

Percutaneous aspiration bone biopsy by fluoroscopic guidance

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The advantages of percutaneous needle aspiration of skeletal lesions were described in 1931 by Coley et al.¹ The availability of image intensification, biplane fluoroscopy, and improved bone scanning techniques makes this procedure more feasible.² The procedure is done under local anesthetic with sterile preparation of the skin.

The reasons for percutaneous biopsy range from the patient who is a poor surgical risk to the patient with metastatic disease who does not need surgical intervention.² In addition some biopsies are done for suspected infection. Percutaneous biopsy has few risks and complications have been minimal. The advantage of fluoroscopic guidance is the accurate localization of the biopsy needle in the suspected area. Coley et al¹ have aptly stated that even though roentgenography can establish correct or nearly correct diagnosis in the majority of cases, histologic diagnosis is essential to avoid error. Aspiration is adaptable to all types of bone tumors, except those in which the tumor is deeply situated and surrounded by a zone of normal bone through which the needle cannot penetrate easily.¹ Aspiration biopsy of bone is indicated in cases of infection or for metastatic neoplasms

which require radiation or chemotherapy. However, the procedure is not limited to these two entities and has proved successful in the diagnosis of multiple myeloma^{1, 3, 4} and Paget's disease of bone.^{4, 5} In addition, metabolic deficiency states such as osteoporosis and osteomalacia have been diagnosed with similar techniques.⁶ Open biopsy is of no advantage in these cases. Shortened hospital stay, decreased cost, and reduced patient morbidity are important advantages of the aspiration technique. In selected cases the procedure can be done on an outpatient basis. The skeletal system is the frequent repository for metabolic, infectious, and neoplastic disease. It has been said that all malignant tumors will eventually metastasize to bone.⁴

This report is a review of 56 cases of closed bone biopsies of various sites done at the Cleveland Clinic from 1972 through 1975 (Table 1). Approximately 50% (25 cases) were on an outpatient basis.

Technique

The method described by Lalli³ in a review of 23 biopsies was utilized

Table 1. Biopsy sites

Ribs	19
Vertebral body	11
Pelvic bones	6
Disc space	5
Humerus	3
Skull	3
Sternum	2
Scapula	1
Clavicle	1
Patella	1
Transverse process vertebra	1
Acromion	1
Femur	1
Sacrum	1
Total	56

in the 56 cases reported in this paper. Roentgenograms are reviewed to determine the best approach. Vertebral body biopsy is usually done with the patient prone; the needle is placed approximately 4 cm from the midline at 35° angulation medially.⁷ The intended site is visualized under fluoroscopic control and the skin is marked. The skin is appropriately prepared with Betadine solution and covered with sterile drapes. Local anesthetic is infiltrated superficially and down to and including the periosteum. A new, sharp spinal needle (18- or 20-gauge) is preferred to a reusable needle. The stylet is kept in until the needle penetrates the periosteum. In metastatic lesions the bone is frequently soft and penetration can be accomplished with hand pressure. Occasionally this is not sufficient and advancement of the needle must be aided by the use of a small mallet. The stylet is withdrawn and the needle is rotated in the lesion. While aspirating with a 10 cc glass syringe, the needle is withdrawn and the small amount of contents is placed on a glass slide, which is then immediately immersed into absolute alcohol. The needle and syringe are then rinsed in normal saline, and the solution is sent for a wet smear analysis. The results are usually available within 20 minutes. As indicated a portion of the material may be cultured for identification of bacteria.³

The technique described is similar to that used for biopsies in other parts of the body. The C-arm fluoroscopy unit is valuable in determining the exact depth of penetration. When this is not available a cross table roentgenogram is helpful, but more time-consuming.

In some sclerotic lesions a Craig needle^{4, 8, 9} is necessary. For other lesions, a trephine needle is often recommended,⁶ but is more likely to increase the discomfort to the patient and the risks of bleeding or injury to adjacent structures. The advantage of the larger needles is that the core of tissue is relatively undistorted. This is helpful in diagnosing nonmalignant metabolic bone disorders.

Results

A review of percutaneous bone aspiration in 56 patients revealed positive histopathologic diagnosis in 28 (50%). The biopsy sites were vertebral bodies or ribs in 30 biopsies, with the remainder from various sites (*Table 1*).

