

## Spontaneous Alterations in the Size of Lymph Nodes after Lymphography

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### Summary

A total of 124 normal lymph nodes in 20 patients with Hodgkin's disease were measured in lymphograms by means of planimetry with point counting. Anteroposterior views were used both in the lymphography (24 h) and at subsequent check-up studies. A statistically significant reduction ( $p < 0.05$ ) of 3.5% in the area of the lymph nodes was observed in the period after lymphography (range, 4-189 days; average, 26.8 days) during which no irradiation or chemotherapy had been given. Correction for technical factors and an evaluation of errors of measurement were made.

Alterations in the size of the lymph nodes after lymphography are an important factor in the evaluation of the effect of treatment. We were under the impression that spontaneous variations occur in the size of lymph nodes also when the patient does not receive any treatment. The paper presented here is a contribution to the clarification of this problem.

### Material

The series studied consisted of 20 patients, viz. 7 women and 13 men aged from 14 to 67 years, all with a histologically confirmed diagnosis of Hodgkin's disease. They were subjected to lymphography and subsequent check-up studies. None of them received any form of irradiation or chemotherapy during the observation period, which ranged from 4 to 189 days and averaged 26.8 days, but 16 underwent staging laparotomy and splenectomy during this period. Only normal lymph nodes were included in the study. On nine occasions, radiographs of the same patient were taken on the same day with the same technique. These radiographs were used in the evaluation of the accuracy of the method of measurement.

### Method

- a) The area of the lymph nodes was measured on anteroposterior radiographs of the lumbar and pelvic regions. The measurements were made by planimetry and point counting (8). Whenever possible, one lymph node was measured in the lumbar, common iliac, external iliac and inguinocrural regions on both sides. The same lymph nodes were measured at lymphography and subsequent check-up examination.
- b) The difference between the total areas of the lymph nodes measured on the radiographs taken on the two occasions was determined in each patient. The ranks of these differences were tested by means of the Wilcoxon test for pair differences (1).
- c) Alterations in the area of the lymph nodes due to minor differences in the object-film distance, focus-film distance (110 cm) or positioning were corrected proportionately to the alterations in the products of two osseous measurements. For the groups of lumbar and common iliac nodes the height and width of the body of  $L_4$ , and for the groups of external iliac and inguinocrural nodes the height of the sacral bodies and the great transverse diameter of the pelvic inlet were used (Fig. 1). These corrected values were also compared with those obtained in the lymphography as mentioned in paragraph b. Each group was tested separately in order to determine any difference among the four groups not detectable in the evaluation as a whole.

Table 1 Anatomical distribution of the lymph nodes studied.

Region	No. of nodes
Lumbar	23
Common iliac	36
External iliac	31
Inguinocrural	34
Total	124

Table 2 Percentual alteration in the areas of lymph nodes in radiographs taken on the same day, without and with correction for magnification. Each letter corresponds to a pair of identical radiographs.

	Without correction	With correction
A	+ 7.2	+ 8.9
B	+ 2.4	- 2.0
C	+14.1	+ 6.4
D	- 1.3	- 5.0
E	- 1.2	- 2.3
F	+ 9.9	+11.9
G	- 3.3	- 3.3
H	- 7.3	- 5.0
I	- 1.0	+ 0.9

b) Without correction for magnification, a significant average reduction in the original area of 3.5% was observed ( $p < 0.05$ ).

c) After correction for magnification, the average reduction was 1.7%. This difference is not statistically significant. No significant difference was disclosed by separate testing of each group of nodes from the lumbar, common iliac, external iliac and inguinocrural regions. On an average, the factor of magnification was found to be  $\pm 4.9\%$ .

d) No significant difference was found in the evaluation of the lymph nodes in the radiographs taken on the same day, whether with or without correction for magnification. In this control

d) The accuracy of the corrections for magnification was assessed by measuring the lymph nodes and osseous structures in radiographs of the same patient taken on the same day. Thus, as there cannot be any difference in the size of the nodes, the difference in the measurements must be due to centring, positioning, errors of measurements, etc. The two ranks of area differences before and after correction proportionately to the measurements of the skeleton were analysed statistically by a Wilcoxon rank test for two samples. The reason for making this test was that the correction for magnification can theoretically introduce an error larger than the value it is intended to correct because the small differences in centring, positioning, etc. also follow a casual distribution.

### Results

a) A total of 124 lymph nodes were measured; their anatomical distribution is shown in Table 1.

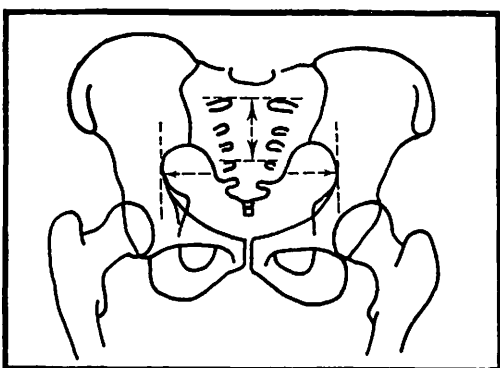


Fig. 1 Example of measurements of the osseous structures used in the correction for magnification of the external iliac and inguinocrural lymph nodes.

