Surgical Breast Tissue Specimen Handling and Transportation in Radiology

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In the United States, approximately 1.6 million surgical breast biopsies are performed each year. The preferred treatment of clinically nonpalpable breast masses is wide local excision by wire-guided localization.[1] Specimen radiography should be performed on the excised breast tissue of all image-detected abnormalities found during preoperative workup[2] because radiologic assessment of the margins of a nonpalpable breast mass can be used to assess the surgical procedure.[3] Furthermore, some type of specimen imaging is required as a standard of care according to the American College of Radiology guidelines for the evaluation of surgically excised breast ductal carcinoma in situ as well as invasive breast carcinoma.[4,5]

Breast tissue specimens are transported from surgery to radiology and then to pathology for final histological examination. Transportation and handling procedures vary among facilities. Some facilities place specimens in simple plastic containers, such as an emesis basin, to look for needles, wires, and previously placed markers to assist in analyzing excised breast mass margins. Some use tissue containers with alphanumeric grids to make a more precise evaluation, providing the exact location of an excised mass. Others might place additional needles in the tissue or use dye, such as India ink, to indicate the location of the lesion of concern for the pathologist.

A 2014 survey of Society of Breast Imaging members about breast tissue specimen handling revealed that almost every facility had a protocol for handling the specimen and that the protocols varied because no standardized method for storing, imaging, and transporting the specimen between the departments existed.[6] According to the study, 60% of radiologists indicated that the specimen gets transferred 2 or more times, in different containers, during transport from surgery to radiology, back to surgery, and finally to pathology. In some cases, the radiologists were unaware of the process, but they all used various types of tissue handling and transporting containers based on the physician's preference or procedure location.[7] The need to transfer the specimen several times increases the risk of spilling bodily fluids, contaminating equipment, and exposing hospital personnel to blood or to injury with needles remaining in the excised tissue. Furthermore, only 13.8% of survey respondents were aware of the costs of using several containers during specimen transfer and imaging.

Nearly all of the radiologists who participated in the survey (94.6%) agreed that a standardized method for breast tissue specimen handling would result in more uniform results and an overall improvement in patient care. This article describes a standardized method for handling and transporting excised breast tissue specimens from the operating room to the radiology department throughout several medical centers at the Henry Ford Health System in Detroit, Michigan.

Procedure and Methods

The breast tissue handling process starts with wire localization performed in the medical imaging department the day of surgery. Radiologists guide the needle

to the area of interest using mammography images or ultrasonography. They place more than one wire if a mass is large or additional nodules are present. After this procedure, another mammogram is performed, and precise measurements are made and used as a reference for surgery.

Next, a completed patient information label is attached to a tissue specimen container that includes an alphanumeric grid. This is the only container used in every step of the procedure; the specimen is not switched to another container. The labeled container is transported with the patient to surgery. The area of interest is excised, and the tissue specimen is placed within the container for transport to radiology. The operation usually is paused while the specimen is being evaluated for definitive mass margins in the radiology department.

Once the breast tissue specimen arrives in the radiology department, mammographers use 2 identifiers to verify that the label on the specimen container matches the patient. The container is opened and tissue is compressed using the alphanumeric grid. The grid is used to flatten the specimen for better image resolution. After the lid is replaced, the container with the breast tissue specimen is placed on a mammography Bucky for magnification imaging, and no further tissue handling or preparation is required (see **Figure 1**).

After imaging, the mammographer asks the radiologist to check the specimen images (see **Figure 2**). Mass margins visualized on the image confirm a successful and complete mass resection and that no additional tissue removal is necessary. The grid is removed and discarded, and the container with the tissue is transported immediately to the pathology department.

Analysis and Results

Initially, analysis of breast surgical specimen management and transportation at the different medical centers in the Henry Ford Health System revealed that 3 containers were used to evaluate breast tissue specimens at different locations. Members of the breast imaging department, with the help of the supply chain management team, sought to develop a standardized process that would improve cost efficiency and safety in handling the excised breast tissue specimens at all locations.

