The Evolving Role of Staging Laparoscopy in the Treatment of Colorectal Hepatic Metastasis

Klaus Thaler, MD; Shalini Kanneganti, MD; Yashohdan Khajanchee, MD; Charlyn Wilson, RN; Lee Swanstrom, MD; Paul D. Hansen, MD

Hypothesis: Laparoscopy is an increasingly important tool in the staging and treatment of hepatic malignancies. This study evaluates the effect of staging laparoscopy (SL) using intraoperative ultrasonography (IOUS) on the regional treatment of isolated hepatic colorectal metastasis.

Design: Analytic cohort study.

Setting: Tertiary care center.

Patients: Consecutive patients who have a colorectal metastasis confined to the liver and selected for surgical regional treatment.

Interventions: All patients underwent preoperative evaluation followed by SL/IOUS. Operative plans were based on preoperative imaging and were either carried out or altered intraoperatively according to SL/IOUS findings.

Main Outcome Measure: Effect of SL/IOUS on surgical management.

Results: Between September 1996 and May 2004 one hundred fifty-two SL/IOUSs were performed in 136 patients (77 males and 59 females), who had a mean (SD) age of 63 (11) years. Data sets were complete in 138 events. All patients had isolated hepatic disease as defined by preoperative computed tomography in 152 (100%) and positron emission tomography in 107 (70%). Staging laparoscopy/IOUS identified surgically untreatable disease in 34 events (25%) because of peritoneal metastases (n=15), nodal involvement (n=11), diffuse hepatic disease (n=5), no identifiable disease (n=2), and untreated disease (n=1). Laparoscopic treatment events included radiofrequency ablations (n=78), hepatic artery pump implantations (n=40), resections (n=26), and combined procedures (n=37). Overall, SL/IOUS changed the treatment plan in 66 (48%) of 138 of events. This includes 32 (23%) of 138 events in which SL/IOUS findings significantly altered the actual procedure performed relative to the preoperative plan. Three minor complications occurred in the SL/IOUS-only group with a mean (SD) hospital stay of 1.3 (1) days.

Conclusion: In the regional management of isolated colorectal hepatic metastasis, SL/IOUS avoids unnecessary laparotomies and influences definitive surgical intervention in a substantial proportion of patients.

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Hepatic metastases from colorectal cancer are a leading cause of morbidity and mortality in the Western world. In one third of these patients, metastatic disease is confined to the liver and potentially amenable to curative treatment. Resection remains the gold standard of regional treatment with means of 5-year survival rates of 28% to 58% in large prospective series. Traditionally, only 60% to 80% of patients who are operated on with the intent of a resection for cure actually have a resection. In addition, many patients who might be candidate for a potential resection are never offered the option because of the perceived morbidity of traditional open exploratory surgery and resection. Preoperative determination of the best surgical treatment has always been a challenge. This remains true even as imaging studies have continued to improve. Surgical exploration continues to be the final determinant of the patient’s true stage as well as the access for application of new therapeutic options. The ability to accurately stage metastatic colorectal cancers and to offer a continuum of surgical treatments laparoscopically has benefited patients greatly by minimizing their recovery time and treatment morbidity. Laparoscopy and other innovative forms of therapy are increasingly offered to ex-
tend treatment options to a larger segment of the potential patient pool, to reduce procedural morbidity, and to improve overall outcomes.

