Manipulation of the Primary Breast Tumor and the Incidence of Sentinel Node Metastases From Invasive Breast Cancer

Nora M. Hansen, MD; Xing Ye, MS; Baiba J. Grube, MD; Armando E. Giuliano, MD

Hypothesis: The incidence of sentinel node (SN) metastases from invasive breast cancer might be affected by the technique used to obtain biopsy specimens from the primary tumor before sentinel lymph node dissection.

Design: Prospective database study.

Setting: The John Wayne Cancer Institute.

Patients and Methods: We identified 663 patients with biopsy-proven invasive breast cancer who underwent sentinel lymph node dissection between January 1, 1995, and April 30, 1999. Patients were divided into 3 groups based on type of biopsy: fine-needle aspiration (FNA), large-gauge needle core, and excisional. A logistic regression model was used to correlate tumor size, tumor grade, and type of biopsy with the incidence of SN metastases.

Results: Of the 676 cancers, 126 were biopsied by FNA, 227 by large-gauge needle core biopsy, and 323 by excisional biopsy before sentinel lymph node dissection. Mean patient age was 58 years (range, 28-96 years), and mean tumor size was 1.85 cm (range, 0.1-9.0 cm). In multivariate analysis based on known prognostic factors, the incidence of SN metastases was higher in patients whose cancer was diagnosed by FNA (odds ratio, 1.531; 95% confidence interval, 0.973-2.406; \( P = .07 \), Wald test) or large-gauge needle core biopsy (odds ratio, 1.484; 95% confidence interval, 1.018-2.164; \( P = .04 \), Wald test) than by excision. Tumor size \( (P < .001) \) and grade \( (P = .06) \) also were significant prognostic factors.

Conclusions: Manipulation of an intact tumor by FNA or large-gauge needle core biopsy is associated with an increase in the incidence of SN metastases, perhaps due in part to the mechanical disruption of the tumor by the needle. The clinical significance of this phenomenon is unclear.

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melanoma, the sentinel node (SN) concept is based on the fact that the afferent lymphatic channel draining the primary tumor courses first to an SN in that specific regional lymphatic basin. In 1994, Giuliano et al modified SLND for the staging of early breast cancer. Since then, intraoperative lymphatic mapping and SLND for breast cancer has emerged as a less invasive, more accurate staging procedure.9,10 Several SLND operative techniques have been successful in breast cancer.11-15

Because of reports of tumor displacement with different types of biopsies,16 we evaluated the incidence of SN metastases in patients undergoing FNA, large-gauge needle core biopsy, or excisional breast biopsy before SLND. We hypothesized that the type of biopsy might affect the incidence of SN metastases.

### METHODS

Between January 1, 1995, and April 30, 1999, patients with biopsy-proven invasive breast cancer and clinically negative axillary lymph nodes were entered into various prospective studies of SLND. If the SN contained no evidence of tumor, completion axillary lymph node dissection was not performed. If the SN contained tumor cells, axillary lymph node dissection was recommended and performed unless the patient refused further surgery. All patients signed an informed consent form in accordance with the ethics standards of the joint Saint John’s Health Center/John Wayne Cancer Institute institutional review board and in compliance with the Helsinki Declaration. Patients with primary tumors larger than 5 cm by physical examination or mammography, multicentric tumors, locally advanced disease, ductal carcinoma in situ, or stage IV disease when first seen were excluded. Also excluded were patients who underwent more than 1 type of biopsy for diagnosis of breast carcinoma.

Patients underwent breast biopsy at the Joyce Eisenberg Keefer Breast Center, John Wayne Cancer Institute at Saint John’s Health Center, or were first seen with a biopsy-proven diagnosis of breast cancer from an outside facility. All biopsies were FNA, large-gauge needle core, or excisional. Slides from outside facilities were reviewed by our pathologists to document carcinoma before SLND. Fine-needle aspiration was performed with a 23- or 25-gauge needle. Core biopsy was performed by the surgeon using a handheld technique or ultrasound guidance or by the breast imaging service using stereotactic or ultrasound guidance. An 11- or 14-gauge needle was generally used for stereotactic biopsies, with an average of 12 core samples; a 14-gauge needle was generally used for ultrasound core biopsies, with an average of 6 core samples. The exact needle size and number of core samples were not documented for this study.

