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Multiple Marrow Aspiration in Man from the Posterior Ilium

By Howard R. Bierman and Keith H. Kelly

BONE MARROW aspiration has become an accepted diagnostic procedure. The small yet persistent mortality rate associated with sternal marrow aspiration has resulted in the gradual evolution of many safeguards, particularly in the development of special needles with guards, stops, trephines, augers, etc. Since the introduction of sternal marrow aspiration[1] an increasing number of deaths related to the procedure have been reported[2] despite the recommendation of the use of safer sites such as the anterior iliac crest,[3] the spinous processes[4] and the posterior iliac spine and crest.[5] No deaths attributable to marrow aspiration have been reported employing sites other than the sternum.[6-12]

Despite many recent advances, the sternum remains the most commonly employed aspiration site today. The sternal marrow cavity in the adult contains 5 to 10 cc. at the maximum yet the intricate compartmentalization prevents aspiration of any sizeable quantity of marrow from a single site without significant admixture of blood. The limited space of the sternal marrow restricts the procedure to a single sample at any given time which may not be repeated too often without fear of nonrepresentative sampling because previous aspirations frequently leave hemorrhagic residua extending 1 to 2 centimeters from the puncture site.

The need for larger quantities of bone marrow for biochemical analyses and physiologic investigations in addition to frequent repeated aspirations for morphologic and histochemical studies led to a re-evaluation of the bone marrow aspiration technic and a search for a safer and more suitable site for marrow aspiration.[6] The answer to a safer procedure therefore indicated an avoidance of the hazardous areas and to select the most appropriate site distant from vital areas which would permit the easy employment of simple aspiration devices, afford the maximal amount of marrow with minimal discomfort to the patient. The posterior iliac spinous area is the thickest marrow-containing area in the child or adult. This area can be approached easily with the patient in the prone or lateral position. The thickness of the ilium permits as many as 8 marrow samples from separate levels from a single puncture by the employment of a needle designed to permit the aspiration of 10 to 20 cc. of marrow with minimal dilution of blood. The greater trochanter of the femurs has also been tried but has proven more difficult than the posterior ilium.

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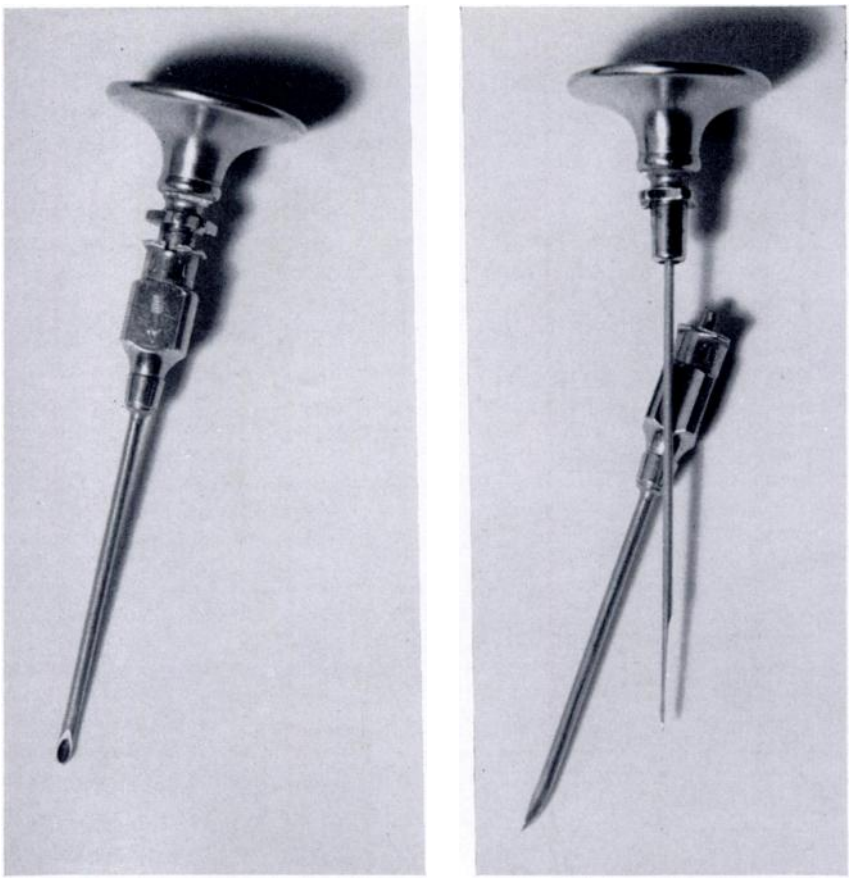

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FIG. 1.—Bone marrow aspiration needle with side opening. Groove in hub coincides with nipple on stylet assuring proper fit and alignment, and indicates direction of distal opening of needle.