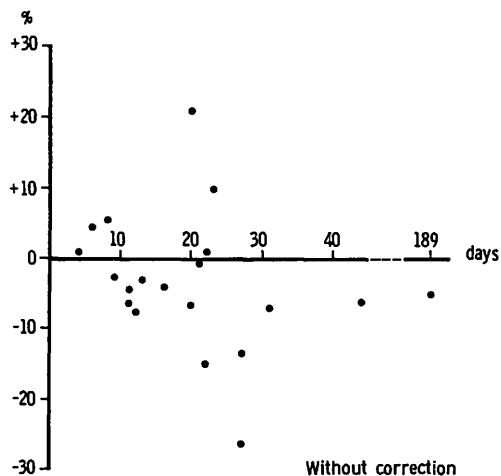


Fig. 2 Graphic representation of the values in Table 3.

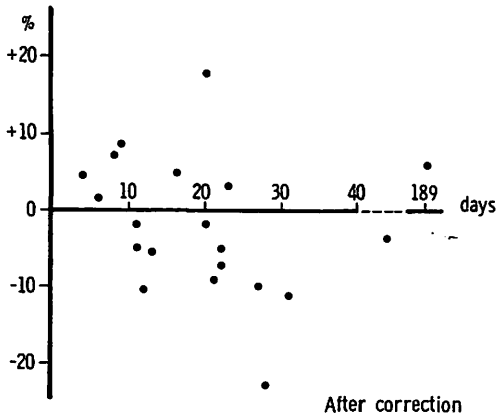


Fig. 3 Graphic representation of the values in Table 3.

material, 29 lymph nodes were measured. The radiographs were marked at random "a" or "b". The differences in the measurements in "b" as compared with "a" are listed in Table 2 and are due only to errors of measurements. Alterations in the area up to  $\pm 14\%$  can thus be ascribed to casual factors (average without correction,  $\pm 5.7\%$ ; with correction,  $\pm 4.7\%$ ).

e) Laparotomy with splenectomy was performed in 16 patients, and this is a factor which can influence the result. Lymph-node biopsy was done during the laparotomy.

The percentual alteration in the area of the lymph nodes is given in Fig. 2, Fig. 3 and Table 3 arranged in accordance with increasing duration of the period between lymphography and check-up. The patients not subjected to laparotomy are the first four (Nos. 7, 13, 10 and 8). The percentual alterations in the area measured in these patients show a significant positive difference, but this can be due to the short period of observation.

### Conclusion

In the period after lymphography (range 4–189 days; average, 26.8 days), a spontaneous reduction in the area of the lymph nodes of the order of 3.5% occurs ( $p < 0.05$ ). In practice, errors of measurements and small differences in centring, positioning, focus-film distance and object-film distance can be responsible for alterations of up to 14% in spite of the use of planimetry in the measurements. Correction for magnification by comparison with alterations in the measurement on the skeleton does not give a better estimation, provided that a constant radiographic technique is used.

### Discussion

Other authors (2, 3, 4, 5) have reported major alterations in the size of the lymph nodes after lymphography. Their method of measurement was, however, different and the periods of observation longer so that the results are not comparable. *Elke* (3) calculated the volume of the nodes from the length (a) and width (b) by the formula  $v = 0.524 \times a \times b^2$ , which presupposes symmetry of form. *Elke* used lateral and oblique views, which are difficult to reproduce, and no correction for magnification was made. It is our impression that the error of measurement

Table 3 Percentual alteration in the area of lymph nodes in the time interval between lymphography and check-up examination, without and with correction for magnification.

No. of patient	Interval (days)	Without correction (%)	With correction (%)
7	4	+ 1.2	+ 4.7
13	6	+ 4.4	+ 1.5
10	8	+ 5.6	+ 7.3
- 8	9	- 2.5	+ 8.7
11	11	- 6.6	- 2.2
19	11	- 4.3	- 5.0
16	12	- 7.7	-10.6
5	13	- 3.0	- 5.5
20	16	- 4.2	+ 4.9
1	20	+21.1	+17.8
12	20	- 6.5	- 1.9
17	21	- 0.6	- 9.3
14	22	-15.2	- 7.4
15	22	+ 0.8	- 5.2
3	23	+10.2	+ 3.2
4	27	-26.0	-23.1
18	27	-13.7	- 9.8
9	31	- 7.1	-11.6
2	44	- 6.3	- 4.0
6	189	- 4.9	+ 5.7

increases very much in the months after lymphography because the progressive disappearance of the contrast medium results in blurring of the periphery of the lymph nodes. In routine analysis of lymphograms, the diagnosis and treatment are most frequently known beforehand, and it is a well-established fact (7, 6) that, in the presence of clinical information, the interpretation of radiographs may give a result which differs from that of a "blind" analysis. The erroneous interpretation of the factors referred to above is certainly of importance in this connection.

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