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PRELIMINARY NOTE

Skeletal Muscle Scans in Progressive Muscular Dystrophy and Related Neuromuscular Diseases

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Progressive muscular dystrophy is a disease characterized by progressive muscular wasting. At the present time there is no suitable method to get definitive data on the distribution of muscles involved. The purpose of the presented paper is to use a skeletal muscle scan as an effective means of evaluating the distribution and severity of muscle involvement and the pathogenesis of pseudohypertrophy.

Wagner and co-workers (1) first produced a muscle scan of the human leg with ^{131}I labeled macroaggregated human serum albumin (MAA), which had been developed for use in lung scanning. The present work is concerned with the use of ^{131}I MAA, ^{125}I MAA, and $^{131}CsCl$ as tracers in patients with Duchenne form, limb-girdle form of muscular dystrophy and related neuromuscular diseases.

Approximately 300 μC of ^{131}I MAA or ^{125}I MAA was injected percutaneously into the femoral artery of patients, who were scanned 20 minutes after injection. Some patients received 1.5-2.0 mC of carrier free $^{131}CsCl$ intravenously. The scanning was started two to three hours after injection.

The area scanner was equipped with a 3- by 2-inch NaI (Tl) crystal and a 37-hole focusing lead collimator. Certain original scan records were examined by a multidot rescanner. Profile scans of the leg were performed with the same crystal housed in a lead slit collimator. Both scans were carried out in the supine position.

Although no truly normal subjects were studied, the normal ^{131}I MAA area scans of the leg showed most of the radioactivity to be in the thigh and calf containing the large muscle masses, while the regions of the knee and ankle had less radioactivity. The normal ^{131}I MAA profile scans of the leg showed three peaks representing radioactivity in the thigh, calf, and foot. Normally a peak over the thigh was the most prominent. These results are in agreement with those reported by Wagner, *et al.*

With ^{125}I MAA the scanning resolution was improved in comparison with ^{131}I MAA.

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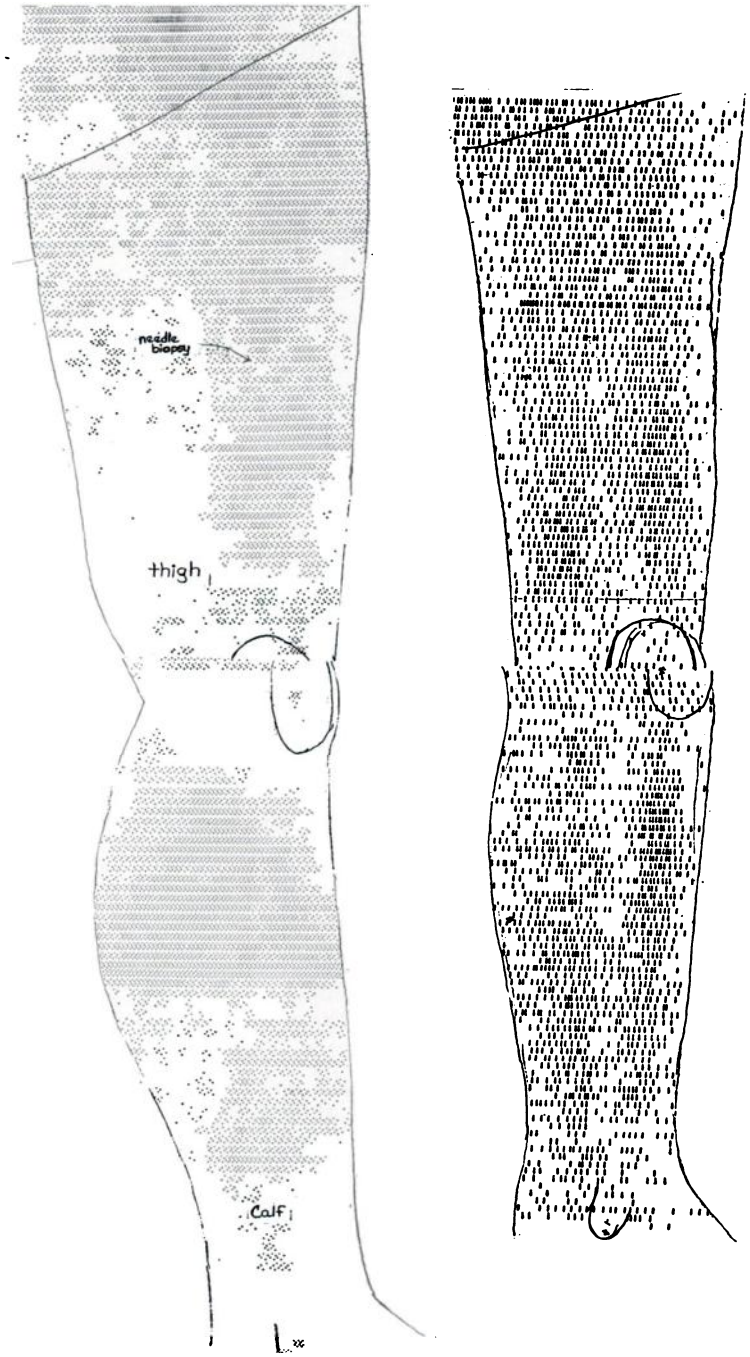