Radiofrequency ablation (RFA) is a newer method of liver tumor destruction, using electrical energy to destroy tumors while leaving the surrounding parenchyma intact. Radiofrequency ablation has not yet been shown to be equivalent to surgical resection, although it may be a useful adjunct to resection in patients with bilobar disease or as an alternative to resection in patients who are otherwise unacceptable candidates for resection.4 Hepatic artery implantable pumps (HAIPs) have been beneficial in providing regional chemotherapy in both the adjuvant and palliative settings.5 Recent studies have demonstrated the safety and utility of laparoscopic approaches to both RFA and HAIP treatment.6,7

Staging laparoscopy has been shown to be superior to preoperative imaging with spiral contrast computed tomography (CT) in detecting occult metastases from hepatic malignancies.8-12 Together with intraoperative ultrasonography (US), laparoscopy can save up to 67% of patients with primary and secondary hepatic malignancies from the morbidity of unnecessary laparotomies.13 Another recent study specifically reported a reduction in unnecessary laparotomy rates in patients with colorectal hepatic metastases who were initially thought to be candidates for resection.14 The yield of staging laparoscopy (SL) was greatest in patients with a high clinical risk score (CRS) as defined by Fong et al.1

With an increasing number of options available to the surgeon, especially lower impact or minimally invasive procedures, a broader spectrum of patients will be taken to the operating room (OR) for exploratory surgery and treatment. Because this is expanding the role of laparoscopy, we have tested the hypothesis that staging laparoscopy using intraoperative ultrasonography (SL/IOUS) has a significant effect both on identifying surgically untreatable patients and in selecting the optimal treatment strategy.

Figure 1. Schema showing selection process for the regional treatment approach to patients with potentially curable hepatic metastases from colorectal cancer. CRS indicates clinical risk score; HAIP, hepatic artery implantable pump; and RFA, radiofrequency ablation.

The study population was a consecutive series of patients with colorectal hepatic metastases presenting to a tertiary care referral center. Prospectively collected data were analyzed retrospectively. All patients were candidates for regional surgical treatment as documented by preoperative imaging and were taken to the OR for SL/IOUS. A treatment plan was developed based on preoperative imaging and was recorded, as was the actual procedure that was performed following an SL/IOUS. Treatment options represented a continuum ranging from anatomic resection, resection plus RFA, RFA alone, RFA with an HAIP, an HAIP alone, or no treatment. All procedures were performed by a single surgeon, fellowship-trained in hepatobiliary and minimally invasive surgery (P.D.H.).

The serum carcinoembryonic antigen level, plain chest radiography, and spiral contrast CT of the abdomen were obtained in every patient of the study cohort within 4 weeks of surgery. Chest CT was added as appropriate. Positron emission tomography (PET) was unavailable during the first third of the study. Positron emission tomography was used routinely in conjunction with CT once it became available. Based on preoperative imaging, a surgical treatment plan was formulated and documented.

Staging laparoscopy was performed with 2 or 3 access ports in the upper abdomen. Limited adhesiolysis was added as needed to enable exploration of the peritoneal cavity. A more extensive adhesiolysis of the porta hepatis was used to obtain adequate access for US examination of this area. Biopsy specimens were obtained of suspicious peritoneal lesions. Intraoperative US (flexible probe, 5-7.5 MHz; BK Medical, Herlev, Denmark) was used prior to treatment in all cases. Scanning following a standardized protocol including all 8 liver segments, the porta hepatis, and the paraceliac nodal bed. Intrahepatic tumors were evaluated for size, location, and relationship to hilar structures. New hepatic or extrahepatic disease found during SL/IOUS was confirmed by intraoperative biopsy specimens. Lymph nodes that were round, heterogeneous, or displacing adjacent tissues were excised and sent for immediate pathologic sectioning. Extrahepatic or nodal disease typically precluded therapeutic intervention. Three patients with limited, single-focus extrahepatic disease were treated.

The final plan for treatment was always based on SL/IOUS data. Figure 1 shows our selection protocol for treatment of patients with hepatic colorectal metastases. Patients were considered unresectable if clear margins could not be achieved or if the functional liver remnant was incompatible with survival. Relative contraindications for resection were poor general medical condition or a high CRS as calculated by Fong et al.3 The CRS contains 5 clinical variables shown to be independent predictors of survival in patients undergoing hepatic resection for colorectal metastases. One point is assigned to each of the following with the CRS as the sum: lymph node-positive primary tumor, disease-free interval between primary tumor diagnosis and liver metastases less than 12 months, more than 1 hepatic lesion, largest diameter of the hepatic lesion more than 5 cm, and a serum carcinoembryonic antigen level exceeding 200 ng/mL.

