Thin Needle Aspiration Biopsy of Endocrine Organs

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ABSTRACT

The purpose of this paper is to summarize the advantages and disadvantages of the fine needle aspiration technique in reference to the endocrine organs. The principles of technique and interpretation are presented. The application of aspiration biopsies to the breast, the prostate, the pancreas and the thyroid are briefly discussed.

Introduction

The use of a cell sample obtained by aspiration of a tumor or of a lesion for diagnostic purposes in an American invention. In 1930, Hayes Martin, who was to become one of the foremost head and neck surgeons of our era, and Edward Ellis, who was Dr. James Ewing’s histology technician, jointly published a paper entitled, “Biopsy By Needle Puncture and Aspiration.” It is a matter of record that this method of diagnosis has not become widespread in the United States and, for many years, has been confined to the daily practice at the Memorial Hospital for Cancer in New York City. It is also a matter of record that a number of European investigators, most notably Sixtus Francén and Josef Zajicek in Stockholm, rediscovered the needle aspiration biopsy of organs. They modified the method somewhat by using a thin rather than a large caliber needle and by devising an instrumentarium which is suitable for application of the method to the aspiration to almost any organ in the body. It is also a matter of record that with the development of aspiration cytology throughout Europe the American pathologists and clinicians became interested in utilizing this relatively simple technique for diagnostic purposes.

The technique offers a number of major advantages: the aspiration itself may be performed on an outpatient basis and, in skilled hands, it is painless or nearly so. The preparation of the material for interpretation can be very rapid by use of a few very simple technical pointers. In skilled hands, the interpretation of cell patterns, and notably the differential diagnosis between a cancer and a benign lesion, is usually accurate and may encompass a precise diagnosis of the disease. There are also several disadvantages to this method of diagnosis, the most important of which are the lack of familiarity of clinicians with the technical require-
ments of the method and of most pathologists with cell patterns of diagnostic significance. It might be added that these cell patterns are quite different from histologic abnormalities and are difficult to interpret in the absence of training and experience.

In our experience, which spanned many years at the signout desk at the Memorial Hospital and now quite a few years in association with other institutions, it has been relatively easy to teach the interested parties how an aspiration biopsy should be interpreted. It is more difficult to share with the clinicians the secret of a successful aspiration biopsy, namely an impeccable technical preparation of the material.

The Instruments

The instrumentarium necessary for a successful thin needle aspiration biopsy is very modest (figure 1). A syringe with a tightly fitting piston, placed in a specially devised grip handle, and an assortment of needles of various calibers and various lengths are required. The grip handle allows for the performance of the aspiration procedure with one hand only, while the other hand fixes the target. For the aspiration of organs not accessible to palpation, and most notably intrathoracic and intrabdominal organs, the association of the pathologist with a skilled roentgenologist is essential. The development of ultrasound techniques and of the CAT scanner has now provided the means to guide the needle securely and safely to almost any organ in the body. At Montefiore Hospital and the affiliated Hospital of the Albert Einstein College of Medicine, aspirations of intrathoracic and intrabdominal organs are now commonplace.

Methods of Smear Preparation

There are essentially two methods of preparation of the aspirated material. In both of them, a thinly spread smear of the aspirated material is important. In one of them, the aspiration material is fixed immediately in preparation for Papanicolaou staining and, in the other method, at least one and sometimes all of the slides are allowed to air dry for staining with Giemsa
or one of the hematologic stains or, in some institutions, with hematoxylin and eosin. Residual solid material may be processed by paraffin embedding (cell block technique).

**Targets of Aspiration**

Within the framework of this discussion, the endocrine organs which are most readily accessible to aspiration biopsies are the breast, the prostate, the pancreas and the thyroid. For each one of these organs, a somewhat different approach is required. Breast lesions which are palpable can be aspirated directly under local anesthesia, although most patients will tolerate the insertion of the thin needle without any prior preparation. For lesions of the breast that are not palpable, highly refined techniques of aspiration have now been devised. These are based on stereotaxic roentgenologic evaluation of the mammogram which may guide the needle to the target tissue. The method has been used fairly extensively in Sweden but has not as yet become widespread in the United States.

