METHOD

SPINOUS PROCESS PUNCTURE. A SIMPLE CLINICAL APPROACH FOR OBTAINING BONE MARROW

By J. Philip Loge, M.D.

ARINKIN[1] in 1929 first described sternal puncture as a practical method for cytologic study of hematopoietic activity and since then this simple procedure has been gaining increasing importance as an aid to the clinician.

Other sites for obtaining bone marrow had previously been described. Caronia[2] in 1922 found the aspiration of marrow from the tibia in children to be practical. Nordenson[3] found it possible to obtain marrow by needle puncture from the head of the tibia and femur, the crest of the ilium, the manubrium or body of the sternum, the ribs and the vertebrae. In 2 adults with normal peripheral blood pictures he compared the differential cell counts of marrow from the sternum with that from the vertebrae, ribs, pelvic bone, and tibial epiphyses. He found agreement in all but the latter, the tibial ephyseal marrow proving to be inactive. Postmortem examinations of marrow obtained within five hours after death were carried out by Stasney and Higgins[5] in 14 normal persons following accidental death. Differential counts of sternal, vertebral and rib marrow cells agreed satisfactorily.

Recently interest has been focused on the iliac crest as a site for marrow aspiration by the work of Rubinstein.[4]* He studied the results of simultaneous sternal and iliac aspirations in over 200 normal and abnormal individuals, and believes that the procedure of iliac aspiration is simple; that the marrow obtained represents a cytologically active hematopoietic tissue. He comments that in diseased states the iliac marrow has at times been much more informative than the sternal marrow.

It is the purpose of this paper to describe another site for obtaining marrow by aspiration in adults, namely the lumbar vertebral spinous processes. The technic of spinous process puncture is described, and myelograms of marrow collected simultaneously from the sternum and the spinous process are presented for comparison.

It is probable that Katsunuma in 1941 (Japan) first used the spinous process puncture as a practical hematologic procedure and it was later adopted by Nakao at the Tokyo Imperial University.† In the latter's hands it was preferred to the sternal approach for routine marrow aspirations.

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* Iliac crest punctures were apparently first described by Van den Berghe of Belgium (Van den Berghe and Blitstein: Presse méd., Aug. 4, 1945, p. 419). *Editor.*

† According to Van den Berghe and Blitstein (Presse méd., Aug. 4, 1945, p. 419), A. and C. Heidenreich (Prensa Med. Argent. *12:* 2818, 1936) first introduced spinous process puncture, later used more extensively by de Weerdt (Rev. Belge Sc. Méd. *11:* 297, 1939). *Editor.*

Technic of Spinous Process Puncture

The spinous process of the lumbar vertebrae to be used for marrow aspiration is chosen. We selected L3 or L4, depending on which presented the broadest spinous process. If the patient sits up the spinous processes are easily outlined with the fingers. In slender individuals the topographic details can be observed without

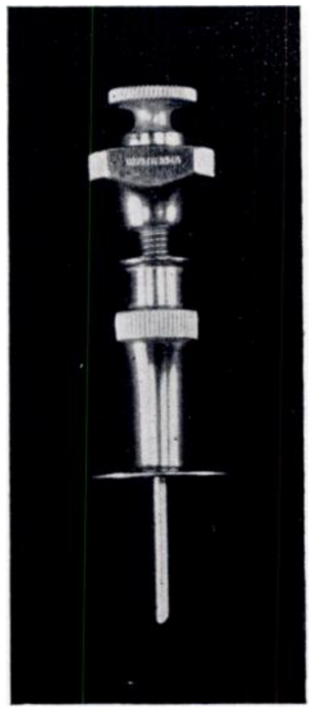

Fig. 1. Klima-Schleicher Sternal Puncture Needle with an Adjustable Guard Which Allows Pressure to Be Applied Near the Needle Point

even superficial palpation. An attempt should be made to obtain as much convexity of the lumbar region as possible to make the spinous process more prominent.

The area over the selected site is prepared with a 1–1000 solution of tincture of merthiolate and then infiltrated with a 2 per cent solution of procaine. Then an attempt is made to infiltrate the periosteum over the spinous process.

