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Elias D. Sedlin

Harold M. Frost

Antonio R. Villanueva

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THE ELEVENTH RIB BIOPSY IN THE STUDY OF METABOLIC BONE DISEASE*

ELIAS D. SEDLIN, M.D.**
HAROLD M. FROST, M.D.***
ANTONIO R. VILLANUEVA, B.S.****

FROM THE ORTHOPAEDIC RESEARCH LABORATORY,
HENRY FORD HOSPITAL

PREVIOUS WORK in this laboratory has dealt with the definition of normal standards for many microscopic indices relative to the internal remodelling of diaphyseal bone cortex.[4-9] These data allow one to answer some of the questions of "How much?", "What kind?", and "How fast did it happen?" relative to the osteoporoses and the osteomalacias. The data were derived from normal mid-rib obtained chiefly at thoracotomy for skeletally innocuous conditions. Although qualitative information obtained from the studies is applicable to other bones, the quantitative numerical data are not, without use of some assumptions.

In many institutions, the standard bone that has been the source of bone biopsy material has been the iliac crest, although the lateral femoral cortex and tibial metaphysis have also been used. These sources have the common disadvantage that a closed system is not present, i.e., quantification of information derived from them is somewhat imprecise, since it is impossible to establish the percentage of total cortical volume being examined, or to make a valid and precise reduction of the specimen to an arbitary sized unit. The lateral femoral cortex and tibial cortex have the added disadvantage of possibly misrepresenting the true state of affairs relative to internal remodelling in the rest of the bone and skeleton. This is because the internal remodelling process is nonuniform in its activity both in relation to time and physical location among different bones (and even within the same cortex). An iliac crest biopsy is more representative of the true situation in the axial skeleton, and since the axial skele-

*Work supported in part by Grant No. AM-04186 of the National Institutes of Health, and 293 of Henry Ford Hospital.
**Post-Doctoral Fellow of the National Institutes of Health.
***Associate Orthopedic Surgeon, Henry Ford Hospital.
****Research Associate, Orthopedic Research Laboratory.

ton shows remodelling changes faster and earlier than the appendicular skeleton in most circumstances, it had been routinely used at this institution.

The iliac crest biopsy had permitted gross, positive and negative answers in relation to many questions involved in the diagnosis of metabolic bone disease, but could not be quantified accurately or precisely. Knowing the information that can be obtained from quantitative light microscopy, we felt increasingly that the iliac crest biopsy was inadequate.

The obvious solution to this inadequate biopsy problem was the use of a rib, but the ribs that had been used to derive the normal information[4-9] were unsuitable for resons attributable primarily to the risk of pneumothorax. It was felt that the eleventh rib might serve the purpose, since it is almost completely below the pleural reflection and operative approach presented no problems. Some anatomic differences between this and the middle ribs raised the possibility that the normal data (based on the fifth and seventh ribs) might not be applicable without correction. In order to confirm or eliminate this possibility, specimens of eleventh rib from 25 subjects were obtained at post-mortem representing normal and abnormal bone. Without belaboring numbers, it was seen that the internal remodelling indices did not differ appreciably from mid-rib normal standards. The amount of cortex and the ratio of cortical area to total cross section area were slightly different, but for the study of changes in internal remodelling these differences were of no consequence.

It was with some hesitancy that the first of these biopsies was performed. The patient is positioned in either lateral decubitus position. Local infiltration with 0.5 per cent lidocaine above and below the rib at the posterior axillary line coupled with routine preoperative sedation makes the procedure surprisingly pan free. An incision, 4-5 cm. in length, parallel to Langher's lines directly over the rib at the posterior axillary line is made. The latissimus dorsi and quadratus lumborum are split in the direction of their fibers. The rib is stripped for 4-5 cm. with an elevator and the method of excision is then one of surgeons choice. A small osteotome or rongeur are adequate for the purpose. The wound is then closed in routine fashion.

The procedure has been used on six patients at this hospital and several others elsewhere. The absence of operative pain and postoperative morbidity has astonished us (as well as the referring internists), the patients tolerating this procedure better than an iliac crest biopsy. The information derived from biopsy has justified our hopes.

The preparation of the subject for a biopsy is tailored to the individual case, but some general points can be presented. A complete history, physical, radiologic and chemical examination is performed and this information evaluated. In most instances, the etiology of the suspected metabolic bone disease will be undetermined or fall into a broad etiologic classification. Little information will be available that will enable the clinician to determine the rate of bone formation, resorption and changes in mineral distribution pattern within bone. This type of information (i.e., dynamic) is fundamental in obtaining a useful understanding of the skeletal metabolic disorders. We feel

that a bone biopsy should be considered an essential part of the bone metabolic diagnostic work-up, for the best way to evaluate bone disease at present, is to look at bone.

A routine biopsy provides much information. If one administers several three-day courses of tetracycline to the subject, and couples the tetracycline administration with some form of treatment (thus using the patient as his own control), much more information can be obtained*. After the preparatory study is completed, the biopsy is performed. Several types of studies can be done with portions of the rib. Quantitative radio-densitometry can be done while the specimen is fresh. A portion of the specimen can be then subjected to nitrogen — ashing procedures, and the remainder submitted for microscopic examination. Undecalcified sections[1-3] are strongly recommended, since microradiography in addition to light microscopy can be performed upon them. Routine decalcified sections lessen the amount of information that can be obtained from biopsy. The preparation, preservation and techniques used for specimens that enable the observer to determine an accurate bone formation rate, numbers of formation and resorption foci, etc., are on record. With this data, it is then possible to more accurately classify and treat the type of metabolic bone disease in question.

Summary

The eleventh rib is an excellent biopsy site in the study of metabolic bone disease, enabling one to ascertain the effects of disease with and without treatment in a quantifiable manner that is not possible with other biopsy sites.

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*The authors will be happy to outline a specific program for biopsy and will perform the necessary quantative light microscopy upon request. Advice and experiences can also be obtained from W. Dotter, M.D. and L. Hurxthall, M.D. of the Lahey Clinic, Boston, Massachusetts.