Intraoperative lymphatic mapping and SLND was performed after a breast-conserving procedure or mastectomy. In most cases, the sole mapping agent was a vital blue dye (1% Lymphazurin blue dye; U.S. Surgical, Norwalk, Conn); in selected cases, blue dye was used with technetium Tc 99m sulfur colloid. If a radioisotope was added, it was injected either the day before or the morning of the SLND procedure, and a lymphoscintigram was obtained.

Evaluation of the primary tumor was performed by the Pathology Department at Saint John’s Health Center, and all original biopsy slides were reviewed. Sentinel nodes were step sectioned and stained at each level with hematoxylin-eosin. If the hematoxylin-eosin-stained slides did not reveal metastases, the nodal sections were stained by cytokeratin immunohistochemistry (IHC) with a monoclonal anticytokeratin antibody cocktail (Zymed Laboratories Inc, South San Francisco, Calif). Nodal metastases were stratified according to the American Joint Committee on Cancer (AJCC) staging effective during the treatment, based on the 5th edition of the AJCC Cancer Staging Manual. A micrometastasis was a tumor deposit measuring 2 mm or less on hematoxylin-eosin staining; a macrometastasis was a tumor deposit larger than 2 mm on hematoxylin-eosin staining; and an IHC metastasis was a tumor deposit identified only with IHC stains.

Univariate and multivariate logistic regression models were used to correlate tumor size, tumor grade, and type of biopsy to the incidence of SN metastases.

### RESULTS

Between January 1, 1995, and April 30, 1999, 663 patients with 676 invasive, clinically node-negative, biopsy-proven breast carcinomas underwent SLND at the Joyce Eisenberg Keefer Breast Center, John Wayne Cancer Institute at Saint John’s Health Center. The mean age of the patients was 58 years (range, 28-96 years). Most of the cancers (58%) were palpable on physical examination. Infiltrating ductal carcinoma accounted for 85% of cases, whereas infiltrating lobular cancer was identified in 15% of cases.

Of the 676 carcinomas, 126 were diagnosed by FNA, 227 by large-gauge needle core biopsy, and 323 by excisional biopsy. The mean tumor size was 1.85 cm (range, 0.1-9.0 cm). The mean tumor size was largest in the FNA group (2.08 cm) and smallest in the excisional group (1.63 cm) (Table 1). Although our exclusion criteria excluded patients with tumors larger than 5 cm on physical examination or mammogram, some patients did have pathologic tumors larger than 5 cm that had been underestimated by physical examination or radiologic workup. These patients were included in the study.

Most patients underwent breast conservation (83%) instead of mastectomy (17%). Overall, the tumors in this study had favorable prognostic markers. Most tumors were estrogen receptor–positive (83.5%), progesterone receptor–positive (63.0%), and epidermal growth factor receptor–negative (70.6%).

Sentinel node macrometastases, micrometastases, or IHC-detected metastases were identified in 39% of cases. The incidence of SN metastases was 47% in the FNA group, 49% in the large-gauge needle core group, and 32% in the excisional group. This was not surprising because the size of the primary tumor was larger in the FNA group than in the excisional group.