Of the 28 positive results, 21 lesions

(75%) were metastatic; these 21 comprise 36.8% of the total number of patients (*Table 2*). The other seven positive results were myelomas, 2; histiocytic lymphoma, 1; histiocytosis, 1; osteogenic sarcoma, 1; neurilemmosarcoma, 1 (*Fig. 1*); and disc space infection, 1 (*Table 3*). One patient had a large lytic lesion in the sacrum without a known primary malignancy (*Fig. 2*). The biopsy results were compatible with adenocarcinoma of the thyroid.

In 11 patients with known primary malignancies, biopsy results were negative. The primary lesions were lymphomas, 2; hypernephroma, 1; melanoma, 1; lung, 1; breast, 2; Hodgkin's disease, 1; prostate, 2; and parathyroid adenoma, 1. Therefore, of the total 56 patients, 31 had a known primary malignancy, and 11 of the 31 had negative biopsy results. These comprise 20.4% of the total, and are considered true false negatives.

A total of 28 had negative biopsy results; i.e., no tumor cells were found or cultures were sterile. This included three patients who had osteoporosis with collapsed vertebral bodies, and the absence of tumor

Table 2. Sites of primary malignancy

Lungs	8
Breast	8
Retroperitoneal mass	1
Middle fossa	1
Pancreas	1
Prostate	1
Thyroid	1
Total	21



Fig. 1. Primary bone lesion. Biopsy proven neurilemmosarcoma.

cells confirmed the clinical impression (*Fig. 3*). Four patients with possible disc space infection did not have purulent fluid on aspiration, and the findings correlated with the clinical follow-up. One was positive for staphylococcal infection (*Fig. 4A and B*). Three patients had Paget's disease which was confirmed by the

absence of tumor cells and the fact that the bone felt hard at the time of biopsy. In one patient with negative aspiration biopsy, an open biopsy revealed a cavernous hemangioma. Seven patients had suspicious lesions without known primary malignancy; biopsy results were negative for tumor cells. In all seven cases the clinical follow-up was consistent with a benign process. This group was considered to represent successful biopsy results (true negatives), in addition to osteoporosis, Paget's disease, and sterile disc spaces.

The overall success rate (true positive plus true negative) was 73.2% (*Table 4*). This is slightly higher than in some of the previous studies,^{4,5} whereas the histologic diagnosis, 50%, is slightly lower.^{2,4,5}

Table 3. Pathologic diagnosis obtained from aspiration

Abnormal cells consistent with metastatic malignancy	21
Multiple myeloma	2
Histiocytic lymphoma	1
Histiocytosis	1
Osteogenic sarcoma	1
Neurilemmosarcoma	1
Disc space infection	$\frac{1}{2}$
Total	28



Fig. 2. Large lytic lesion in right side of sacrum. Biopsy specimen was positive for metastatic adenocarcinoma of thyroid origin.



Fig. 3. Collapse of dorsal vertebrae. Biopsy specimen was negative for malignant cells. These findings were consistent with clinical follow-up for osteoporosis.

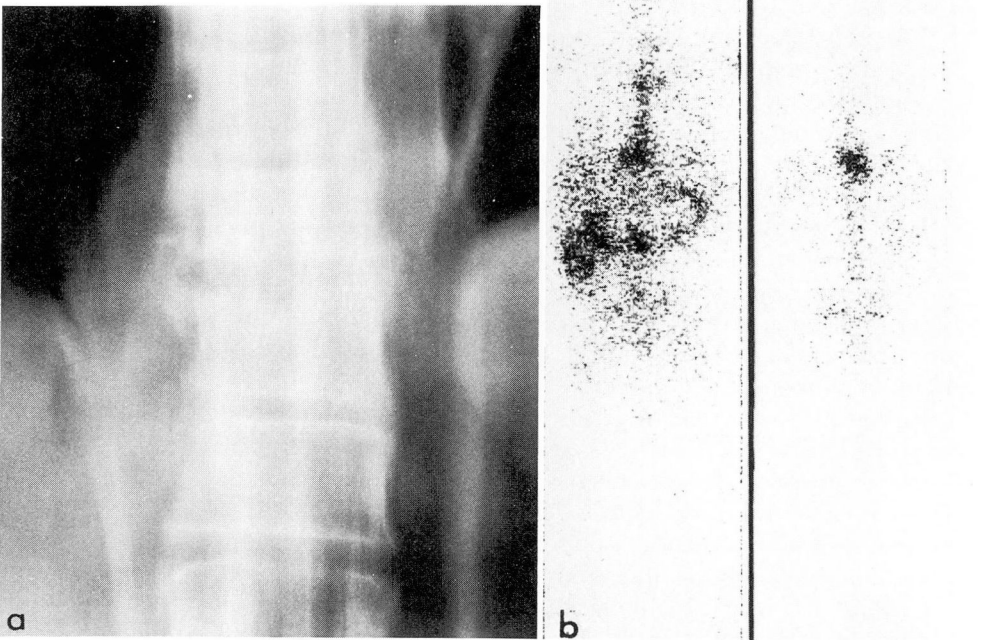


Fig. 4. **A**, Vertebral body erosion was not seen on original films, but was suspected from **B**, a positive gallium scan. Culture was positive for staphylococcal infection.