Relative contraindications for RFA were tumor size greater than 4 cm and proximity to primary biliary structures. If all disease was eradicated by resection and/or RFA, the procedure was considered curative. Resection and RFA were only undertaken with curative intent; debulking was never a treatment goal. Hepatic arterial infusion pumps were implanted as adjuncts to resection and/or RFA if more than one lesion was treated or as the only palliative measure if lesions were not resected or ablated (Figure 1).
A CT scan was obtained 1 week after RFA to give a new baseline regarding the size, location, and appearance of the ablation. Patients were then followed up postoperatively with CT scans and clinical visits every 3 months for the first year, then every 6 months thereafter. Patients underwent repeated SL/IOUS when follow-up imaging detected treatable new or recurrent hepatic tumors.

Comparison between the documented preoperative plan and the actual final procedure performed was tabulated. Only intended treatment events, where complete data were available, were the subject for subsequent outcome analysis. Data are shown as means (SDs). The yield of SL/IOUS on operative outcome was analyzed for the entire study group and stratified into subgroups regarding (1) the ability to treat and (2) the need to change preoperative treatment plan. *P* < 0.05 was considered statistically significant. The institutional review board of Legacy Health System, Portland, Ore, approved the creation and use of this database.

### RESULTS

Between September 1996 and May 2004 one hundred thirty-six patients underwent SL/IOUS for hepatic metastases from colorectal cancer with the intention-to-treat (Table 1). Fifteen patients with recurrent disease confined to the liver underwent more than 1 procedure, resulting in a total of 152 staging and/or treatment events. All patients had isolated hepatic disease as defined by preoperative CT in 152 (100%) and PET in 107 (70%). Complete data were only available in 138 SL/IOUS with intended treatment events, which were the subject for subsequent outcome analysis.

In 8 events, the intended treatment was palliative laparoscopic placement of an HAIP only. Staging laparoscopy IOUS revealed surgically untreatable disease in 34 patients; 15 patients were found to have previously unrecognized peritoneal disease, 11 patients had nodal disease, 5 patients had extensive hepatic disease, and 1 patient could not be explored owing to adhesions. Two patients had negative results of exploratory procedures. One of these was a false-negative result. The intraoperative biopsy specimen was negative for cancer, but 3-month follow-up imaging revealed clear progression; the patient was returned to the OR for restaging and treatment (Table 2).

When SL/IOUS revealed treatable disease, laparoscopic RFA was performed in 78 events, resections were performed in 26 patients (laparoscopically, *n* = 13; open, *n* = 13), and HAIPs were placed in 40 events. One treatment event potentially included more than 1 procedure (resection, RFA, and HAIP), which was true for 37 combined treatment events. Hence, the total number of procedures performed (*N* = 181) was actually higher than the total number of treatment events. A total of 18 patients were converted to an open procedure and 2 patients were found to have additional disease during laparotomy, one with portal adenopathy and the other with peritoneal disease (Figure 2).

A change of the treatment plan was defined either as an actual switch to a different treatment modality or as a change in the number of planned RFA/resection events per patient. In 69 patients with a preoperatively planned resection, 18 were found to be untreatable and 28 patients had alternate treatments. This resulted in a 67% (46/69) incidence of changed resection plans (Figure 3). Three patients who were preoperatively thought to have unresectable malignancies were found to have resectable malignancies at SL/IOUS.