The SN(s) was the only positive node(s) in 61% of patients in the FNA group; 39% of patients had non-SN metastases, with a range of 1 to 16 positive non-SNs. The SN(s) was the only positive node(s) in 63% of patients

### Table 1. Number of Cancers and Mean Tumor Size by Biopsy Group

<table>
<thead>
<tr>
<th>Biopsy Group</th>
<th>Cancers, No.</th>
<th>Mean Tumor Size (Range), cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine-needle aspiration</td>
<td>126</td>
<td>2.08 (0.1-7.5)</td>
</tr>
<tr>
<td>Large-gauge needle core</td>
<td>227</td>
<td>2.03 (0.1-9.0)</td>
</tr>
<tr>
<td>Excision</td>
<td>323</td>
<td>1.63 (0.1-9.0)</td>
</tr>
<tr>
<td>Total</td>
<td>676</td>
<td>1.85 (0.1-9.0)</td>
</tr>
</tbody>
</table>
in the core group and 69% of those in the excisional group, with a range of 1 to 21 and 1 to 20 positive non-SNs, respectively. The presence of non-SN metastases and the number of positive non-SNs did not correlate with the biopsy type.

Of 59 metastases detected in the FNA group, 15 (25%) were IHC metastases, 7 (12%) were micrometastases, and 37 (63%) were macrometastases. Of 101 metastases detected in the core group, 27 (27%) were IHC metastases, 24 (24%) were micrometastases, and 50 (50%) were macrometastases. A similar trend was seen in the excisional group, where 35 of the 103 SN metastases were macrometastases. A similar trend was seen in the core group, where 35 of the 103 SN metastases were macrometastases.

The median interval between biopsy and the SLND procedure was 15 days overall (range, 1-232 days), corresponding to a median interval of 9.5 days for the FNA group, 16.0 days for the large-gauge needle core group, and 17.0 days for the excisional group. Some patients underwent neoadjuvant chemotherapy, which delayed the definitive surgical procedure, and other patients chose to delay their surgical intervention. The time from biopsy to SLND procedure was not significantly correlated with the presence of SN metastases (P = .29).

To determine whether the type of biopsy affected the incidence of SN metastases, a stepwise procedure was used to find the multivariate logistic regression model. This model was then used to correlate tumor size, tumor grade, and type of biopsy with the incidence of SN metastases. Univariate analysis demonstrated that tumor size, tumor grade, and type of biopsy independently correlated with the incidence of SN metastases (Table 3). Multivariate analysis based on known prognostic factors demonstrated that the incidence of SN metastases independent of age, tumor size, and tumor grade was higher in patients whose cancer was diagnosed by FNA or large-gauge needle core biopsy than by excisional biopsy. This difference was greater and statistically significant in the large-gauge needle core group vs the excisional group (P = .04) (Table 4).

To determine whether the type of biopsy affected the size of SN metastases, a multivariate logistic regression model was used to correlate tumor size, tumor grade, and type of biopsy with the size of SN metastases: macrometastases vs micrometastases and IHC metastases. In the FNA group vs the excisional group, a statically significant difference was noted; however, it favored the presence of macrometastases rather than the expected micrometastases and IHC metastases. In the large-gauge needle core group vs the excisional group, there was no statistical difference between type of biopsy and the size of SN metastases.

**COMMENT**

A suspicious mass identified during physical examination or by mammography or ultrasonography should be biopsied to determine whether it is cancerous. Large-gauge needle core, FNA, and excisional breast biopsies are safe and reliable diagnostic tools. Major complications, such as bleeding and infection, are rare and can often be treated in the outpatient setting. The type of biopsy chosen depends on the type, location, size, and palpability of the lesion and on the preference and experience of the individual performing the biopsy.

The use of FNA dates back to the 1930s, when it was first described for diagnosing breast lesions by Martin and Ellis. Its introduction was a response to concern that surgical excisional biopsy might lead to dis-
For more than 60 years, FNA has been an established procedure for the diagnosis of breast lesions in Europe, and it has become a more accepted approach in the United States in the past 30 years. Fine-needle aspiration is an easy and reliable way to diagnosis breast cancer in the palpable lesion. It is quick, relatively painless, and inexpensive. In a study and review of 3000 palpable breast lesions, FNA had a sensitivity of approximately 87%. However, its accuracy is highly dependent on the cytopathologist; a review of 31 340 FNAs demonstrated sensitivities ranging from 69% to 98% and specificities ranging from 34% to 100%. False-negative rates (reportedly 0%-4%) are often due to sampling errors and are more common in small, well-differentiated carcinomas and lobular carcinomas. Kline et al reviewed 3345 breast aspirates; in half of the false-negative cases, the needle tract did not extend into the tumor; most of these tumors measured less than 1 cm. Among experienced cytopathologists, a false-positive result is rare (0%-0.4%).