Fig. 1. *Left.* **Iodine-131 MAA muscle scan of the leg of a patient with limb-girdle form of muscular dystrophy. Note defect in activity distribution in muscles.**

Fig. 2. *Right.* **Cesium-131 muscle scan of the leg of a patient with limb-girdle form of muscular dystrophy. The contour of each muscle mass is clearly visible. Note defect in activity distribution in M. gastrocnemius.**

Remarkably, the increased scanning resolution was obtained with ^{131}Cs chloride. Delineation of the distribution of radioactivity in the leg corresponded exactly with the contour of each independent muscle mass. The $^{131}CsCl$ profile scans showed similar patterns as compared with ^{131}I MAA. There were no side effects from these procedures.

In patients with muscular dystrophy, the muscles involved were seen as areas of decreased radioactivity. Figure 1 is the ^{131}I MAA scan of the left leg of a patient with limb-girdle form of muscular dystrophy. Localized areas of decreased radioactivity in the thigh, proved by needle biopsy to have muscle involvement, and in the calf, can be seen. Figure 2 shows the $^{131}CsCl$ scan of the left leg of another patient with limb-girdle form. The contour of each muscle mass; M. vastus fibralis, M. vastus tibialis, M. rectus femoris, M. gastrocnemius, M. soleus and M. tibialis anterior, can be recognized separately on the scan. The most apparent information from the scan is that the main part of M. gastrocnemius is seen as a definite cold area of decreased uptake. To confirm the interpretation made on the scan, further studies will be done with dystrophic mice (Bar Harbor S. 129).

For the study of the circulation of the leg one would want a tracer emitting gamma rays of sufficient energy. However, muscle scanning described here was primarily designed to detect the distribution of muscles involved. Iodine-131 is lacking ability to define the contour of each muscle mass because of its high gamma energy. Although only the surface layer is visible on scanning with ^{125}I MAA, its soft radiation appears enough for this purpose.

During the course of a study of ^{132}Cs as an agent for calibrating the amount of ^{137}Cs in the human body with a whole-body counter, we noticed that ^{132}Cs was deposited in the thigh and calf (2). As cesium is metabolized similar to potassium, it is apparent that cesium is taken up by normal skeletal muscles. Cesium-131 was the best choice of tracer in this study. The soft emission from ^{131}Cs made it possible to obtain sharp delineation. Blood obtained two hours after injection showed no detectable radioactivity on the scan. With this isotope there is no hurry in performing the scan and there is no discomfort to the subject, because intraarterial injection can be avoided. However, $^{131}CsCl$ is still far from ideal because of its relatively long effective half-life in the human body.

Although it is to be stressed that a larger series of studies must be done before any firm conclusion, the preliminary data suggest that skeletal muscle scanning is an objective method for evaluation of the degree of muscle involvement in progressive muscular dystrophy and related neuromuscular diseases. The technique will make a significant contribution to our knowledge of muscular dystrophy.

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REFERENCES

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