FIG. 2.—Stylet and needle separated.

METHOD

Needle: The needle consists of a 4 centimeter shaft with a side opening at the distal end (figure 1). It is available in #13 to #18 sizes* and different lengths. The shaft continues through the hub of the needle, appears above the well and permits a luer-lok syringe to pass into the hub of the needle. The shaft of the needle thus lies within the barrel of the syringe, and allows for delivery and prompt visualization of the first droplet of material directly in the syringe. The luer-lok attachment produces an airtight connection which assists materially in aspiration.

A stylet with a slightly concave, smooth head, one inch in diameter, fits tightly into the shaft and completely covers the side opening at the distal end when fully and properly inserted (figure 2). The stylet is guided to its proper position by a notch fitting a groove in the proximal end of the needle and when fully engaged, the pressure exerted upon the flat disc top of the stylet is transmitted through the shaft of the needle and not upon the hub, thereby avoiding undue stresses upon the connection of the hub and the shaft. The tight fitting stylet and the shaft act together as a single unit with the hub acting only as a convenience and guide and not as a stress point.

The opening to the side at the distal end of the needle affords a single cutting edge, and

* Becton-Dickinson Co., Rutherford, New Jersey.

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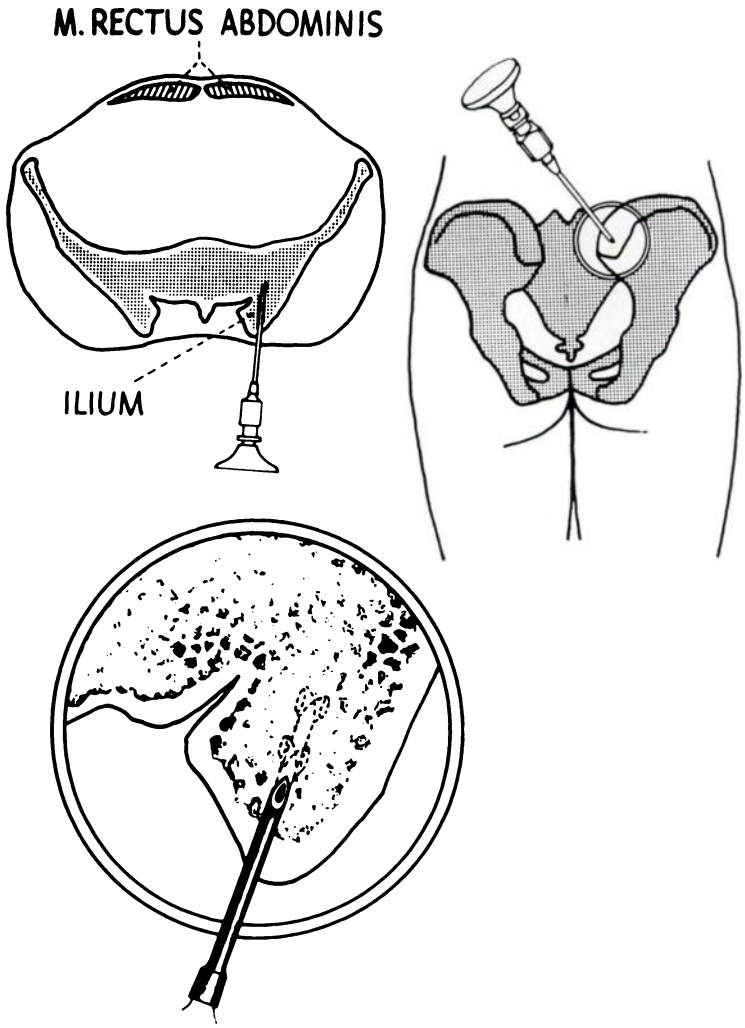

FIG. 3.—Schematic representation of multiple bone marrow aspiration from posterior ilium.

prevents the needle from being plugged with soft tissue, blood or bone upon its entrance into the marrow cavity. The 1½ inch needle length has been found to be perfectly safe in children or adults, when using the posterior iliac spine approach, since the ilium at this point is 2 to 4 inches thick in its anteroposterior diameter.