Diagnostic large-gauge needle core biopsy is a safe and effective alternative to FNA or excisional biopsy. A core biopsy sample allows a more detailed histologic interpretation that can more completely characterize the lesion and often distinguish between invasive and noninvasive disease. Core biopsy can be performed using manual palpation, ultrasound guidance, or a stereotactic approach. Because needle sizes ranging from 11 to 18 gauge allow collection of larger specimens, insufficient specimens are uncommon. The biopsy sample is evaluated by a pathologist rather than a cytopathologist, which obviates the need for personnel specially trained in cytopathology and permits the evaluation of tumor architecture. Sensitivity and specificity rates are high for large-gauge needle core biopsy. In one study, a 79% accuracy rate was reported, with no false-positive results. In another study, a sensitivity of 89% increased to 94% in lesions larger than 2.5 cm. Large core samples obtained using 14-gauge cutting needles improve sensitivity, specificity, and overall diagnostic accuracy compared with FNA or smaller core samples.

For breast cancer and other tumors, FNA carries a theoretical risk of tumor seeding, but the incidence of needle tract seeding is low. Seeding of the needle tract and mechanical displacement into the lymphatic or vascular system has been documented in breast cancer, but the clinical implications are not known. None of these studies documented a survival disadvantage with FNA.

In an animal study, Ryd et al performed FNA in solid and ascites-growing mouse tumors. The incidence of “successful tumor takes” was a function of the number of cells seeded after FNA and was in the range of 10³ to 10⁶ cells. Tumor seeding of the core biopsy needle tract has been reported in several series, but again the clinical significance of these findings is not known. The incidence of tumor seeding has been shown to increase with larger needle diameters. Diaz et al reported a 32% incidence of tumor cell displacement after large-gauge needle core biopsy; the incidence and amount of tumor displacement was inversely related to the interval between core biopsy and excision, suggesting that displaced tumor cells do not survive displacement. Other researchers report a diagnostic dilemma with displaced tumor cells in the breast stroma owing to large-gauge needle core biopsy, particularly in patients with noninvasive cancer. Several studies have evaluated the impact of core biopsy on local recurrence. In a study by Chao et al, 2 cases of subcutaneous breast cancer recurrence at the stereotactic biopsy site were identified 12 and 17 months after definitive treatment of the primary breast tumor. An additional patient underwent excision of the skin and dermis at the time of mastectomy, and tumor cells were identified in the dermal scar. All 3 patients had undergone a stereotactic core biopsy with multiple passes of a 14-gauge needle followed by modified radical mastectomy. Other studies have not documented an increase in local recurrence rates.

Few studies have examined lymph node findings after needle biopsies. Carter et al described histologic findings in axillary lymph node dissections performed 2 weeks after needle core biopsy (n=3) or excisional biopsy (n=12). All breast excision specimens showed evidence of previous surgical manipulation, and 3 specimens contained displaced cellular fragments in the lymphovascular spaces next to the needle track. Each case had breast-derived epithelial cells in the subcapsular sinus of a draining lymph node; however, in 4 cases these epithelial cells were not from the breast cancer. The authors concluded that previous surgical or needle manipulation could cause mechanical transport of tumor or normal breast epithelium to the subcapsular sinus of the lymph node and that these displaced cells do not have a negative effect on prognosis.