The aspiration of the prostate is performed with the help of a simple special instrument which is inserted onto the index finger of the person performing the aspiration with the patient in the lithotomy position. The simple instrument or the guide helps to insert the needle into the part or parts of the prostate which are palpably abnormal (figure 2). In the absence of palpable abnormalities, no aspiration biopsies of the prostate should be attempted. The aspiration of the pancreas or of the adrenals must be performed with the assistance of ultrasound devices or a CAT scanner. My personal experience is limited to the aspirations of the pancreas because no lesions of the adrenals have come to my attention. On the other hand, a very similar procedure, namely the aspiration biopsy of renal masses or tumors, has been repeatedly performed with a great deal of success. There are a few simple technical tricks in the performance of the aspiration biopsy. Once the needle is inserted into the target tissue, a distinct feeling of resistance should be encountered. The aspiration should be performed by exerting a negative pressure on the piston of the syringe. It is important that the piston should be released and the pressure equalized before the needle is withdrawn. Otherwise, the material present in the needle will be aspirated into the lumen of the syringe upon withdrawal and thus be lost. It is also important to have a trained nurse or a technician who is thoroughly familiar with the methods of smear preparation. With the help of such a skilled person, excellent preparations can be obtained.

**Principles of Interpretation**

It is obvious that the interpretation of the cytologic material will vary significantly from organ to organ. Nevertheless, certain principles may be outlined. In general, benign tissues aspirated from the target organs show good cohesiveness of the component cells which tend to occur in flat sheets or clusters. Cells from malignant lesions, on the other hand, will tend to detach themselves from clusters and occur singly. It is also common for malignant lesions to produce large, thick, three-dimensional, multi-layered clumps of cells, wherein nuclear abnormalities may be often observed. The final diag-

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**Figure 2.** Diagrammatic representation of aspiration biopsy of the prostate (Franzén's method).
nosis of cancer must be based, in most instances, on cytologic criteria. In most, but not all the organs, the nuclear abnormalities will be usually quite striking; these consist of hyperchromasia, variability in nuclear sizes and the presence of large nucleoli. However, for each organ some very distinct cell patterns may be observed which, depending on the skill of the observer, may result either in an astute diagnosis or in a diagnostic disaster. If one is to lay down a single, most important ground rule for a successful use of aspiration biopsy, this should be: do not make the diagnosis of cancer on insecure evidence.

The Breast

The breast is perhaps the most common target for an aspiration biopsy. The procedure can be performed with relative ease because of the ready accessibility of the organ or, as mentioned previously, in rare instances under roentgenologic stereoscopic guidance.1 The preparation of the patient is minimal. Cleansing of the skin and, sometimes, local anesthesia may be desirable but are not essential. The insertion of the needle must be guided by palpation of the lesion with the other hand. Once the lesion has been reached, the tip of the needle will clearly sense some form of resistance. It is advisable to insert the needle in several areas of the target tissue without withdrawing it. Once again, before the syringe and the needle are withdrawn, the piston of the syringe must be released and the pressure equalized. Once the needle is withdrawn, the contents of it are expelled onto a clean glass slide and spread by using another slide to crush whatever tiny fragments of tissue may be present and by finally pulling the slides apart. The choice of methods of smear preparation has been discussed.

The various forms of breast cancer are usually quite readily recognized in the aspirated material. The clusters of cells tend to fall apart, and individual cells are nearly always available for inspection and determination of their nuclear characteristics. There are, however, some exceptions to this rule. In some of the very well differentiated tubular or ductal carcinomas, the cell clustering will persist and single cells will be difficult to come by. In highly fibrotic or scirrhous carcinomas of the breast, the amount of aspirated material is sometimes very scanty and no definitive diagnosis can be obtained. The most important lesions in the differential diagnosis of breast cancer are with fibroadenomas and papillomas. In both instances a rich cell population may be aspirated. Although the relationships of the cells in papilloma and fibroadenoma are usually quite different from those in cancer, nevertheless, in the hands of an inexperienced observer a diagnostic mistake can be made.

It is advisable during a training period to perform aspiration biopsies and examine smears obtained on breast biopsies or mastectomy specimens received in the surgical pathology laboratory. In this way basic familiarity with the cell patterns of this organ may be obtained. There is nothing more frightening than to realize that one has recommended a major surgical procedure based on a diagnostic error.

There are several papers summarizing the results of breast aspiration biopsies. These are shown in tables I and II from Zajicek.8 It may be seen that in skilled hands the diagnosis of breast cancer on smears is a secure procedure which may guide the surgeon in the performance of a mastectomy. The diagnostic mistakes are few and far apart and usually made by people who do not have a great deal of personal experience with the method.

The Prostate

Urologist colleagues who here performed several hundred aspiration biopsies of the prostate claim that the proce-
dure is an easy one to perform and that it causes little or no discomfort to the patient. The method has now been applied at Montefiore Hospital to all patients who show palpable abnormalities of either or both lobes of the prostate, whether or not suspicious for cancer. The technique of the aspiration was discussed previously and is shown in figure 2. The complications of the procedure are few and the results appear to be superior to those of a needle biopsy.