Thirty-six patients were taken to the OR for planned RFA only. Seven patients had SL/IOUS only and 14 had procedures altered by SL/IOUS. In 5 events more lesions were treated than anticipated by preoperative imaging, in 5 events fewer lesions were found based on SL/IOUS, and in 4 events RFA was added to the resection (Figure 4). Eight patients were taken to the OR to receive an HAIP for palliative treatment. Five patients had an HAIP only as planned. Overall, staging provided additional effect on 66 (49%) of 138 patients (*P* < 0.001) (Figure 5).

Overall mortality was 1.5% and morbidity 28%. One death was due to pneumonia and myocardial infarction on postoperative day 15; the second death was due to a sudden cardiac event on postoperative day 10. In the SL/IOUS-only group there were 3 minor complications. Mean (SD) length of hospital stay was 1.3 (1) day.

### Table 1. Demographics of the Study Population

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of patients</td>
<td>136</td>
</tr>
<tr>
<td>Male</td>
<td>77</td>
</tr>
<tr>
<td>Female</td>
<td>59</td>
</tr>
<tr>
<td>Age, mean ± SD, y</td>
<td>63 ± 11</td>
</tr>
<tr>
<td>No. of procedures</td>
<td>152</td>
</tr>
<tr>
<td>Preoperative CT</td>
<td>152 (100)</td>
</tr>
<tr>
<td>Preoperative PET</td>
<td>107 (70)</td>
</tr>
<tr>
<td>Clinical risk score*</td>
<td>2.4 ± 1.1</td>
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</tbody>
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*Abbreviations: CT, computed tomography; PET, positron emission tomography.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value (%)</th>
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<tbody>
<tr>
<td>Preoperative PET</td>
<td>107 (70)</td>
</tr>
<tr>
<td>Preoperative CT</td>
<td>152 (100)</td>
</tr>
<tr>
<td>Clinical risk score*</td>
<td>2.4 ± 1.1</td>
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### Table 2. Findings at Staging Laparoscopy

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
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<tbody>
<tr>
<td>Untreatable—SL/IOUS only</td>
<td>34</td>
</tr>
<tr>
<td>Peritoneal metastases</td>
<td>15 (44)</td>
</tr>
<tr>
<td>Nodal metastases</td>
<td>11 (32)</td>
</tr>
<tr>
<td>Extensive hepatic metastases</td>
<td>5 (16)</td>
</tr>
<tr>
<td>Conversion owing to adhesion</td>
<td>1 (3)</td>
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<tr>
<td>No disease identified</td>
<td>2 (6)</td>
</tr>
<tr>
<td>False-negative result</td>
<td>1 (3)</td>
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</tbody>
</table>

*Abbreviation: SL/IOUS, staging laparoscopy with intraoperative ultrasonography.*
In the past, most of the literature regarding SL for liver tumors reported outcome data of a mixed patient population including primary and secondary malignancies. They had in common a clear benefit of SL over preoperative imaging alone in detecting additional disease and precluding unnecessary laparotomy. 8-13 The yield for patients with hepatic metastases from colorectal cancer though was difficult to interpret because of small numbers and lack of subgroup analysis. Recently, Grobmyer et al14 reported a benefit of SL specifically for patients with colorectal liver metastases. Their results suggested that patients would benefit from a selective application of SL according to their CRS.

Our article also describes the efficacy of SL/IOUS in patients with colorectal hepatic metastases. Our study population, however, was different from those of previous reports in that we included not only candidates for resection but also potentially unresectable patients eligible for RFA, for hepatic artery pump implantation, or for combined regional modalities. This is important because, in our experience, it is difficult to accurately identify which patients are candidates for which treatment(s) preoperatively, even in the era of high-quality 3-phase liver CT and PET scans. This is unfortunate as the ability to accurately plan surgery preoperatively is of great value as it allows the surgeon and OR to be fully prepared and the patient to be well counseled in advance.

Newer treatment modalities can be applied as an alternative or as an adjunct to resection and their use has seen growing support in the literature. There is a definite overlap in patients who would benefit from resection, RFA, and/or HAIP. Staging laparoscopy/IOUS provides a key step toward making a well-informed treatment selection, prior to performing a laparotomy, and may avoid an unnecessary laparotomy all together.