The results of the present study indicate that the type of biopsy is associated with differences in the incidence of SN metastases. We agree with Carter et al that nodal metastases may reflect mechanical manipulation and disruption of the tumor by the biopsy needle, but no statement can be made regarding whether these metastases would eventually impact regional recurrence or overall survival. Fidler and Hart showed that a growing primary tumor contains heterogeneous populations of cells, some of which are highly metastatic. Tumor cell dissemination is thought to occur shortly after primary tumor vascularization, and most metastases from a primary breast cancer are initiated when the primary tumor is smaller than 0.125 cm. Although mechanical disruption might facilitate the lymphatic transport of metastatic cells, the successful colonization and growth of these cells in a draining lymph node is a highly complex process. If tumor-host interactions do not favor the development of clinically relevant metastasis, mechanical disruption might well prove to be prognostically unimportant.

Many breast cancer studies have attempted to document the significance of occult nodal metastases identified by evaluation of multiple sections and IHC stains. The results of these studies are conflicting, and the true significance of these metastases remains unknown. The American College of Surgeons Oncology Group recently completed accrual to the Z0010 study, which was designed to evaluate the significance of micrometastases in the SN or the bone marrow of patients with invasive breast cancer. It is hoped that the results of this study will finally address the significance of microme-
tastases in the regional lymph nodes of patients with invasive breast cancer. In the meantime, further investigation is needed to confirm our observation that the type of biopsy is associated with the incidence of SN metastases. Until this observation can be further evaluated and validated, we do not plan on changing our practice patterns, which presently incorporate the use of FNA, large-gauge needle core biopsy, and excisional biopsy in the management of breast lesions.

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Corresponding author: Nora M. Hansen, MD, Joyce Eisenberg Keefer Breast Center, John Wayne Cancer Institute at Saint John’s Health Center, 2200 Santa Monica Blvd, Santa Monica, CA 90404 (e-mail: hansenm@jwci.org).

REFERENCES

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DISCUSSION

Clive Grant, MD, Rochester, Minn: I admire the fact that even after pioneering the technique of sentinel node biopsy, [Dr Hansen and colleagues] continue to investigate its utility and ramifications.

They have studied scientifically what many patients ask: “Does disturbing the tumor by needle biopsy lead to an increased risk of tumor spread?” While we clinicians have tended to answer such a question glibly, “no,” we have just heard evidence, “yes it does—needle biopsy whether by FNA or core needle increases the frequency of SLN metastases.”

Before we fully accept these findings, it is incumbent upon us to search for other potential explanations for their results, which leads to my questions:

1. In performing sentinel lymph node mapping, could you be confident that you had not violated the tumor when injecting blue dye adjacent to it?
2. Similarly, how did you control for operatively cutting into or across the tumor in the 3 groups?
3. In the literature, Dr Rosser has suggested that the mere trauma of breast massage to enhance lymphatic transfer of dye into or across the tumor in the 3 groups?
4. Did you log the time interval between the needle biopsies and the tumor excision, and if so, did you have a chance to analyze if this had any impact?
5. And last, were records kept on the location within lymph nodes of the metastases, eg, to differentiate subcapsular malignant cells from metastatic deposits within the parenchyma of the lymph nodes?

Needle tract seeding is an uncommon but previously documented problem. However, in contrast to the use of needle biopsy in most other settings, in breast cancer it has become the standard of care prior to curative management. Even if these lymph node metastases are traumatized and might not survive or influence subsequent disease relapse, it would seem that they could have profound implications at least on subsequent adjuvant therapy recommendations.