Table 4. Review of 56 cases of aspiration bone biopsy

Patient	Positive histo- pathologic find- ings	Negative histo- pathologic find- ings	Positive satisfactory
	No. of patients	No. of patients	Percent
Known primary malignancy	20	11	35.7
No known primary malignancy	1	7	14.3
Suspected osteoporosis	0	3	5.3
Possible myeloma	2	0	3.6
Suspected disc space infection	1	4	1.8
Possible Paget's disease (2 patients with carcinoma of prostate)	0	3	5.3
Suspected primary malignancy	4	0	7.2
Total	28	28	73.2

Discussion

Many sophisticated diagnostic procedures are available in the general medical center, but few have decreased cost, hospital stay, or eliminated hospital admissions. With the advent of computed axial tomographic (CAT) scanning and CAT guided biopsies, it is anticipated that there will be increased enthusiasm for bone biopsies in the near future.

The advantage of closed fluoroscopically guided aspiration bone biopsy is the high degree of accuracy obtained, in addition to the financial and psychological benefits to the patient.

In a review of 29 cases in 1970, 16 results were positive.³ Most procedures were done for metastatic lesions, but four were for myeloma, one of which was positive. The highest percentage of positives is achieved in the metastatic lesions of the lung and breast. The few cases of hypernephroma have not been confirmed with aspiration biopsy. The causes of failure include nonpenetration of the lesion, complete miss of the lesion, or insufficient material for satisfactory examination. Failure to obtain cells depends on several fac-

tors. The following reasons were first reported in 1931: (1) difficulty in aspiration because of texture of the tumors; (2) faulty technique; (3) small fragments secured by aspiration are often sufficient only to indicate that malignant tumor cells are absent.¹

Complications

Recently Debnam and Staple² described the theoretical complications of percutaneous bone biopsy. They included damage to the spinal cord and membranes, hemorrhage, wound infection, and further collapse of already destroyed bone. In their review of 68 biopsies, minor complications occurred in six patients. Those described were two with benign vasovagal responses, a 25% pneumothorax not requiring a chest tube, and one sinus tract which drained for 2 weeks following biopsy of a tuberculosis disc infection. In our review of 56 cases, there were no known complications.

Summary

A review of 56 cases of percutaneous aspiration bone biopsy done from 1972 through 1975 demonstrates that the diagnosis was made in

50%; in 73.2% the clinical impression was supported. In 18 cases no diagnosis was made, and in most instances this was due to an inadequate specimen. The procedure was proved safe in all cases and the possible increased morbidity as a result of open biopsy was avoided. Although closed biopsy has certain advantages over open biopsy we do not anticipate that the open approach will be abandoned in the near future.

References

1. Coley BL, Sharp GS, Ellis EB: Diagnosis of bone tumors by aspiration. *Am J Surg* **13**: 215, 1931.
2. Debnam JW, Staple TW: Needle biopsy of bone. *Radiol Clin North Am* **13**: 157-164, 1975.
3. Lalli AF: Roentgen-guided aspiration biopsies of skeletal lesions. *J Can Assoc Radiol* **21**: 71-73, 1970.
4. Stahl DC, Jacobs B: Diagnosis of obscure lesions of the skeleton; evaluation of biopsy methods. *JAMA* **201**: 229, 1967.
5. Nagel DA, Albright JA, Keggi KJ, et al: Closer look at spinal lesions; open biopsy of vertebral lesions. *JAMA* **191**: 975, 1965.
6. Paterson CR: Bone biopsy. *Nurs Times* **70**: 195-196, 1974.
7. Ottolenghii CE: Aspiration biopsy of the spine. *J Bone Joint Surg* **51A**: 1531-1544, 1969.
8. Craig FS: Vertebral-body biopsy. *J Bone Joint Surg* **38A**: 93-102, 1956.
9. Cramer LE, Kuhn C III, Stein AH Jr: Needle biopsy of bone. *Surg Gynecol Obstet* **118**: 1253-1256, 1964.