Some authors have reported discouraging results in detecting lymph node metastases during an SL. Jarnagin et al13 found only 1 of 7 metastatic nodes at SL/IOUS. Grobmyer et al14 only used IOUS at the discre-
tion of the surgeon and missed extrahepatic disease in 16 patients; 11 of them were found with nodal metastases at laparotomy. Reasons for this are not totally clear but may relate to the comfort and facility of the surgeon with laparoscopy and/or laparoscopic US, both of which have an appreciable learning curve.

The routine addition of laparoscopic US has improved the results over diagnostic laparoscopy alone, especially in detecting nodal disease. In patients with hepatobiliary and pancreatic malignancies, laparoscopic staging procedures have previously been shown to increase the rate of resection of metastatic colorectal disease. Long-term follow-up will be required to confirm the results of laparoscopic staging procedures in the remaining 84 patients. Thirty-four (25%) unnecessary laparotomies were prevented of a possible 136.

We partially attribute our success rate to the routine use of US in every patient and a large experience in US applied on a daily basis in our surgical practice. Our standardized protocol for diagnostic US examination is described earlier. A critical factor is the willingness of the surgeon to take the time to look for and, when appropriate, resect and section suspicious nodes.

A considerable number of patients were found treatable based on SL/IOUS but 23% required changes in their actual treatment plan. This is of particular importance for the RFA group. There has been a trend toward referral of patients for percutaneous RFA as opposed to a surgical procedure. Wallace et al found that preoperative CT was only accurate in 45% of patients undergoing RFA for hepatic metastases, with not all metastases being detected in most patients. This is confirmed by our results showing that 19% of these patients have untreated disease and the number of treatments was altered in an additional 39%. Additionally, percutaneous RFA would have resulted in 5 unnecessary procedures and missed treatable lesions in another 5 patients. We consider this a significant clinical effect of SL/IOUS in this subset of patients. Percutaneous approaches should be used on a selective basis only.

Many patients who underwent changes in their treatment modality based on SL/IOUS were treated laparoscopically. Our institution has had much experience with advanced laparoscopic procedures and has been an early adopter of laparoscopic liver resections, RFA, and HAIP placements. Data are collected on all such cases and have been previously published. Though controversial, we believe minimally invasive approaches to hepatic malignancies definitely have a place in the continuum of hepatic tumor treatment and will be applied increasingly in the future.

The literature describes resectability rates after SL for colorectal liver metastases as ranging between 51% and 75%. Our resection rate was only 33%, well below reported data. This likely reflects the mixed study population, including a substantial number of patients with more advanced disease.

Positron emission tomography is useful for identifying extrahepatic disease but not for planning a liver procedure. Almost 50% of our procedures were influenced by SL/IOUS despite preoperative PET scans being performed in 70% of patients preoperatively. A subgroup analysis of patients with CT and PET scans compared with patients with CT scans alone did not reveal a significant difference in the yield of SL, although the numbers are small. Further breakdown of SL/IOUS yield with regard to extrahepatic disease for patients with preoperative PET scans vs no PET scans did not reveal any significance, neither for detection of peritoneal nor for nodal disease (data not shown). A recent publication looked also specifically at the effect of PET-CT vs CT imaging on the treatment of patients with metastatic colorectal disease to the liver. Similarly, the authors found no benefit of PET-CT prior to resection (sensitivity 95% vs 91%, respectively), but a significant effect on the detection of recurrence after hepatectomy. These findings, however, will need to be further confirmed by controlled trials.

