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Editorial

The Definition and Diagnosis of Osteoporosis

Although we are inclined to think of osteoporosis as a modern disease, particularly in view of its apparently greater prevalence in the more prosperous societies of the world, the contribution of bone fragility to fractures in the elderly has been known for at least 200 years. It is difficult to say when the term "osteoporosis" was first used in the modern sense, but it was certainly employed by pathologists in the mid-nineteenth century and was clearly distinguished from osteomalacia by Pommer almost exactly 100 years ago.

At the clinical level the crush fracture syndrome was still being confused with osteomalacia in the 1930's, but by the end of that decade Albright had definitively identified it with osteoporosis, which he defined as "too little calcified bone," and his teaching has been amply confirmed. We now recognize that osteoporosis is not only the principal cause of spontaneous vertebral compression but is also a major contributor to most fractures in the elderly. It is also common ground that osteoporosis represents a reduction in the volume of bony tissue relative to whole bone volume. Histomorphometry has established this concept beyond all reasonable doubt by showing that crush fractures in the spine are generally associated with trabecular bone volumes in the iliac crest below about 15% compared with volumes in normal young adults of about 20 to 30%. From this, it has become common practice to equate vertebral compression with osteoporosis and to use it in the selection of patients for clinical trials. It has proved a useful approach which was justified in the 1970's when bone densitometry was in its infancy but has been extrapolated to the point where a fracture (any fracture) is considered essential to the diagnosis of osteoporosis—or even diagnostic of it.

This practice is not only undesirable but positively misleading. While it is true that spontaneous vertebral compression, *because* it is spontaneous, generally denotes the presence of severe osteoporosis, this is not true of other fractures, which nearly always involve an element of trauma. Whether a bone breaks or not depends on the relation between the severity of the trauma and the strength of the bone, the main determinant of which is its "density," i.e., its relative content of bony tissue. What osteoporosis does is to increase the fracture risk, not cause the fracture. It is a simple matter to show, by comparing fracture and non-fracture cases, that fracture risk is a continuous variable which rises as bone density falls, though not, of course, in a simple linear manner.

As indicated above, the invoking of a fracture to justify a diagnosis of osteoporosis dates from the days before high precision densitometry; it should no longer be the practice of specialists with access to the new technology. There was a time when hyponatremia was recognized from the state of the tongue, diabetes from the taste of the urine, and anemia from the color of the skin. These signs, though still of clinical interest, do not form the basis of contemporary definition and diagnosis in these fields. Nor should analogous thinking form the basis of definition and diagnosis in the bone field.

Few workers would dispute Albright's definition of osteoporosis as "too little calcified bone." Yet, many are reluctant to follow it through to its logical conclusion. We can now easily measure the amount of calcified bone, or at least the amount of mineral in a bone, which is generally the same thing. If it is reduced, osteoporosis must be present (discounting the rare case of osteomalacia), and the main problem is to define the standard against which this reduction should be measured. For this there are ample precedents in other fields of clinical physiology where the normal range is usually derived from young healthy adults. The same standard should be applied to bone. In any given laboratory, using any given technique in any given part of the skeleton, I submit that osteoporosis is present when the concentration of bone (mineral) lies more than two standard deviations below the mean of

young adults of the same sex. If forearm measurements are used, this implies, of course, that some 50% of women have osteoporosis by age 65 and nearly 100% by age 80. These figures will be rather different if vertebral densitometry, or some other technique or site, is used. But the principle remains the same. Only whole body measurements can overcome the problem of regional differences in the skeleton, but they are subject to more error than regional measurements and are less generally available.

The concept that all women and most men become osteoporotic, if they live long enough, is distasteful to some. Yet, the fact that blood pressure rises with age, and that hypertension of some degree affects virtually everyone sooner or later, has not prevented physicians from defining normal blood pressure in terms of the young adult range. In assessing its significance in an individual, however, age must be taken into account, and the same is true of bone. In absolute terms, a bone density measurement below the young normal range denotes osteoporosis and increased fracture risk—at least in that bone, if not elsewhere—but the clinical significance of the measurement is also a function of the age of the subject; a value which, though osteoporotic, lies within the normal range for the age of the subject means something different from a value which is low for age. By loose analogy with hypertension, the latter may be termed, "accelerated osteoporosis," the former, "simple osteoporosis"; bearing in mind that the measurement is only *strictly* applicable to the measured bone. In patients with two or more crush fractures, trabecular bone density is generally so low that it represents "accelerated osteoporosis" at any age—which is why these cases differ in so many respects from subjects of the same age without crush fractures. But even here it is likely that classification by fracture will yield to classification by densitometry because of the inherently greater precision of the latter.

It is surprising that osteoporosis research has made the progress it has when the central object of the work lacks a common definition. Such a definition is clearly overdue. Perhaps this Guest Editorial will help to fill the gap.

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