The Role of Selective Lymphadenectomy in Breast Cancer

Douglas Reintgen, MD; Emmanuella Joseph, MD; Gary H. Lyman, MD, MPH; Tim Yeatman, MD; Lodovico Balducci, MD; Ni Ni Ku, MD; Claudia Berman, MD; Alan Shons, MD; Karen Wells, MD; John Horton, MB, ChB; Harvey Greenberg, MD; Santo Nicosia, MD; Robert Clark, MD; Steven Shivers, PhD; Weiguo Li, MD; Xiangning Wang, MD; Alan Cantor, PhD; and Charles Cox, MD

Lymphatic mapping and sentinel node biopsy allow full nodal staging information with a minimally invasive procedure.

Background: Axillary node dissection is considered a standard staging procedure in patients with breast cancer. The procedure is associated with significant morbidity and provides pathologists with many lymph nodes to evaluate.

Methods: A total of 174 women participated in a trial that included preoperative lymphoscintigraphy and intraoperative lymphatic mapping using a combination of a vital blue dye and radiocolloid mapping.

Results: The intraoperative lymphatic mapping correctly identified a sentinel lymph node (SLN) in 160 (92%) of 174 patients. One skip metastasis (0.7%) occurred in 136 women who had a subsequent complete node dissection.

Conclusions: Lymphatic mapping and SLN biopsy using a combination of mapping techniques provide accurate nodal staging for women with breast cancer. With this technique, approximately 70% to 80% of women with no axillary metastases could be spared the morbidity of a complete node dissection.

Introduction

Radioguided surgery techniques have the potential to change the face of general surgery practice, as laparoscopic surgery did 10 years ago. This technology has changed the standard of surgical care for patients with melanoma and, based on preliminary trials, has potential applications in breast cancer, colon cancer, other skin malignancies (Merkel cell cancer, advanced squamous cell cancer), vulva and vaginal malignancies, bone tumors, and parathyroid adenomas. The number of new cancers to which these methods may be applied totals 350,000 cases per year in the United States.

The use of lumpectomy for breast preservation changed the standards of care and decreased both psychologic and physical morbidity for women with breast cancer. However, most of the recovery time and long-term morbidity of the standard surgical approach (either modified radical mastectomy or lumpectomy, axillary dissection, and radiation therapy) involved side effects of the axillary dissection. The contribution of radical dissection of the axilla to the survival of women with breast cancer is controversial. Multiple reports have shown that axillary dissection was associated with a 40% incidence of acute lymphedema, a 5% chance of chronic lymphedema, a 20% incidence of paraesthesia, and a 100% rate of having a drain. The next logical step in the progression of breast cancer care would be an attempt to make the axillary dissection more conservative and less morbid. The use of lymphatic mapping with sentinel lymph node (SLN) biopsy allows full nodal staging information with a minimal invasive procedure. No prognostic information is lost, operations are more conservative, patient morbidity decreases, and cost savings are realized for the health care system. Radiocolloid and vital dye particles are taken up by the efferent lymphatics from the primary site and migrate to the regional basins. These mapping agents are deposited and concentrated in the SLN, and surgeons can identify this first node visually and with a hand-held gamma counter. If metastatic cells are migrating through the breast lymphatics, they will encounter the SLN and be trapped in this node for a period of time, similar to the lymphatic mapping agents. Thus, the radiocolloid and blue dye identify the node most likely to contain metastatic disease among the 20 to 25 nodes in the regional basin.

Importantly, lymphatic mapping techniques do not establish the presence of metastatic disease in the SLN (removal and histologic examination are required), but rather allow the surgeon to provide one or two SLNs to the pathologist for detailed examination instead of 20 to 25 with a typical complete axillary dissection. The sensitivity of the pathology examination can be increased, thus providing a more accurate staging. This report describes Moffitt Cancer Center's experience in using the lymphatic mapping and SLN techniques (selective lymphadenectomy) to stage the patient with breast cancer.

