In this issue of CHEST (see page 738), the article by Chandan and colleagues offers a look at the utility of core roll preparations (CRPs) for the immediate assessment of neoplastic lung lesions. For those who have not heard the phrase core roll preparation before, it is used by the authors to refer to a type of imprint cytology sample that can be obtained from core needle biopsy specimens. Essentially, the core needle biopsy sample is transferred to and lightly rolled on a glass slide, to produce a cellular preparation that can be rapidly air-dried, stained, and reviewed by the pathologist to provide feedback about lesional representation and, often, diagnosis. The authors retrospectively reviewed stained slides from fine-needle aspiration (FNA) and core needle biopsy/CRP samples collected from the same patient during the same visit, and have reported that a specific malignant cell type could be determined for 23 of 25 patients (92%). This result was superior to those they obtained from FNAs alone or CRPs alone, both of which usually provided a malignant diagnosis but often were not conclusive, alone, for the determination of a specific histologic tumor type. Whether the results reflect the complementary values of both techniques or, instead, reflect the added value of more samples, cannot be discerned from the numbers. The authors, however, favor complementarity and suggest that the CRP smear pattern can provide architectural information that can help with the assignment of a specific histologic tumor type.

Applications of imprint cytology to the evaluation of core biopsy samples have been studied most extensively for breast diseases and have received relatively scant investigation outside of this area.\(^1\)\(^–\)\(^13\) That this is true was surprising to the author of this editorial, who, over the last several years, has had extensive hands-on experience using this technique to evaluate core needle biopsy specimens of a wide variety of lesions, including many lung masses. A recently published paper by Paulose and colleagues\(^6\) represents the largest study of touch imprints performed on core biopsy samples of the lung. This study focused on a slightly different question than did that of Chandan et al, and compared touch imprint cytology interpretations with the histologic interpretations of the parent core needle biopsy specimens, revealing sensitivity, specificity, positive predictive value, and negative predictive value of 89%, 100%, 100%, and 68%, respectively, for the imprint smear interpretations.\(^6\)

In my institution, as at the institution where the study of Chandan et al was performed, pathologists often use rapid touch imprint cytology sampling on core needle lung biopsy specimens to ensure that the tissue acquired is adequate to establish a firm histologic diagnosis, for triaging tissue for additional studies (eg, cultures, flow cytometry, genetic studies, and electron microscopy), and for eliminating unnecessary additional passes. The downstream effects of our immediate interventions have resulted in

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Core Roll Preparations and the Pathologist as Consultant

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numerous diagnoses of malignant neoplasms. Biopsy specimens manifesting opportunistic infections in immunocompromised patients and granulomatous infections in otherwise healthy people also have been appropriately sent for culture and histochemical staining due to the rapid evaluation of the sample. Counting the number of passes that theoretically were not performed, and the number of repeat procedures avoided, is something we have not pursued, but I am sure that these numbers are not negligible.

In fact, the topic of the article by Chandan et al touches on a greater issue, the potential for multi-specialty collaboration to improve the quality of clinical care. Although pathologists often have had little involvement in procedural planning, the immediate assessment of an FNA sample and/or CRP, like the frozen section, incorporates the pathologist into this process and results in an improved procedural outcome. Other opportunities exist for the proactive inclusion of the pathologist in the planning of diagnostic procedures. Most pathologists are trained in the selection of tests pertaining to the diagnosis of diseases in anatomic pathology samples. Deciding when a fresh tissue sample is needed for immunofluorescence, histochemical staining, flow cytometry, or gene rearrangement studies is covered in the typical anatomic pathology residency, and most pathologists can serve as resource personnel for clinicians who would like advice about when to consider performing these procedures. It is also to the advantage of the pathologist to supply this expertise, since the pathologist will eventually be responsible for interpreting the patient’s biopsy results, whether they come with or without the findings of additional studies.

A preprocedure consultation with the pathologist also can be helpful for deciding which surgical and/or cytologic procedure is best suited for the individual patient. Most benign processes in the lung, for example, cannot be definitively diagnosed by FNA and usually require the architectural information supplied by a biopsy specimen for diagnosis. Although interstitial lung diseases cannot always be diagnosed by tranbronchial biopsy, in the right clinical and radiographic context tranbronchial biopsies may supply enough information for the diagnosis of most of these disorders. For some interstitial lung diseases, however, a wedge biopsy is needed to document the appropriate histopathologic pattern.