A Klima-Schleicher sternal puncture needle (fig. 1) with the guard set at about $1\frac{1}{2}$ cm. is pushed through the skin and fixed with a rotary motion in the spinous process, midway between the upper and lower border. The needle, with firm pressure, is advanced at a 90° angle into the skin until it is firmly fixed to the bone (figs. 2 and 3). The obturator is now removed and a dry tight syringe is used to aspirate the marrow. The patient sometimes complains of an uncomfortable sensation as the marrow is being withdrawn. Occasionally at $1\frac{1}{2}$ cm. the needle is not firmly fixed, and it is then necessary to reset the guard for a greater depth. This occurs commonly in patients with heavy musculature or obesity. Rarely, though the needle is firmly fixed, aspiration fails to produce a marrow sample; the needle is then advanced slowly a few millimeters at a time until marrow is obtained. At

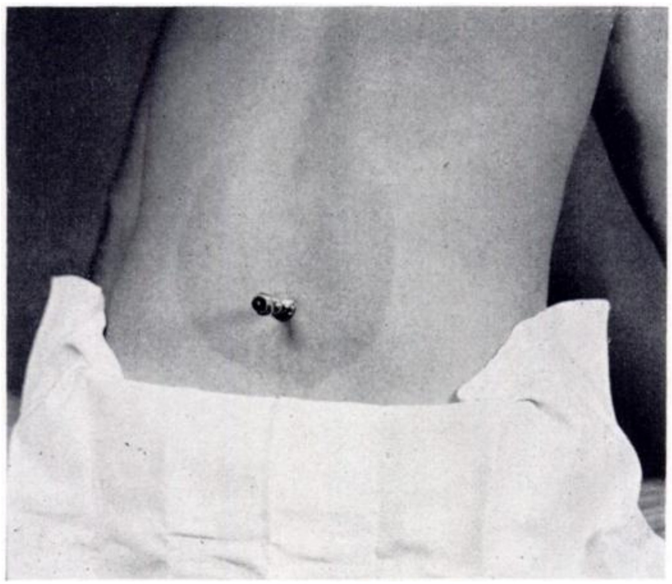

FIG. 2. KLIMA-SCHLEICHER NEEDLE FIXED IN THE SPINOUS PROCESS OF THE THIRD LUMBAR VERTEBRA

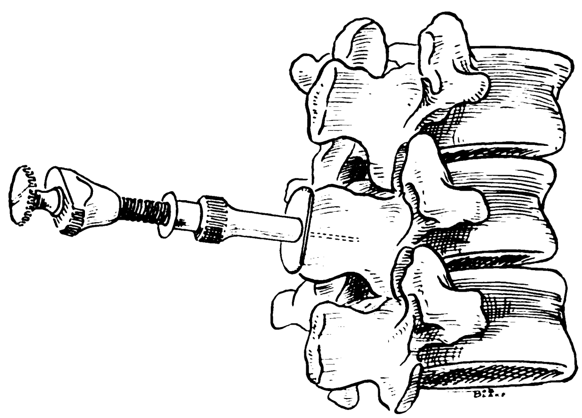

FIG. 3. LUMBAR VERTEBRAE 2, 3, AND 4 WITH THE KLIMA-SCHLEICHER NEEDLE FIXED IN THE SPINOUS PROCESS OF L3

no time in our experience was it necessary to go beyond a depth of $2\frac{1}{2}$ centimeters.

Occasionally, some difficulty is encountered when attempting to fix the tip of the needle in the presenting crest of the spinous process. This difficulty is minimized by (1) selecting the spinous process with the broadest surface, and (2) using the Klima-Schleicher needle which makes it possible to apply pressure and direction near the needle point. In the hands of the author spinous process puncture was not easily accomplished with the Osgood B-D needle or needles of a similar type where no guard is provided near the needle tip.

The marrow cavity of the spinous process is quite limited when compared to that of the sternum. However, an adequate marrow specimen for cytologic study is readily available. There is some variation in the amount of marrow obtainable, depending on several factors: (1) the position of the needle point in the marrow cavity, (2) the size of the anatomic space, and of course (3) the cellularity of the marrow itself. The quantity of marrow aspirated in the series presented here was 0.1 – 0.4 cc., and was easily available in each case.

Clinical Material and Methods

Twenty-five patients were selected who were hospitalized for nonspecific upper respiratory infections. Their ages ranged from 17 to 75; 80 per cent of the patients were between 17 and 29.

The spinous process puncture was performed first. Immediately thereafter an equal quantity of marrow was obtained from the sternum opposite the second interspace with an Osgood B-D needle of the same gage. Following each puncture, cover slip or slide smears were made directly and later stained with either a Wright-Giemsa or Wilson stain. Total nucleated cell counts were done using the unoxalated marrow obtained. Marrow reticulocyte counts, using the brilliant cresyl blue method, were completed in 9 of the 25 cases.

After both spinous and sternal marrow samples had been obtained, a blood sample was drawn by puncturing the finger so that a white blood count, differential cell count, Sahli hemoglobin, and reticulocyte count could be checked. A reticulocyte count was made in 9 of the 25 patients studied.