Patients and Methods

Patient Population

From April 1994 to October 1996, all patients presenting to our center with the suspicion of breast cancer were evaluated for enrollment into the study. Enrollment criteria included patients with breast cancer (invasive and in situ) documented by fine-needle aspiration (FNA) or incisional or excisional biopsies of palpable masses or core biopsies of mammographic abnormalities. All patients had a clinically negative axilla on physical examination. Pregnant women and patients with tumors that could not be adequately localized by palpation or by stereotaxis were excluded. A total of 174 women were enrolled in the study after they provided written informed consent. The study was reviewed and approved by the Institutional Review Board at the University of South Florida for the protection of human subjects.
Patients underwent intraoperative lymphatic mapping using a vital blue dye (Lymphazurin, Zenith Parenterals, Rosemont, Ill) and a filtered technetium-labeled sulfur colloid (Syncom International, Tampa, Fla) followed by complete axillary node dissection on the initial protocol. All patients received both the vital blue dye and the radiocolloid mapping. The SLNs were identified and sent to pathology as separate specimens. All tissue was processed by the pathology department using standard procedures.

**Preoperative Lymphoscintigraphy**

Patients underwent preoperative lymphoscintigraphy in order to document all nodal basins at risk for metastatic disease and to mark the location of the SLN. Axillary or internal mammary nodal drainage alone, drainage to both basins, or no discernable drainage to either basin was noted. An attempt was made to visualize any “in transit” intramammary nodes.

The technique involves a peri-tumor injection of an average 450 microcuries (μCi) of filtered technetium sulfur colloid followed by gamma camera scanning of the patient (Figs 1 and 2). Imaging was performed using a large field-of-view gamma counter set at a 20% window and fitted with a low-energy, general-purpose, parallel-hole collimator. Anatomic landmarks were marked with a hot marker or by masking a cobalt image behind the lymphoscintigraphy. Images were obtained of the breast, sternum, and axilla with the arm of the patient raised above the head. This positioning allowed as much separation as possible between the injection site and the regional basin. A minimum of 100,000 counts were obtained for each view and recorded on film. Dynamic flow studies were performed immediately after injection in order to visualize the afferent lymphatics and to locate the SLN.

The location of the SLN was noted with an intradermal tattoo, which primarily provided a guide as to the location of the node (high vs low, anterior vs posterior) in the axillary. Any intramammary or internal mammary nodes were noted when visualized.

**Intraoperative Mapping**

The technique followed for intraoperative lymphatic mapping and SLN identification in patients with breast cancer is similar to that previously reported for melanoma patients. Patients came to the operating room two to four hours following the injection of the radiocolloid in the nuclear medicine suite. The technique involves a peritumor injection of an average 450 μCi of filtered technetium sulfur colloid. For palpable tumors, isosulfan blue 1% dye (3 to 5 cc of lymphazurin) was injected around the area of greatest activity in the axilla in counts per second. The axillary incision was then made over the area of greatest activity. Careful dissection was used to identify the blue-stained afferent lymphatics, and these lymphatics were followed to the SLNs that stained blue (Fig 3). The gamma-detection probe was used to confirm the location of the SLN and to guide the dissection in cases where the afferent lymphatics were difficult to identify. In vivo radioactivity was measured in counts per second with the SLN fully exposed. An estimate of the background activity was obtained by counting four areas in the axilla equidistant from the injection site and away from the SLN.

A hand-held, gamma-detection probe (Neoprobe 1000, Neoprobe Corp, Dublin, Ohio) was used to assist in SLN detection. The probe was used in the nuclear medicine suite to help in locating the SLN in relation to the remainder of the nodes in the axilla. The Neoprobe was also used prior to making a skin incision to identify the area of greatest activity in the axilla in counts per second. The axillary incision was then made over the area of greatest activity. Careful dissection was used to identify the blue-stained afferent lymphatics, and these lymphatics were followed to the SLNs that stained blue (Fig 5). The gamma-detection probe was used to confirm the location of the SLN and to guide the dissection in cases where the afferent lymphatics were difficult to identify. In vivo radioactivity was measured in counts per second with the SLN fully exposed. An estimate of the background activity was obtained by counting four areas in the axilla equidistant from the injection site and away from the SLN.
Localization ratios were recorded as radioactivity (measured by the Neoprobe in counts per second) over the SLN vs a neighboring non-SLN. Activity ratios were used to eliminate uncontrolled variability such as differences in the dose of radioactivity used, different distances of the SLN from the injection site, harvest of the SLN before or after excision of the primary (excision of activity at the injection site), and differences in elapsed time from injection until lymphatic mapping occurred. Higher localization ratios allow for an easier mapping procedure and will increase the success rate of the SLN harvest.

