sup>3</sup> popularized the use of the omentum as a pedicle flap. The omental free flap was first described by McLean and Buncke,<sup>4</sup> and Harii.<sup>5</sup> Jurkiewicz described the use of omentum for chest wall reconstruction.<sup>6</sup> Since

the omentum provides a large amount of vascularized tissue, it has been used not only as a pedicle flap, but also as a free flap in the management of difficult wounds.

This article reports experimental and clinical evidence that the omentum can be successfully harvested as a free flap using laparoscopic assistance. Gross and microscopic studies document the viability of this approach. The abdominal incision required to perform this operation was minimal and the procedure was well-tolerated by the animals and the patient. If the omentum is not needed in its entirety, one can custom design the free flap. The long, large vessels can simplify the microanastomosis in difficult cases and avoid the use of vein grafts.

The use of minimally invasive surgery is gaining large popularity throughout the surgical world. Although more clinical experience and follow-up is needed to reach definitive conclusions, we believe that our technique of harvesting the omental free flap with the laparoscope may prove to be of major clinical significance and very useful for reconstructive surgery with less morbidity.

## Acknowledgments

The authors thank Cheryl Patterson, PA-C, Donna Scott, and Patricia Mills, RBP for assistance with the manuscript.

## References

1. Dubois F, Icard P, Berthelot G, Levard H. Coelioscopic cholecystectomy. Preliminary report of thirty-six cases. *Ann Surg* 1990; 211:60-62.
2. Reddick EJ, Olsen D, Daniell J, et al. Laparoscopic laser cholecystectomy. *Laser Med Surg News Adv* 1989; 38-40.
3. Kiricuta I. Use of the omentum in plastic surgery in Rumania, Ed. Medicala 1980.
4. McLean DH, Buncke HJ, Jr. Autotransplant of omentum to a large scalp defect with microsurgical revascularization. *Plast Reconstr Surg* 1972; 49:268-274.
5. Harii K, Atmator S. Use of the gastroepiploic vessels as recipient or donor vessels in the free transfer of composite flaps by microvascular anastomosis. *Plast Reconstr Surg* 1973; 52:547-548.
6. Jurkiewicz JM, Arnold GP. The omentum: account of its use in the reconstruction of a chest wall. *Ann Surg* 1977; 185:548-554.

## Discussion

DR. MAURICE J. JURKIEWICZ (Atlanta, Georgia): I would agree with all of the conclusions of Dr. Gadacz, that is, the use of the omentum provides broad coverage and it is a good flap to use. It has a long pedicle and therefore it's easy to use. Vein grafts are not required as an interposition in order to get an appropriate arterial conduit or venous return. Our experience with the omentum dates back to 1973. At the end of 1990 we had accumulated 72 instances of the use of the omentum. We began originally with its use as a transposition flap to cover chest wall defects. Primarily these were osteoradionecrosis following treatment for carcinoma of the breast. We subsequently extended its use to treatment of mediastinal wound infections. The omentum is my first choice for patients with growth dis-

turbances of the head and neck region primarily around the orbit following treatment of neoplasms in children, and secondly, in patients who have growth disturbance as the result of hemifacial microsomia or hemifacial atrophy. In our experience in the approach to harvesting the omentum, we've had certain complications. We would disagree that prolonged ileus is a problem, at least, by traditional standards. Understandably, the laparoscopic approach to intraabdominal surgery has shifted the curve of the duration of ileus to the left. Therefore, I'm not sure where the standard is. But by ordinary standards, only one patient had prolonged ileus. It was a transposition flap there was an element of gastric outlet obstruction that lasted for about 2 or 3 days. There were three wound infections in the total cohort of patients at the donor site. In each instance, these were associated with individuals who had a necrotizing wound on the chest wall. There were two hernias in the transposition flap procedure. There were three deaths in the series, all in patients who had rampant mediastinitis. The patients died of cardiac failure or multiple organ failure. The comments of Dr. Talman are totally appropriate. Clearly, the laparoscopic approach at the present time is an experimental procedure in the harvest of the omentum. Dr. Talman did outline, I think, certain approaches that would be entirely appropriate, that is, a prospective randomized study after suitable laboratory work to determine whether, in fact, the harvest of the omentum through this approach would be any better than its harvest with an ordinary laparotomy. I say that because this flap is used to cover a large defect, and therefore to get it out of the abdomen, one has to enlarge the wound. In the experimental animals and in man, the authors enlarged the wound to 8 cm, quite adequate for an open approach.

**DR. WILLIAM MEYERS** (Durham, North Carolina): Considering Dr. Talman's admonition, this seems to be a clever application of laparoscopy to a subspecialty by a wise surgeon. I'd like to ask Dr. Gadacz if he could really speculate on the use of laparoscopic and other endosurgical techniques in the subspecialties. First of all, could we take advantage of his imagination about where else this is going to be applied, for example, the third ventricle by the neurosurgeons and other plastic surgical procedures and by the orthopedists outside of the joint? And the second question is, is there going to be a learning curve among the subspecialists, for example, a colon injury with the omental procedure that you described, insufflation of the third ventricle, et cetera?

**DR. RENATO SALTZ** (Closing Discussion): First, we would to thank you very much for accepting this paper and the honor to present it. We would like to thank you, Dr. Jurkiewicz, for your comments, and we agree with you. This is a preliminary approach in the use of the omentum and will need further cases to completely evaluate this new technique. I would like to thank Dr. Meyers for his comments. And, yes, Dr. Gadacz has extended this technique to the other subspecialties at the Medical College of Georgia. He has done some work with the neurosurgeons placing lumbar peritoneal shunts and also with thoracic surgery. We feel that the use of minimally invasive surgery continues to gain large popularity, and although more clinical experience and follow-up are needed to reach definitive conclusions, we feel that our technique of harvesting the omental free flap may prove to be of major clinical significance and very useful for reconstructive surgery.