Technic: Following the usually accepted precautions of skin sterilization, the needle is entered through the intact skin after local anesthesia of the skin, cutaneous tissue and periosteum of the bone. No prior skin incision has been required nor is recommended with this needle. When the tip of the needle engages the periosteum, firm pressure is then applied to the proximal end of the needle and it is advanced through the cortex into the bone marrow until firmly anchored in place, usually 1 centimeter below the surface of the periosteum. The stylet is then withdrawn, the luer-lok syringe attached and the aspiration is performed (figure 3). The stylet is replaced promptly following the aspiration of whatever amount is desired and the specimen is examined to see if satisfactory material has been obtained. If additional specimens are required, the needle with the stylet firmly engaged can be advanced 1 to 2 centimeters deeper or can be rotated 90 to 270 degrees and the aspiration repeated (figure 3). The stylet is then reinserted, the shaft grasped firmly, together with the head of the stylet and the needle withdrawn. Firm pressure for one to

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TABLE 1.—*Per cent Differential Counts of Marrow Smears (200 W.B.C.) of Posterior Iliac Bone Taken by Single Puncture from Multiple Sites in 5 Patients*

Patient	Depth	Opening	PMN's & Band Forms	Myelocytes	Myeloblasts	Basophils & Eosinophils	Lymphocytes	Monocytes	Others	Normoblasts	Erythroblasts
HER	1 cm.	Medial	50.5	31.5	2	4.	12.	0	0	12.	4.5
		Lateral	61.5	25.	0	2.5	7.5	3.5	0	18.5	5.
	2 cm.	Superior	55.	31.5	1.5	4.	7.5	0	0.5	13.	1.5
		Inferior	59.	28.5	0.5	1.5	9.5	1.	0	5.5	4.
Average per cent			56.5	29.13	1.	3.	9.13	1.12	.12	12.25	3.75
GIB	1 cm.	Medial	57.5	31.	0.5	0.5	9.5	1.	0	9.	1.5
		Lateral	62.5	25.5	0	3.	7.	2.	0	6.5	0.5
		Superior	59.	30.	1.5	2.5	7.	0	0	9.	2.5
		Inferior	52.5	36.	1.5	1.5	8.	0.5	0	9.	0.5
	3 cm.	Medial	47.	21	1.	1.5	27.	2.5	0	6.5	0.5
		Lateral	57.	14	1.	2.	22.5	3.5	0	3.5	0.5
		Superior	59.5	19.5	0	2.5	17.	1.5	0	6.5	1.
		Inferior	58.5	21.5	1.	1.	17.	1.	0	11.5	1.5
Average per cent			57.	25.	1.	2.	14.	1.	0	7.6	1.
RYO	1 cm.	Medial	52.	16.	3.5	4.	20.5	7.	0.5	6.	0.5
		Lateral	53.5	7.	0.5	2.	28.5	6.5	3.	6.	1.
		Superior	54.	9.	1.	1.5	31.	3.	0.5	8.	1.
		Inferior	44.5	15.	2.	4.	30.5	3.	1.	13.5	3.
	2 cm.	Medial	45.	9.5	1.	1.	39.	4.	0.5	4.5	0
		Lateral	49.	13.	2.	1.	32.	2.	1.	13.5	1.5
		Superior	41.	17.5	2.	2.	35.	2.5	0	8.5	1.5
		Inferior	47.5	10.5	2.	4.	32.5	4.	0.5	12.5	0
	3 cm.	Medial	45.	13.	1.	3.	33.5	5.	0	7.5	1.5
Average per cent			48.	12.	2.	2.	31.	4.	1.	9.	1.
AVA	1 cm.	Medial	45.	44.	1.5	5.	2.5	0.5	1.5	15.	2.5
		Lateral	59.	33.	2.5	3.	1.5	0.5	0.5	1.	2.
		Superior	42	45.5	5.	2.5	4.	0.5	0.5	4.5	0.5
		Inferior	59.5	28.	0.5	2.5	5.	4.5	0	1.5	1.
	2 cm.	Medial	60.5	24.5	1.	2.5	7.5	4.	0	2.	0.5
		Lateral	58.	26.	0	2.5	6.5	7.	0	1.5	0
		Superior	68.	20.5	0	1.5	6.5	3.	0.5	2.	0
		Inferior	69.5	21.	0	0.5	6.	3.	0	3.	0.5
	3 cm.	Inferior	54.5	32.5	1.5	5.5	4.	2.	0	5.	2.
Average per cent			56.	30.5	1.	2.7	4.	2.	0.3	4.	1.
PAL	1 cm.	Medial	9.5	3.5	86.	1.	0	0	0	3.	0
		Lateral	12.	3.	82.	3.	0	0	0	4.	0.5
		Inferior	17.	9.5	69.	4.5	0	0	0	8.	0.5
	3 cm.	Medial	5.5	4.5	86.	0.5	3.	0.5	0	1.5	0
		Superior	4.5	2.5	87.	3.5	2.	0.5	0	3.5	0
		Inferior	3.	1.	95.	1.	0.	0	0	2.5	0
Average per cent			7.	6.	84.	2.	0.8	0.2	0	4.	0.16