In the series reported by Grobmyer et al, patients were assigned a CRS (CRS 0–5, described earlier) that had previously shown predictive value as a survival prognosticator for patients after hepatic resection for colorectal metastases. The authors found no benefit of SL in the low-risk group (CRS 0–1), a moderate benefit of 11% in the intermediate-risk group (CRS 2–3), and a higher yield of 24% in the high-risk group (CRS 4–5). However, additional disease was missed at SL in 4% of patients in the low-risk group and in a considerable number (10%) of patients in the intermediate-risk group. By using the same score for our study patients, we found only a trend to-
ward a slightly increased yield of SL/IOUS in the high-risk group but equal benefits for all other groups (data not shown). The lack of significance may be related to the small number of patients in our subgroups, or to the different composition of our patient clientele.

Cost analysis of SL/IOUS for patients with potentially resectable hepatic malignancies recently showed the staging procedure to be favorable. A prospective analysis by Jarnagin et al. demonstrated significantly decreased hospital charges for all patients who underwent SL, including unnecessary events, when compared with all laparotomies performed. Overall operative time was longer but had no effect on outcome. Accordingly, Grobmyer et al. demonstrated that preventing unnecessary laparotomies with SL decreased hospital stay and enabled patients to start on chemotherapy earlier, additional benefits that may add to cost reduction.

Staging laparoscopy combined with laparoscopic US provided a significant effect in the multimodal approach to our population of patients undergoing regional treatment of hepatic colorectal metastases. Staging laparoscopy/IOUS also acts as a bridge to a potential laparoscopic approach. Based on our experience, we think that every patient taken to the OR for treatment of isolated hepatic colorectal metastases should undergo prelaparotomy staging with SL/IOUS.

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CONCLUSIONS

Staging laparoscopy combined with laparoscopic US provided a significant effect in the multimodal approach to our population of patients undergoing regional treatment of hepatic colorectal metastases. Staging laparoscopy/IOUS also acts as a bridge to a potential laparoscopic approach. Based on our experience, we think that every patient taken to the OR for treatment of isolated hepatic colorectal metastases should undergo prelaparotomy staging with SL/IOUS.

REFERENCES

were unresectable fell into the non-PET scan group? The second question that goes along with that is: do you believe that patients with normal PET scans for extrahepatic disease really need the SL?

I am not going to challenge any of the RFA, HAIP, or resection decision making that is based on IOUS because, quite frankly, I do not think that is new. In fact, not performing a complete IOUS of some form and a careful manual examination of the liver parenchyma and nodal basin would be considered substandard when doing these operative procedures. So I point back to the technology. What we are seeing here is technical evolution. The diagnostic SL is the alternative to inspection and adding IOUS, done laparoscopically, is the alternative to palpation. My third question then becomes, in those patients who were converted, were any sites of disease identified by palpation that were missed by SL/IOUS?

It is obvious that the criteria for a trip to the OR, although I am sure appropriate, are potentially quite loose. And, I say that because the documentation is that 17 (23%) of 69 of the perceived treatable patients were deemed to be nonoblation or non-resection candidates at the time of the operation. I think this is an important point because of the contributions of the preparation of the OR, the preparation of the equipment, the fiscal impact of the equipment depreciation, the use of disposables, and the use of acute care resources. From the patient's side, are included anxiety, false hope, economic expense, and potential delay in what would be curative therapies. This is a big global set of comments, but I would like to hear Dr. Hansen's comments on these particular issues and dilemmas they raise.

After reading the manuscript and hearing this excellent presentation, I believe there is a subset of patients who will benefit from SL/IOUS done laparoscopically. This certainly would have included the 15 patients with extrahepatic disease I presume the 5 patients reported with extensive hepatic parenchymal disease. The laparoscopic IOUS I continue to question, although I think I see a niche for it in the evaluation of the portal nodes that are suspicious on preoperative CT. My fourth question, how many patients have had portal node biopsy specimens yielding those 11 positive ones, and should we, or can we, accept the fact that the nodes that were not selected for biopsy were truly negative. Personally, I still find it difficult to tell the difference between a positive node and a negative node, even before sending it off to the pathologist, when I am able to squeeze it with my fingers.