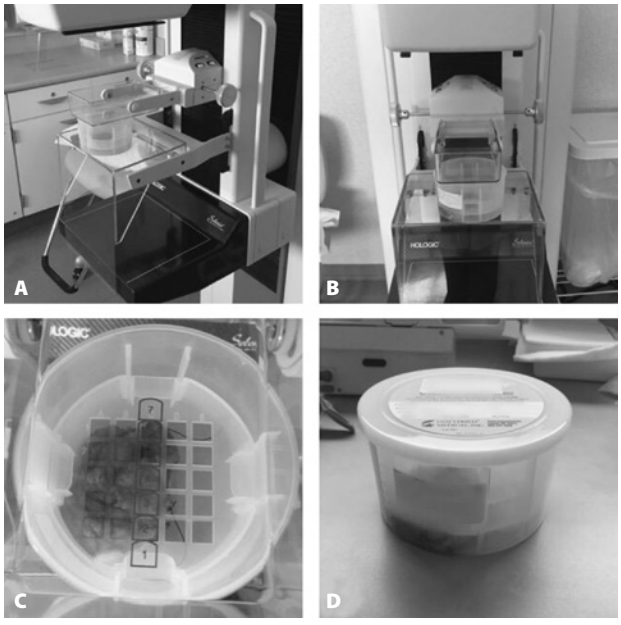

Figure 1. *A-B. Photographs of a breast tissue specimen within container C after the grid is placed. C. Superior view of the container with the compression grid in place. D. Sealed container C with specimen. Images courtesy of the authors.*

Each of the 3 containers (A, B, and C) in use had different features. Container A was a thinner, smaller plastic container containing a paper grid.[8] Container B also was made of thinner plastic and contained a coated grid.[9] Container C was made of thick, leak-resistant plastic and contained a compression grid.[10]

All 3 containers were compared to discern their safety, accuracy, ease of handling, and cost. Container A was well built and sufficiently tough to prevent needles or wires from puncturing the container. The paper grid attached inside was helpful in describing specimen size and orientation. However, the container itself was thin and could not seal tightly with a larger specimen, which increased the potential to spill bodily fluids during transport. Although container B could be sealed well, it was not sturdy enough to prevent a needle or wire sticking through and posed a risk of injury. It did, however, have the advantage of keeping the specimen in place; the special coating on the grid consisted of 2 sets of radiolucent coordinates that enabled more precise localization. Container C's thicker plastic resisted

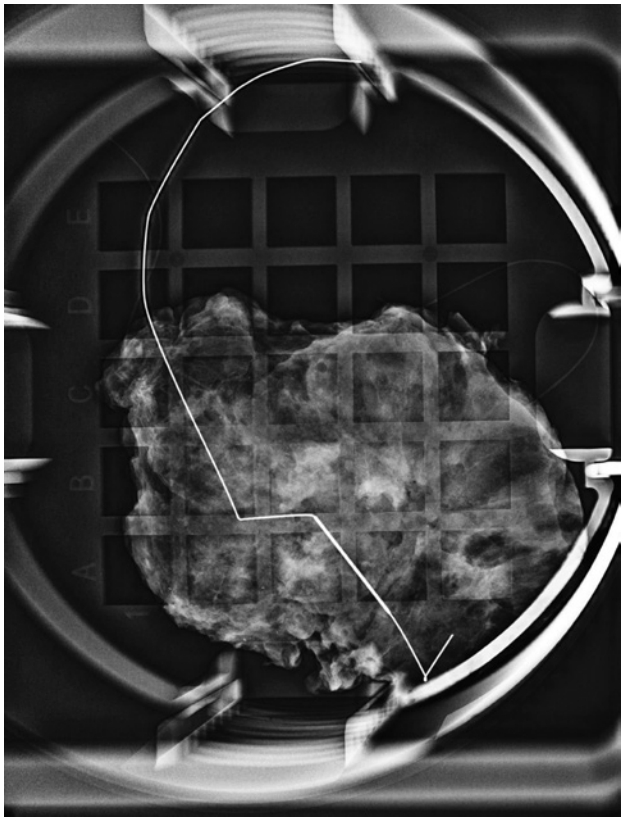

Figure 2. *Radiograph of a surgical breast specimen with a localization wire in container C with a grid. Image courtesy of the authors.*