The cell patterns in prostate cancer differ quite remarkably from those in the breast. Particularly difficult to diagnose is a low grade or grade I, well differentiated carcinoma of the prostate. These lesions tend to form cell clusters, named by Francén “microglandular complexes,” that, to the inexperienced observer, may appear quite benign. Such clusters are quite cohesive and are made up of cells that appear to gather around a central deposit of eosinophilic material, presumably gland contents. The diagnosis of this type of prostatic carcinoma may be quite rewarding because the prognosis and survival of patients with these lesions seem to be significantly better than that of patients with carcinomas of high grades. In Sweden radiotherapy and chemotherapy are used for patients with high-grade prostatic cancer rather than surgery or hormonal therapy. The survival of the last group of patients is only about 50 percent after a year of follow-up and it drops to nearly zero at five years. By contrast, survival of 80 percent is achieved after five years with conservative therapy for the well differentiated prostatic carcinoma.

An additional benefit of prostatic aspiration biopsy is the follow-up of patients during conservative treatment. The effects of estrogen therapy, in the form of glycogen-filled squamous cells replacing cancer cells, may be readily ascertained by an aspiration biopsy.

The reliability of the aspiration biopsy of the prostate has been firmly established at Montefiore Hospital by simultaneous use of aspirations and transrectal biopsies. In several patients with clinical suspicion of disease, the cytologic diagnosis was positive whereas the biopsy was negative. The opposite happened only once. If one considers the difficulty of achieving the diagnosis of prostatic disease by conservative means and if one considers the significant differences in the diagnostic outcome when palpation is compared with sampling of the organ, it becomes obvious that a painless or nearly painless, easy to use and reliable method of diagnosis is available,—one that has not received the widespread acceptance that it deserves.

The Pancreas

Under ultrasound or CAT scanner guidance, aspirations of almost any lesion of the pancreas can be performed. The target is demarcated and its size and depth de-
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The needle is inserted through the abdominal wall, under local anesthesia, directly into the lesion. Although the long needle must cross a number of intraabdominal organs before reaching the pancreas, it is remarkable that no complications owing to viscus perforation have ever been recorded and they have not been seen in our own experience. It is possible that the miniscule perforations that the thin needle causes are sealed very rapidly. In any event, neither the Swedes nor we have ever seen a case of acute peritonitis subsequent to an aspiration of an intraabdominal organ. Once again, the cytology corresponds to the pathology. For most pancreatic lesions the cytologic pattern of cancer is perfectly obvious, with many large cancer cells present in the aspirated material. There are very few points of differential diagnosis, because normal or even diseased pancreas, for example, in acute pancreatitis, yields very few cells and certainly very few cells that imitate cancer.

The Thyroid

Aspirations of the thyroid belong to the most difficult procedures from clinical and interpretative points of view. Because the thyroid is a very vascular organ, blood tends to obscure cytologic evidence. The aspiration must be very rapid and performed by a skilled person. Löwhagen and Sprenger described the cytologic patterns of thyroid neoplasms and pointed out the difficulties in cytologic identification of follicular tumors and, to some extent, papillary carcinomas. In these diseases, the cells tend to be uniform and monotonous; even in skilled hands the diagnosis is difficult. On the other hand, papillary carcinomas may be recognized by two features. One of them is the presence of psammoma bodies which are not usually observed in the absence of cancer. The other feature is large intranuclear invaginations of the cytoplasm (pseudo-nucleoli, nuclear holes) which are reasonably characteristic of this disease.

Less well differentiated tumors, such as anaplastic carcinomas, small cell carcinomas, spindle and giant cell carcinomas, are readily diagnosed. Thyroid adenomas and various forms of thyroiditis that may be accompanied by changes in the make-up of the acinar cells (Askenazy cells, Hürthle cells) constitute an important source of diagnostic error. Aspiration of the thyroid cannot be recommended to beginners as it requires considerable diagnostic skills for accurate interpretation.

Other Organs

The adrenal has not been aspirated in my personal experience but aspiration of renal masses and tumors has been repeatedly performed by us with a great deal of success. It is of particular interest that in a number of malignant lesions of the kidney correctly diagnosed by aspiration biopsy, the angiograms did not disclose the customary "flush" pattern of a malignant tumor.

Conclusions

In this brief presentation, limited to a few organs, the basic facts and data about the technique of aspiration biopsy of organs were presented. The many advantages and some of the disadvantages of this procedure have been discussed. There is no doubt that the interpretation of the aspiration biopsy patterns in smears can be mastered by pathologists with practice and experience. The method is eminently suitable for the diagnosis of cancer and occasionally of other diseases of various organs. Aspiration biopsy can be performed as an office procedure and, therefore, offers some significant advantages to the patients in terms of cost or hospitalization and the rapidity of the diagnostic decision. There is little doubt that the demand for this approach to diag-
nosis will rapidly increase and will represent a new major challenge to the profession of pathology.

References