What I think is really important is the use of CRS, and it is an enticing concept. I think if you can link the specific elements of what we would consider the classic gang of 6, the number of lesions, size, disease-free interval, nodal status, age, serum carcinoembryonic antigen levels, to the yield on SL/IOUS, then we could really create a very finite cost-effective, appropriate, efficient indication to put into this algorithm. Finally, it is always a pleasure to have the time to read, digest, and enjoy the hard work of my respected colleagues and to share the forum with very distinguished members, officers, and guests of the Pacific Coast Surgical Association.

Jon M. Greif, MD, San Diego, Calif: I have one question, not clear in your abstract or presentation. Is your SL/IOUS being done as a separate operative procedure, preceding your planned treatment perhaps by a week or so, as was once described by Dr. Andrew Warshaw as part of the preoperative evaluation of pancreatic cancer? We, too, precede our treatment of colorectal hepatic metastases with a PET scan and hepatic protocol spiral CT scan, and we find that that pretty well makes the decision for us as to whether or not the liver lesions are resectable and/or amenable to RFA. If deemed resectable, we start the operative procedure laparoscopically, occasionally finding extrahepatic disease, thus precluding resection or ablation. With the US scan, we may find additional hepatic lesions, which may alter the treatment plan to perhaps combined resection and RFA, or RFA alone. We would certainly agree that there is an important role for SL/IOUS in the treatment of colorectal hepatic metastases, but again, I wondered if you are doing this as a separate preoperative evaluation, or at the time of your planned resection and/or ablation.

Theodore X. O’Connell, MD, Los Angeles, Calif: My first question is regarding the patients whose malignancies are not resected. Obviously, that is good if you find extensive disease, disease outside of the liver, and so forth. But it is out of the ordinary after PET and spiral CT scanning to find too many patients like that. My second question is regarding the outcome results. Fifty percent of your patients had the treatment altered, but we have no outcome results. We do not know how it was altered and whether the outcome was any better. Can you give any kind of outcome results in those treatment-altered patients to show that they actually benefitted by the alteration of the therapy.

Anton J. Bilchek, MD, Santa Monica, Calif: I agree that laparoscopy and laparoscopic US are important in staging, but your data suggest that most treatment changes were based on laparoscopic evidence of diffuse peritoneal disease or bilobar hepatic disease. Did results of US further change the management of your patients?

Second, how did you select patients for resection, and was resection performed via laparoscopy? Third, do you have any data comparing rates of recurrence and overall survival after RFA vs resection?

Sherry M. Wren, MD, Palo Alto, Calif: Dr. Hansen, your group has pioneered the placement of laparoscopic HAIPs in the past. What is your practice now with new systemic agents such as oxaliplatin and Avastin (bevacizumab) that are available? Do you believe there is a continued role for HAIP placements?

Andrew DiFronzo, MD, Los Angeles, Calif: I have 2 questions. The first is regarding peritoneal metastases. These were not characterized during the presentation. Was this diffuse carcinomatosis, or was this the occasional, maybe single, isolated extrahepatic peritoneal metastasis, and, if that was the case, would you consider resecting a single peritoneal metastasis in addition to hepatic resection? The final question: did you correlate Memorial Sloan-Kettering CRS, the initial CRS, with your intraoperative findings? In other words, were patients who had a higher-risk CRS of say 3 or 4 the ones who ended up having the extrahepatic disease and so forth?

Dr. Hansen: First, I will address Dr. Wragman’s questions as best I can. Regarding PET scans, we did look at a comparison of the patients who underwent PET scans preoperatively vs those who did not. The bottom line was that our numbers were just too small to be meaningful. When we compared the 30% of our patients who did not undergo preoperative PET scans to the 70% who did, there did not appear to be a substantial difference in the subsequent incidence of additional disease found at SL. There may, however, be confounding factors; for example, the 30% who did not undergo PET scanning were among our first patients included in this study. We do believe that SL is valuable even in the presence of a normal PET scan. This seems to be confirmed by the strength of the overall results in this study.