The SLN was defined as follows: all blue-stained nodes and nodes that had activity ratios of SLN vs neighboring non-SLN greater than 10 were harvested and identified as SLNs. After removal of the SLN, the central bed was reexamined for activity, and if the activity remained above 150% over background, the dissection was continued in search of additional SLNs. A nonstained, adjacent lymph node (non-SLN) was harvested in most cases to serve as a control for background nodal activity. The SLNs and the control nodes were measured for activity once excised. After all SLNs were removed, the patient underwent routine modified radical mastectomy or lumpectomy followed by complete axillary node dissection in the initial protocol. If there was too much interfering radioactivity from the primary site (‘shine-through’), the lumpectomy or mastectomy was performed prior to the axillary dissection.

No internal mammary node dissection was performed, since any possible SLNs in this location could not be localized adequately due to interference from primary site activity. In addition, internal mammary node dissection or sampling would add morbidity to the procedure and is not a part of the current surgical treatment of invasive breast cancer.

After the documentation of a very low (<1%) skip metastasis rate, defined as a negative SLN with a positive node discovered on the subsequent complete axillary dissection, an early stopping point was reached and another in-house protocol started. If the SLN was negative for metastases, the patient was followed. If the SLN was positive, the patient underwent a complete axillary node dissection. In the second study, a skip metastasis in women with SLN-negative basins was defined as the development of recurrent nodal disease in the regional basin during the follow-up interval.

Pathologic Examination

Frozen sections of the primary tumors were not used for confirmation of the FNA results, since we had no false-positive FNA results with 1,311 cases over a five-year period. In addition, these women had a mammogram and a clinical examination highly suspicious for carcinoma. This practice is supported by other reports. All excised nodal tissue was submitted to pathology. Lymph nodes were identified as SLN (1, 2, 3, etc.), as adjacent non-SLN, or simply as axillary contents. No frozen sections of the nodes were performed in order to allow the pathologist four to five days for the histologic examination. A routine protocol for examining the lymph nodes was used. First, all lymph nodes were identified and dissected free from the surrounding fat and connective tissue. The nodes were then bisected and placed in paraffin blocks for embedding. One to two sections were obtained from the central cross section of each block and stained with hematoxylin and eosin. SLN and non-SLN were processed in a similar fashion.

Statistics

Statistical inference on the probability of nodal involvement was based on the binomial distribution (binomial test) applied to untied pairs of observations (ie, when only SLNs are involved). The rationale for this is that paired observations, either both negative nodal groups or both positive nodal groups, provide no information concerning the comparison of the two groups. All information concerning this comparison is contained in the untied pairs of observations. Under the null hypothesis that nodal metastases may occur in SLNs and non-SLNs equally, the probability of an untied pair favoring involvement of either nodal group will be the same. The test of the null hypothesis then constitutes the probability under null hypothesis of obtaining results as extreme (or more extreme) as those observed. A two-tailed test of the null hypothesis is presented.

False-negative SLN localizations are defined as a negative SLN, with other nodes in the basin being positive for metastatic breast cancer. Sensitivity was calculated by the number of patients in which the histology of the SLN was reflective of the histology of the remainder of the nodal basin. The unit of analysis was the patient and not the number of lymph nodes harvested. A negative predictive value was defined as how often a negative SLN reflects the remainder of the nodes in the basin being negative.

Results

A total of 174 women with newly diagnosed breast cancer were enrolled in the study. The primary breast cancer was removed by either lumpectomy (60%) or mastectomy (40%) followed by complete axillary lymph node dissection in the initial 136 patients in the trial. The success rate of SLN identification was 92% (160 of 174 patients). An SLN was identified in 164 of 178 possible basins. Fourteen patients had unsuccessful mappings, with nine (64%) having inner quadrant tumors in which no discernable lymphatic flow to the axilla was documented with either preoperative lymphoscintigraphy or intraoperative lymphatic mapping with either the vital dye or radiocolloid. In addition, all 14 patients had a complete axillary node dissection as part of their standard care, and none of the patients had any sign of axillary metastases. The remaining five patients had technical problems in the mapping, and no dye or radiocolloid appeared in the regional basin.

In the women with successful localizations, an average of 1.2 SLNs per patient were obtained. Of the 160 patients, 38 (23%) with successful localizations had metastatic disease to the axilla. Of the 38 patients with metastases, the range of involved SLNs was 1 to 4. The SLNs were positive in 37 of 38 patients with metastatic disease to the axilla.
disease (sensitivity = 97%) with one skip metastasis (false-negatives = 1 in 38, 2.6%). The one patient with a skip metastasis had a previous excisional biopsy. In patients with metastatic disease, the SLN was the only site of metastasis in 14 (37%) of 38 patients. The metastatic distribution was significantly in favor of SLN involvement.