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two minutes at the site has proven sufficient to stop any blood that has appeared in patients with low platelet counts or other bleeding phenomena.

Results

Over 500 posterior iliac bone marrow aspirations have been performed in the past three years without complication. The procedure has proven to be equally simple in children and adults. The psychological trauma so often observed with the sternal approach has not been encountered. Ten to 20 cc. of material can be obtained readily from a single puncture site with minimal admixture of peripheral blood. The major portion of this material consists of particles of marrow tissue although volumetric determinations were not done on many of the specimens. Differential counts were made from coverslip preparations of marrow particles selected from the end of the syringe. Samples of bone marrow aspirated from different levels or regions of the posterior ilium have shown a differential count consistent with expected variations.

The aspiration of areas of the marrow within different levels would be greeted with a rush of blood which showed fewer particles than the adjacent areas previously aspirated. The differential counts on these specimens suggested circulating blood rather than marrow. It should be recalled that the bone marrow cavity contains venous lakes which may account for this phenomena. It is also possible that previous aspirations may have disrupted blood vessels supplying or coursing through the bone marrow so that the subsequent aspirations might contain extravasated blood. This phenomenon occurs sufficiently upon the initial aspiration to suggest that the presence of venous lakes might be equally indicted.

Summary

A procedure for aspirating large volumes of bone marrow with minimal admixture of blood is described.

Summario in Interlingua

Es describite un technica pro le aspiration de grande volumines de medulla ossee con minimal admixtiones de sanguine.

REFERENCES

[1] Arinkin, M. J.: Intravitale Untersuchungsmethodik des Kuschenmarks. Folia Haemat *38:* 233, 1929.

[2] Editorial: Deaths following sternal puncture. J.A.M.A. *156:* 992, 1954.

[3] Van den Berghe, L. and Blitstein, J.: Advantages due prelevement de la moelle osseuse par ponction de la crete iliaque. Presse Med. *53:* 419, 1945.

[4] Loge, J. P.: Spinous process puncture. Blood *3:* 198, 1948.

[5] Bierman, H. R.: The posterior iliac crest: an additional safe site for bone marrow aspiration. Calif. Med. *77:* 138–139, 1952.

[6] Breitenecker, L.: Kurzbericht Uber 2 Todesfalle durch Sternalpunction. Wien. Klin. Wchnschr. *56:* 444, 1943.

[7] Scherer, J. H. and Howe, J. S.: Fatal cardiac tamponade following sternal puncture. J. Lab. & Clin. Med. *30:* 450, 1945.

[8] Meyer, L. M. and Halpern, J.: Death following sternal puncture. Am. J. Clin. Path. *14:* 247, 1944.

[9] Fortner, J. G. and Moss, E. S.: Death following sternal puncture: report of two cases. Ann. Int. Med. *34:* 809, 1951.

[10] Foreign Letters (France): Fatal sternal puncture. J.A.M.A. *150:* 831, 1952.

[11] Ibid.: Death from sternal punctures. *155:* 1276, 1954.

[12] Bierman, H. R.: Unpublished data—Two deaths following sternal puncture.

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