Hemograms of both sternal and spinous marrow samples were performed (table 1) and 500 nucleated cells were counted in each smear, following the criteria for cytologic identification outlined by Wintrobe.[6]

Discussion

Marrow samples were obtained, in equal quantity, from the spinous processes of L3 and L4 and from the sternum opposite the second interspace. The hemograms, based on 500 nucleated cells, were analyzed and compared favorably. It is true that attempts at accurate quantitative determinations of marrow cellularity have been disappointing, and the procedure of routinely obtaining total nucleated cell counts has been abandoned by some hematologists. Total nucleated cell counts, nevertheless, furnish an estimate of marrow cellularity.

Table 1 lists the essential hematologic data obtained in each case. The differential counts of the peripheral blood samples are not included.

It is important to note that in the two oldest patients, aged 72 and 75, the cellularity of the spinous marrow was equal to that of the sternal sample and that the hemograms were almost identical. This suggests that the marrow of the vertebral spinous processes remains an active hematopoietic center in the advanced age group, an observation, to our knowledge, not previously recorded.

TABLE 1.—*Ten representative paired hemograms of simultaneous marrow samples from the sternum (st.) and lumbar spinous process (sp.) of L3 or L4. The peripheral blood data is included*

Case number	Age	RBC (millions per cu. mm.)	Hemoglobin % (Sahli)	WBC (thousands per cu. mm.)	Reticulocyte % (peripheral blood)	Marrow sample	Nucleated cells (thousands per cu. mm.)	Reticulocyte % (marrow)	Myeloblasts	Promyelocytes	Myelocytes (neutrophilic)	Myelocytes (eosinophilic)	Myelocytes (basophilic)	Metamyelocytes (neutrophilic)	Metamyelocytes (eosinophilic)	Metamyelocytes (basophilic)	Neutrophils	Eosinophils	Basophils	Lymphocytes	Reticulum cells	Monocytes	Pronormoblasts	Normoblasts	Plasma cells
15	22	4.65	90	8.85		Sp.	65.2		0.2	1.6	15.8	0	0	31.2	0.4	0	13	1.0	0	11.8	0	0	0.4	23.4	1.2
						St.	63.7		0	1.4	11.6	0	0	40	0	0	13.2	0.8	0	15	0	0.2	0.2	17.0	0.6
16	18	4.54		8.95	0.9	Sp.	80.2	8.4	1.2	1.0	18.4	0.2	0	41.2	0	0	16.8	0	0	4.8	0.4	0	1.0	15.0	0
						St.	115.2	8.1	0.6	2.6	23.2	0.4	0.4	36.0	0.6	0	12.4	0	0	4.2	0.2	0.2	0.4	18.2	0.6
17	75	4.05	80	7.95	0.7	Sp.	12.6	1.9	0	0.8	11.4	0	0	14	0.8	0	57	0	0	8.4	0.2	0	0.2	6.8	0.4
						St.	13.2	1.8	0.4	1.2	21	0.2	0.2	12.4	0	0	50	0	0	8.2	0.4	0.2	0.2	5.0	0.6
18	55	4.25	85	7.96	0.8	Sp.	30.7	3.8	0.2	1.0	8.4	0.6	0	26.0	0.8	0	43	1.0	0	7.0	0	1.4	0.2	9.8	0.6
						St.	34.1	4.1	0.8	0.6	20.8	0.2	0	24.0	0.4	0	30.2	1.8	0	8.4	0.4	1.2	0.6	10.0	0.6
19	72	4.58	90	8.95	1.2	Sp.	65.1	4.2	0.4	0.4	13.6	0	0.2	16.6	0	0	45	1.0	0.2	10	0	0.4	0.4	11.4	0.4
						St.	63.4	8.4	0.6	2.4	14.2	0.6	0	16.4	1.6	0.2	32	1.0	0	10.6	0	0.8	0.4	19.2	0
20	17	4.65		8.15	0.3	Sp.	87.1	6.8	1.4	1.2	29	0.4	0	29.0	0	0	11.2	0.4	0	1.8	0.4	0.8	0.2	23.8	0.4
						St.		8.3	0.6	0.4	30	0.2	0	22.6	0	0	17	0	0	1.4	0.2	1.0	0.8	25.4	0.4
22	19	4.75	100	9.80	0.9	Sp.	125	8.5	0.4	1.0	11.0	0	0	45.6	0.2	0	25.2	0	0	9.0	0	0.2	0.6	6.8	
						St.	115.3	9.3	0.4	1.4	13.0	0	0	56.6	0.6	0	14.0	0	0	7.6	0	0	0	6.4	
23	52	4.56	90	11.90	0.8	Sp.	82.1	3.6	0	1.8	12.0	0	0	26.0	0.4	0	29	0.6	0	16.8	0	1.4	0	9.0	3.0
						St.	67.7	4.2	0.4	1.4	15.0	0	0	20.0	2.2	0	29	2.8	0.2	10.8	0.4	1.6	0	12.6	3.6
24	19	4.42		7.95	1.1	Sp.	120.4	6.5	0.4	2.4	12.0	0.4	0	40	0.6	0	26.8	1.4	0	8	0	1.0	0	7	0
						St.	126.2	7.9	0.8	3.2	20.4	0.2	0	35.0	0.2	0	16.2	1.4	0	6	0	0.4	0.6	15	0.6
25	29	4.40	90	7.30	1.2	Sp.	125.0	7.3	0.2	0.4	10.2	0	0	36.0	0.4	0	27.6	0	0	9.0	0.2	0.4	0.2	15.4	0
						St.	130.0	6.5	0.2	1.0	7.6	0	0	48.4	0.2	0	20.2	0.4	0	11.8	0.2	0	0	10.0	0