sharp objects such as wires and needles and was able to accommodate a considerably large tissue specimen, which for the most part eliminated the need for multiple containers (see **Figure 3**). Furthermore, container C had a tightly closing lid with an inner lip that snapped into place after applying pressure. This design creates a seal and prevents bodily fluid from leaking during transportation. In addition, this container had an adjustable grid that could slide into place and provide the reference location while keeping the tissue specimen in place during transportation. The sliding grid also helped provide pressure to the excised breast tissue specimen during imaging.

A cost analysis was performed by identifying all the items used in imaging and handling surgical breast specimens among the various medical centers. In addition to the tissue specimen containers, imaging departments at some facilities used other items that contributed to increased cost and waste (see **Box**). Further analysis revealed a significant cost difference among the 3 containers. After comparing the cost of using all 3 containers as well as the additional items, container C was determined to be the most cost-effective method for handling, imaging, and transporting breast tissue specimens. Moreover, supply chain management's system-wide projective cost analysis revealed that switching to container C resulted in an overall projected savings of 27% to 28% (see **Table**).

Figure 3. *Surgical breast specimen container with grid. Image courtesy of PathProof, LLC.*

As a result of the analysis, radiologists and surgeons performing surgical breast biopsies in the system switched to using only container C for all steps of the procedure. The standardized process provides consistency and unity. Furthermore, container C's features address the safety of health care workers, minimizing the risk of spilling bodily fluids and injury.

Box

Items Used for Handling Breast Tissue Specimens at the Henry Ford Health System

Emesis basin
Chux blue pad
Filled formalin jar (90 or 250 mL)
Formalin solution (90 or 250 mL)

Table

Cost Comparison Analysis

Medical Facility	Projected Savings (%)
West Bloomfield Hospital	10-12
Henry Ford Hospital	10-12
Macomb Hospital	51
Fairlane Medical Center	25-26
Wyandotte Hospital	10-12
System-wide Savings	27-28

Discussion

Throughout the United States, there is significant variability in the way breast tissue specimens are handled. Some facilities use generic plastic containers or bags to transport and image excised breast specimens, whereas other institutions prefer one of several commercially available products.[11] The decision remains the radiologist's choice, primarily because no standardization exists. However, this preference is not always coordinated with the surgery department, and the breast tissue specimen being transported from the operating room might not remain in the same container for assessment in the radiology department. Consequently, institutions should review, evaluate, and standardize the protocol with which specimens are handled and transported from surgery to radiology and then to pathology.

Although cost is the most obvious concern when implementing new procedures, departments also must consider patient care, risk of exposure to blood-borne diseases, and injuries from wires and needles to health care workers and patients.

The Occupational Safety and Health Administration reports more than 385 000 documented needle-stick injury cases in hospitals per year.[12] According to the Centers for Disease Control and Prevention, a health care worker who incurs a needle-stick injury is exposed to hepatitis B 30% of the time, hepatitis A 1.8% of the time, and HIV 0.3% of the time in reported cases.[13] Furthermore, the Centers for Disease Control and Prevention estimates the cost of postinjury treatment and monitoring to be almost $3000 per case when taking all cases into consideration. This figure does not include inherent physical costs associated with any lost work time for the exposed employee to receive care or the emotional stress related to the postinjury anxiety. Thus, the use of a container designed to facilitate additional safety runs parallel to the Centers for Disease Control and Prevention and Occupational Safety and Health Administration guidelines that encourage the use of built-in safety.

Each facility should evaluate its needs, cost efficiency, and safety concerns before committing to changes. The most important outcome is the standardization of surgical breast tissue specimen handling and management, which can improve result accuracy, cost efficiency, procedure safety, and overall quality of patient care.

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