I do not know the exact number of lymph nodes sent for frozen section to find the 11 positive nodes. Our general philosophy is to harvest nodes every time we place an HAIP or dissect the porta for a lobectomy (the work of dissection is already done), and only when suspicious nodes are seen on US when performing an RFA. We send nodes in approximately half of our patients.

False-negative staging procedures certainly do occur. We did have 1 patient of 18 converted to laparotomy who was found to have a positive portal lymph node unrecognized during SL.
The overall incidence of false-negative results cannot be determined from this data set, as most patients did not undergo laparotomy. Long-term follow-up will be needed to identify these patients.

The third question related to financial costs, as well as the broader social issues, which may be affected by the results of this study. There is a growing literature supporting the use of staging procedures from a financial perspective. The financial cost of unnecessary laparotomies and the cost in perioperative morbidity generally far outweigh the procedural costs of staging. Moreover, the social impact of preventing unwarranted major surgery includes such intangibles as a more rapid recovery of quality of life. This is especially important when considering the expectedly short life span of this patient population.

Dr Greif, our staging and treatment procedures are performed in 1 stage. This is inconvenient for the surgeon and OR staff and makes scheduling and the consent process difficult. Our patients, however, are typically resistant to the idea of 2 surgical procedures and simply want to get the procedure over with as soon as possible.

Dr O'Connell, although I agree that preoperative CT and PET scans seem as though they should provide accurate staging, the data we are presenting suggest that they are not. We found unexpected peritoneal and nodal disease in 25% of our patients. While 30% of our patients did not have a preoperative PET scan, analyzing only the 70% that did have a PET did not seem to alter our results. We might argue that the CT scan or PET scan should be dropped from the protocol, but I believe that the data provided by each study are valuable.

Dr Bilchek, although laparoscopy alone is much easier and found most of our unexpected disease, staging US identified nodal disease in 11 (8%) of 130 procedures. Additionally, many of the treatment alterations were based on a US finding of unsuspected intrahepatic lesions. I believe US should be considered an integral part of SL.

Second, in our institution, we are aggressive in using a minimally invasive approach. Data regarding such procedures are collected prospectively, critically reviewed, and published. Laparoscopic resections are selected based on technical feasibility and patient factors such as comorbid disease or request.

Third, we are writing a report reviewing the outcomes of patients whose malignancies were technically resectable, but underwent RFA owing to comorbid conditions or the patient’s request. The survival curves appear to be similar to historical control for resection.

Dr Wren, we place far fewer HAIPs today than we did prior to the introduction of oxaliplatin therapy. Studies reporting on results of oxaliplatin-based chemotherapy regimens suggest a similar liver response rate to that achieved with HAIP therapy.

The advantages to oxaliplatin are that it provides systemic treatment for a systemic disease, and it does not require surgery. We are limiting HAIP therapy to second-line treatment in patients who have failed or cannot tolerate oxaliplatin.

Dr DiFronzo, we have been fairly strict in our decision to limit regional hepatic treatment to patients with no evidence of untreated, active disease outside the liver. Carcinomatosis has historically been thought to represent widespread, unresectable disease. There is evidence that this view should be relaxed, but these data are limited. In this article we included 3 patients who had limited extrahepatic disease, resected at the time of the liver procedure. One patient had a splenic metastasis and 2 had single foci of omental or peritoneal disease.

Second, we did attempt to do an evaluation of our data using the CRS developed by the Memorial Sloan-Kettering group. Unfortunately, the numbers were too small to make any meaningful statement. We do use the CRS to help guide the aggressiveness of treatment selection. I would like to thank the members of the Pacific Coast Surgical Society for the privilege of presenting this work and their thoughtful questions.