Dr Hansen: The topic of this paper really was borne out by Dr Morton, who questioned the role of needle biopsy due to the risk of tumor cell dissemination. I embarked on this study to allay his concerns, but it seems as though from our results that he was correct. I think the findings of this study are interesting, but currently have not changed our management. We still perform fine-needle aspirations and core biopsies to diagnose cancer. Until I have a good explanation as to why this is happening, we will continue our current practice because it does afford the patient the opportunity to make treatment decisions prior to surgical therapy. To answer your questions, we use peritumoral injection technique with blue dye. Although I can’t be sure that cells are not disturbed by the injection technique, since we don’t inject into the tumor, I would postulate that this would be a low risk. We perform the sentinel biopsy prior to resecting the tumor, so in a sense we are not disturbing the tumor by cutting through it, at least in the FNA and core groups. In the excision group, the tumor had been previously excised. If a reexcision was necessary, it was also performed after the SLND procedure. We perform massage in all cases. I do believe massage has the potential to promote transport of cells through the lymphatics. We use massage to improve migration of the radioactive tracer and blue dye to the sentinel node so it is also reasonable to conclude that we may also be promoting transport of cells to the sentinel node. I don’t know if just by massaging the tumor itself you can push cells from the tumor into the lymphatics, but no one really knows that and the only thing I can say is that we performed massage on everyone, so if there was an effect, it was a similar effect overall.

We did look at the time interval between biopsy and sentinel node procedure, but we didn’t correlate it to whether or not that impacted on the metastasis rate, and that would be a good parameter to further investigate. In terms of the location of the metastasis in the sentinel node, we didn’t specifically look at it in all of these individual patients; however, most of the early metastases are in subcapsular sinus. Many patients in this study had macrometastases, and when we looked at the size of sentinel node metastasis (IHC, micro, and macro) and correlated it with the type of biopsy, there was not a statistical correlation. It would be easier for me to believe our results if we saw a higher percentage of IHC metastases in the FNA and core group, which would theoretically make more sense. We don’t really know what size of metastases can be traumatically displaced into the lymphatic space or vascular space. We assume it is individual cells, but there is no documentation that I have seen that defines the size of particles capable of being transported through the lymphatics. The results of this study are interesting, and we wanted to bring them to this meeting; however, further investigation is needed to determine if these findings are truly related to the type of biopsy.

Leigh Anne Neumayer, MD, Salt Lake City, Utah: This is really an interesting study, but as a clinical trialist, I want people to be certain to not jump from association to cause, and I think by your comments you now realize that for those of us who believe that breast cancer doesn’t happen overnight and that metastases don’t happen overnight that your time from biopsy or FNA to sentinel lymph node dissection of around 9 or 10 days really isn’t long enough to cause 60% of the patients to have macrometastases. It seems to me that you must be pushing whole tumor boluses, and they are able to set up housekeeping and replace the lymph node within hours or days rather than a month or 2. I really want to make sure that people don’t take your findings and make them mean a lot more than what they really do, which is just an association. Remember that often what we are measuring in clinical trials or any prospective studies in particular are surrogates for other things, and we don’t know, but something you didn’t measure may be the causal factor for your findings.

Dr Hansen: I agree with you and I want to emphasize that what we are reporting is an association between the type of biopsy and the incidence of sentinel node metastasis. We have no definitive proof that the type of biopsy actually leads to the metastasis.

Charles W. Putnam, MD, Tucson, Ariz: Recent data in the basic scientific literature indicate that the genotypic changes in breast cancer that facilitate or even enable metastases are extraordinarily early events in the evolution of this tumor. Those data could be taken as arguments either against the basic hypothesis that the biological dice have already been cast by the time a biopsy is performed. Or, the same data could be cited as indicating that kicking down the door, if you will, by inserting a needle might release cells that are already capable of engaging in metastatic behavior. Have you or are you looking at some of the genotypic markers reflecting metastatic ability to see if,
in fact, those cells in the sentinel nodes or in the primary tumor itself have already developed the ability to engage in metastatic behavior before the biopsy needle enters the tumor.

Dr Hansen: Investigators at our institution are evaluating primary cancers and sentinel nodes at the cellular level in an attempt to find cells that have a higher metastatic potential. If we could identify which cells had been transported to the lymph node as a result of the biopsy and evaluate those cells, we could potentially define a population of cells with the metastatic capability.