Many practitioners and researchers have sought methods for obtaining the maximum information from tissue samples, while minimizing the various “costs” to the patient. The article by Chandan and colleagues provides us with one more route to achieve this goal. In this molecular age, I expect that we will see many more variations on this theme.

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Complications of CT Scan-Guided Lung Biopsy

Lesion Size and Depth Matter

Percutaneous transthoracic biopsies are commonly performed for the diagnosis of thoracic lesions. Early reports of needle biopsies of the lung were published in the late 1800s. In 1883, Leyden biopsied the consolidated right lower lobe of a moribund 48-year-old man. The specimen was stained, and bacteria and WBCs were identified. Pneumonia was diagnosed, unfortunately, the patient died 1 day later. Menetrier described a 51-year-old man who presented on May 25, 1885, with a productive cough, fever, and physical examination findings positive at the left base. On July 14, 150 mL pus was extracted via a needle, and the organism was identified as *Streptococcus pyogenes*. The patient died on October 19 of that year. Autopsy showed an organized left pleural empyema with no malignancy. Since then, needle biopsy has gained wide acceptance for diagnosing malignant and benign lung lesions. The common modalities employed in the guidance of percutaneous lung biopsy are fluoroscopy and CT scanning. Since the advent of CT scanning, fluoroscopic guidance has been utilized less often, and CT scanning and CT scan-fluoroscopic guidance dominate the current literature. Ultrasound guidance can be used for the biopsy of subpleural lesions. However, the use of ultrasound as an imaging modality for guiding lung biopsies has not been widely adopted.

Technologic advances in both needle design and imaging equipment have broadened the range of lesions that are accessible to needle biopsy. Lung biopsies can be performed by fine-needle aspiration (FNA), providing a specimen for cytologic examination, or using an automated core biopsy needle, providing a specimen for histologic examination. FNA was introduced by Nordenström in 1965. Numerous reports have advocated the use of FNA, since it is a reasonably simple and safe technique with an accuracy of about 95% for malignant lesions, despite a lower yield for benign lesions. Early reports cited cytology to be less reliable than histology in determining the cell type of malignant lesions. This disadvantage can be obviated by the presence of a cytopathologist during the biopsy, which has been shown to increase the diagnostic accuracy of FNA. However, at many centers, well-trained cytopathologists are not available to immediately interpret FNA specimens. To avoid this problem, several series have advocated the use of automated cutting needles to obtain core tissue for histologic evaluation. Complication rates for automated cutting needle biopsies are comparable to, or slightly higher than those for FNA.

The most common complications of percutaneous transthoracic lung biopsy are pneumothorax and bleeding. Pneumothorax has a broad frequency range of 8 to 64%. Bleeding occurs less often (range, 2 to 10%) but is more frequently fatal. Many reports have evaluated the relationship between specific variables and the complications of percutaneous lung biopsy. Complications are evaluated according to variables related to the patient, the lesion, and the biopsy procedure.

In this issue of CHEST (see page 748), Yeow et al analyzed the risk factors for pneumothorax and bleeding for 660 consecutive CT scan-guided percutaneous coaxial cutting needle biopsies. They consistently performed coaxial cutting needle biopsies because an on-site cytopathologist was not available. The diagnostic accuracy of these biopsies has been previously reported. Multiple variables related to the patient, the lesion, the biopsy needle, and the radiologist were assessed using univariate and multivariate analysis to determine the influence of each specific variable on the rate of pneumothorax and bleeding. The analyzed variables included the presence of emphysema, chest wall thickness, lesion size and depth, lesion necrosis or cavitation, needle size, number of specimens obtained, needle-pleural angle, and the experience of the radiologist performing the biopsies.

The results of multivariate analysis showed that patients with lesions ≤ 2 cm had a higher incidence of pneumothorax than did those with larger lesions. In fact, the risk of pneumothorax was 11 times greater for patients with lesions ≤ 2 cm compared with patients with lesions > 4 cm. Smaller lesion size has been reported previously to correlate with an increased risk of pneumothorax. This may be due to the difficulty in maneuvering the needle into the target lesion, thus extending the time required to biopsy smaller lesions.

The pleura-to-lesion distance was the second factor influencing the risk of pneumothorax. Haramati...