Of the 37 patients with a positive for metastases SLN, all went on to have a complete node dissection, and 23 (62%) of them had more nodes positive in the basin. Ninety-nine patients with a negative SLN biopsy went on to receive a complete node dissection, and in 98 patients, all harvested nodes were negative. The negative predictive value of a SLN negative biopsy is 99%. With a mean of one year of follow-up, no patient who was treated with only a selective lymphadenectomy and not with a complete node dissection has developed recurrent axillary nodal disease in a mapped SLN-negative basin.

Discussion

The status of the regional lymph node in women with invasive breast cancer is the most powerful predictor of survival. It is used for enrollment in adjuvant protocols and to make treatment decisions. Currently, 32 prognostic factors have been identified based on the primary tumor (Table); yet, in multiple regression analyses to determine the interaction among variables and the most powerful for predicting prognosis, the lymph node status remains the most predictive. For women with breast cancer, the presence of metastatic disease in the regional basin decreases five-year survival by approximately 30% to 40%. Recent suggestions have been made to eliminate axillary dissection from the surgical treatment of women with breast cancer, since most women, if not all, with invasive breast cancer will receive some form of adjuvant therapy. Because of the importance of the patient's regional node status, it makes more sense to continue to perform an axillary staging procedure. However, complete axillary nodal dissection may be associated with significant morbidity, including the need for a general anesthesia, postoperative lymphedema of the involved extremity, neuropathy of the arm, seroma formation, formation of a painful neuroma, or local wound problems. These complications are associated with increased hospitalizations and overall costs, as well as considerable discomfort to the patient. In fact, most of the physical rehabilitation and long-term morbidity for the woman after the surgical care of her breast cancer is a function of the axillary dissection and not the removal of the breast. By developing techniques that make the axillary procedure more conservative and less morbid, patient care is benefitted.

Clinical Importance of Accurate Staging

More accurate staging should improve the survival of the breast cancer population by identifying patients who will gain a survival advantage associated with either the surgical procedure itself (complete axillary dissection) or the accompanying adjuvant therapy. More accurate staging and effective therapies result in more than just stage shifting. In addition, a percentage of the population is not exposed to the complications of the more extensive surgical procedure or the toxicities of the adjuvant therapy.

Cost Effectiveness

Additional costs associated with this procedure include the nuclear medicine procedure, the more detailed examination of the SLN by the pathologist, and a second procedure in the 31% of women who have positive SLN biopsies. However, these added expenses pale in comparison to the costs of a full operating room, general anesthesia, and hospitalization. The lymphatic mapping techniques allow women who are undergoing lumpectomy (60% of women with breast cancer at our institution) to have the SLN harvested as an outpatient, thus saving time and expense. A formal cost analysis was not a part of this protocol, but similar analyses for lymphatic mapping and to make treatment decisions. Currently, 32 prognostic factors have been identified based on the primary tumor (Table); yet, in multiple regression analyses to determine the interaction among variables and the most powerful for predicting prognosis, the lymph node status remains the most predictive. For women with breast cancer, the presence of metastatic disease in the regional basin decreases five-year survival by approximately 30% to 40%. Recent suggestions have been made to eliminate axillary dissection from the surgical treatment of women with breast cancer, since most women, if not all, with invasive breast cancer will receive some form of adjuvant therapy. Because of the importance of the patient's regional node status, it makes more sense to continue to perform an axillary staging procedure. However, complete axillary nodal dissection may be associated with significant morbidity, including the need for a general anesthesia, postoperative lymphedema of the involved extremity, neuropathy of the arm, seroma formation, formation of a painful neuroma, or local wound problems. These complications are associated with increased hospitalizations and overall costs, as well as considerable discomfort to the patient. In fact, most of the physical rehabilitation and long-term morbidity for the woman after the surgical care of her breast cancer is a function of the axillary dissection and not the removal of the breast. By developing techniques that make the axillary procedure more conservative and less morbid, patient care is benefitted.