Stephen Gordon Remine, MD, Southfield, Mich: While you are measuring the regional effect of what happens to the fine-needle aspiration, did you still have the material and can you look at the local effect with cytokines EGF [epidermal growth factor] or interleukins to see if there was any significant change in the tumor once it is biopsied and then taken out later? You stated that you did not change your pattern of care. What will it take from additional studies for you to change your pattern of care if not based on this study? And as a last question, there were a number of the patients whom you biopsied where the final excision of the sentinel lymph node was not done until many days later, even in the hundreds. Can you comment on that?

Dr Hansen: We have not evaluated the regional effects of the biopsy with regard to cytokines such as EGF or interleukins, but that would be an interesting study. Our overall median time from biopsy to SLND was high. There were some cases where the SLND procedure was performed greater than 100 days from the biopsy. The outliers were a result of patient choice (they delayed surgery), or the patient had undergone neoadjuvant chemotherapy. In retrospect, I should have excluded those patients with neoadjuvant therapy because the therapy may have influenced the presence of sentinel node metastasis, but there were only a few patients, and the analysis had been completed. We have not changed our clinical practice and continue to perform FNA and core biopsies prior to SLND. I think it is important to have a diagnosis prior to surgical intervention so that a patient can be involved in the surgical management decisions. If we demonstrate a negative impact on survival as a result of FNA or core biopsy, it is at that time that our practice will likely change. Until then, we plan on continuing to perform FNA or core biopsy to diagnose a breast cancer.

Don M. Morris, MD, Albuquerque, NM: Was there any association with tumor grade? One might expect a high-grade tumor to be more likely to do this than a low-grade tumor.

Dr Hansen: We did adjust for tumor grade and tumor size in our multivariate analysis. The type of biopsy (core vs excision) did significantly affect the incidence of sentinel node metastasis, and this was independent of tumor size and tumor grade.

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**Hypertension in Acute Ischemic Stroke: A Compensatory Mechanism or an Additional Damaging Factor?**

Andrea Semplicini, MD; Andrea Maresca, MD; Gabriele Boscolo, MD; Michelangelo Sartori, MD; Roberta Rocchi, MD; Valter Giantin, MD; Pier Luigi Forte, MD; Achille C. Pessina, MD, PhD

**Background:** In acute ischemic stroke, a transient blood pressure (BP) elevation is common, but the best management is still unknown. Therefore, we investigated retrospectively the relationship between BP after ischemic stroke and neurological outcome (evaluated by means of the National Institutes of Health Stroke Scale score at day 7).

**Methods:** The medical records of 92 consecutive patients with acute ischemic stroke, aged 47 to 96 years, were examined. Blood pressure was measured on admission, 4 times during the first 24 hours, 3 times daily for the first 4 days, and twice daily on day 7 (or at discharge). Antihypertensive treatment was given according to American Heart Association guidelines.

**Results:** The region damaged by the stroke was total anterior in 16 patients (17%), partial anterior in 30 (33%), lacunar in 34 (37%), and posterior circulation in 12 (13%). Stroke pathogenesis was cardioembolic in 28 (30%), atherothrombotic in 29 (32%), and lacunar in 34 (37%). The systolic BP range was 140 to 220 mm Hg; diastolic BP, 70 to 110 mm Hg. Initial BP the highest BP during the first 24 hours. The neurological outcome was strongly influenced by baseline stroke severity (NIH Scale score) and admission BP. Better initial neurological conditions and higher initial BP resulted in better neurological outcomes.

**Conclusions:** The outcome of stroke is influenced by the type of stroke and initial BP. Lacunar stroke and the highest BP on admission carry the best prognosis, whereas the reverse is true for posterior circulation infarction and low BP. We found no evidence that, within the present BP range, hypertension is harmful and that its lowering is beneficial. (2003;163:211-216)

*Corresponding author and reprints: Andrea Semplicini, MD, Department of Clinical and Experimental Medicine, Clinica Medica 4, University of Padua Medical School, Via Giustinianini 2, Padua, Italy (e-mail: andrea.semplicini@unipd.it).*


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