The marrow space available for aspiration in any lumbar spinous process is admittedly small. Spinous processes L2, L3, and L4 were obtained from 2 autopsies and subjected to gross examination and some apparent variation was observed in the marrow volume of the vertebral spinous processes of L2, L3, and L4 in the same patient. The variation was greater when the material obtained from the 2 autopsies was compared. Figure 4 shows a median section of L2 from a 75 year old male. Red marrow can be seen in the spinous process and body of the vertebra. No detailed pathologic study was made of the autopsy material as the desired objective was to secure a gross estimate of the size of the available spinous process marrow cavity.

Often, from the technical standpoint, less difficulty was encountered than with the sternal approach. The explanation seems to lie in three factors: (1) some pa-

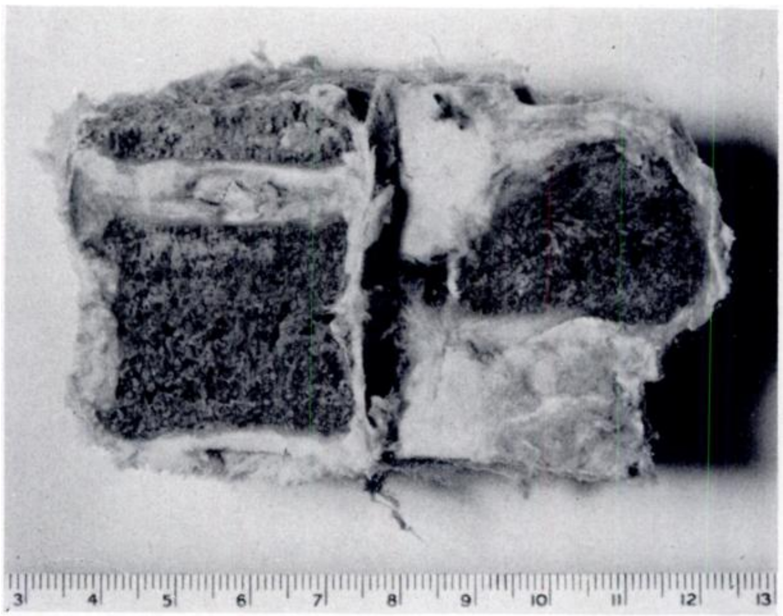

FIG. 4. MEDIAN SECTION OF VERTEBRAL BODY AND SPINOUS PROCESS OF L2 FROM A 75 YEAR OLD MALE. RED MARROW IS APPARENT IN THE SPINOUS PROCESS AND BCDY OF THE VERTEBRA

tients complained of less pain during the spinous process puncture, (2) the psychologic value of doing a procedure out of vision of the patient is important, and (3) the avoidance of the disturbing pressure over the less fixed sternum is helpful. A conscientious attempt was made in each case to infiltrate the sternum and spinous process periosteum with procaine. When questioned, 13 patients preferred the spinous approach, 7 the sternal, and 5 gave no choice.

The spinous process puncture is not offered as a method to supplant the sternal route but rather as another technically simple and hematologically reliable way for the clinician to obtain active marrow. The procedure requires no special skill or equipment other than the use of the Klima-Schleicher needle or one of a similar type. When multiple marrow samples are desired the site for puncture can be varied.

It is possible that some patients with a normal cytological sternal marrow pattern may show a pathologic marrow, when such material is obtained from the spinous process.

Conclusions

1. The puncture of a vertebral spinous process for the purpose of aspirating bone marrow, is technically a simple procedure.

2. Hemograms of marrow samples secured simultaneously from the sternum and spinous process of L3 or L4 in 25 patients corresponded well.

3. The cellularity of the spinous process marrow was found to vary insignificantly from that of the sternal marrow.

4. Spinous process puncture provides the clinician with another approach for obtaining active marrow by aspiration, rivaling the sternal route in simplicity.

ACKNOWLEDGMENT

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