This report describes a procedure originally proposed by Morton et al for melanoma and by Giuliano et al for breast cancer in which lymphatic drainage from primary tumors can be mapped to regional nodes. The first node in the basin (the SLN) can be identified and harvested, and this is the presumptive initial site of metastatic disease. The histology of the SLN is reflective of the histology of the remainder of the nodal basin. Two reports, suggest that lymphatic mapping techniques can be used in women with breast cancer to decrease the morbidity of the surgical procedure. The initial reports from the John Wayne Cancer Center (blue dye only) and the University of Vermont (radiocolloid only) have shown success rates for SLN identification of 65% and 71%, respectively. The original report of the new technology describes a success rate of SLN identification of 65.5% (114 of 174 cases) using a only a blue dye technique. We would argue that if the learning curve for any new technique is so steep that after 174 cases, a success rate of only 65.5% is obtained, it is unlikely that the new technology will be incorporated into the everyday practice of the surgeon. In a recent abstract report of 100 subsequent patients, the success rate of SLN identification with just the vital dye as a mapping reagent was 93%, but this was achieved with a learning curve of at least 274 patients! Thus, the technique had to be improved. The true test of any technology is whether others can replicate the results and incorporate the procedure into practice. By combining the two mapping techniques, as we have done, the success rate of the localization increases and the learning curve is significantly shortened. However, a number of issues must be addressed before the technique can be incorporated into the surgical treatment of the patient with breast cancer.

Cost Effectiveness

Additional costs associated with this procedure include the nuclear medicine procedure, the more detailed examination of the SLN by the pathologist, and a second procedure in the 31% of women who have positive SLN biopsies. However, these added expenses pale in comparison to the costs of a full operating room, general anesthesia, and hospitalization. The lymphatic mapping techniques allow women who are undergoing lumpectomy (60% of women with breast cancer at our institution) to have the SLN harvested as an outpatient, thus saving time and expense. A formal cost analysis was not a part of this protocol, but similar analyses for lymphatic mapping as a way to obtain the nodal staging information in patients with melanoma have shown a savings of $5,000 per procedure; only the melanoma patients with a positive SLN need a second procedure and a complete node dissection. If this technology can be used successfully for women with breast cancer, the potential annual savings for the American health care system is $695 million (based on 185,700 new breast cancer cases per year). This cost analysis does not incorporate the decreased morbidity and the earlier return to work or normal activity that would also be realized by preventing the complications of a complete node dissection.

Preoperative Lymphoscintigraphy in Breast Lymphatic Mapping

Only 1% of the radiocolloid injected around the primary tumor is delivered to the regional basin, thereby making imaging difficult when primary sites are close to the axilla. In addition, internal mammary nodal imaging is virtually impossible with the current technology due to the proximity of inner-quadrant tumors to the basin as well as the technical difficulty of identifying the internal mammary vessels on the chest wall. In addition, tumors in the outer-quadrant cannot be adequately imaged due to the limited range of motion at the shoulder.
Another advantage associated with preoperative lymphoscintigraphy is that if an SLN can be imaged in the axilla, the surgeon can be almost assured that he or she will find an SLN. Preoperative lymphoscintigraphy continues to be evaluated in our protocol with the hope that it will spare the morbidity of any axillary nodal staging procedure by identifying breast cancer patients with no lymphatic drainage to the axilla.

The lymphatic mapping technique allows the surgeon to provide the pathologist with one or two SLNs on which to perform a more detailed examination. Thus, procedures such as serial sectioning, immunohistochemical staining, and perhaps reverse transcriptase-polymerase chain reaction (RT-PCR) analysis, of the SLN can be incorporated into routine practice. Thus, the sensitivity of the examination is increased when compared to routine histology, and a number of patients with breast cancer are staged up with the new technology. Incorporating a more detailed examination into routine practice allows for the detection of those patients with lower volumes of disease. Although the finding of micrometastatic disease in one lymph node was initially thought to be unimportant in breast cancer (patients with one micrometastasis were thought to have the same survival as the node-negative population), more recent studies have shown a poorer survival in patients who are upstaged with serial sectioning, immunohistochemical staining, or RT-PCR analysis. In fact, according to reports within the past two years, immunohistochemical staining or new molecular biology assays for occult metastases have consistently been shown to upstage patients with melanoma, breast, colon, neuroblastoma, prostate, and stomach cancer, and this upstaging has been proven to be clinically relevant in most cases.

In addition, this technology may allow a more rational approach to adjuvant chemotherapy. It is hypothesized that women could have an SLN biopsy, which could then be examined in detail with immunohistologic staining or RT-PCR technology to provide more accurate staging and to restrict the administration of adjuvant therapy to only those patients with solid evidence of metastases. Patients without evidence of micrometastases in the SLN may be spared the morbidity and expense of additional therapy. A randomized trial is being proposed to verify the validity of these hypotheses.

Breast cancers, particularly inner-quadrant tumors, may drain to the internal mammary nodes, so a sampling of the internal mammary nodes would be needed for complete staging. The current experience does not address this issue since internal mammary nodal drainage could not be mapped intraoperatively. Only 1% of the injected dose of the radiocolloid is delivered to the regional basin, and lymphatic mapping to the internal mammary nodes was impossible due to the residual radioactivity at the primary site, despite performing a mastectomy or lumpectomy prior to the SLN harvest. Internal mammary node dissection is not a part of the surgical procedure for primary breast cancer at this time due to the low rate of metastases and the added morbidity of an internal mammary procedure. The inability to map to this basin is not considered a drawback since only a small number of patients present with metastatic disease in this basin in follow-up after primary therapy. This chain can be incorporated into the radiation therapy fields in women with inner-quadrant tumors who have had lumpectomy and radiation therapy to treat their primary tumors.

Combined Mapping Techniques

Previous reports have used either the vital blue mapping or the radiocolloid alone with reports of lower success rates. This has invariably resulted in more difficult dissections with the recommendation that this technology be confined to major medical centers. Certainly, good nuclear medicine and pathology support are needed for the surgeon to be successful. The techniques are complementary in that the vital blue dye mapping becomes more important due to "shine-through" of the radiocolloid from the primary site in women with tumors closer to the lymphatic basin, and the radiocolloid mapping is important in cases in which the blue dye is slow to travel to the regional basin. There is also good evidence in the melanoma population that the radiocolloid is concentrated in the SLN over a period of time. Thus, by waiting two to four hours after injection, localization of the SLN becomes easier and has a higher success rate. Radioactive material is handled in the nuclear medicine suite by licensed personnel rather than in the operating room. Surgical scheduling also becomes easier.

Radiocolloid mapping enables the surgeon to locate the hot spot in the axilla prior to making any skin incision, allows for a directed dissection with the Neoprobe through the axillary fat to minimize tissue disruption, and assures the surgeon that all SLNs have been removed by the return of the activity in the basin down to background levels following the SLN harvest. Vital blue dye mapping alone cannot achieve these advantages. The radiocolloid mapping will identify more SLNs, but the clinical significance of this will have to await a larger study and more follow-up, since there has not been a metastasis in an SLN that was "hot" but not blue in our study. The SLN localization would not have been possible in 42% of the patients in which no blue dye appeared in the axilla, but localization was possible due to the concentration of the radiocolloid in the SLN.

Our data indicate little or no risk of jeopardizing local control or compromising staging information. The only skip metastasis occurred in a patient who had a previous excisional biopsy, and one could argue that the efferent lymphatics from the primary tumor were disrupted by this extensive procedure. Excisional biopsies would decrease the likelihood that the lymphatic channels could be accurately mapped and that the mapped SLN would represent the true SLN and the histologic status of the remainder of the axilla.

Skip Metastases

Earlier reports cite skip metastases that occurred in up to 15% of patients with metastatic breast cancer. In these studies, the axilla was arbitrarily divided into level I, level II, or level III without formal lymphatic mapping. Authors have then reported rates of skip metastases based on this arbitrary division. By incorporating an accurate lymphatic mapping technique, skip metastases do not occur if the mapping is performed with intact tumors. In the present series, the authors identified direct drainage to level-II nodes in 12% of the cases, with none of the primary lymphatics going to level-I nodes. What was previously described as skip metastasis in the literature was more likely a reflection of the inability of previous investigators to map lymphatic flow from the primary breast tumors.

Conclusions

We conclude that lymphatic mapping is technically possible in the patient with breast cancer and that the SLN is reflective of the histology of the remainder of the axillary lymph nodes, particularly if the SLN is negative. Negative nodal staging information is now possible with an outpatient procedure. This strategy has the potential to decrease overall morbidity without compromising patient care. Comparable to lumpectomy as a viable alternative to mastectomy in the management of primary breast cancer - - if these results are confirmed by other investigators - - lymphatic mapping and selective lymphadenectomy could allow a more conservative approach to the surgical management of women with breast cancer.

This study was supported by grant #30079 from the H. Lee Moffitt Cancer Center & Research Institute and by grant R21 CA66553-01 from the National