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LYMPH DRAINAGE FROM THE VULVA AND THE FOOT AS DEMONSTRATED BY ^{198}Au

L. BARTHOLDSON, A. HULTBORN, L. HULTÉN, B. ROOS, M. ROSENCRANTZ and CHR. ÅHRÉN

The lymphatic anatomy of the vulva has been investigated at autopsy by SAPPEY (1874), BRUHNS (1898) and ROUVIÈRE (1932). Contrast medium injected on one side of the vulva could be demonstrated bilaterally in the inguinal nodes. Similar observations were made by TWOMBLY (1953) by means of locally injected ^{198}Au before vulvectomy in a single patient.

Clinical and pathologic experience has demonstrated that also unilaterally malignant tumors of the vulva may give rise to bilateral inguinal metastases. Isolated contralateral lymph node metastases may also occur without associated involvement of ipsilateral inguinal lymph nodes, even in cases in which the primary tumor is unilaterally situated, without extension either to the commissures or to the clitoris and urethra (TAYLOR & NATHANSON 1942, WAY 1948, EDSMYR 1962). Accordingly, bilateral lymphadenectomy or bilateral irradiation has been recommended as a routine procedure in the treatment of carcinoma of the vulva.

On the other hand, in malignant skin tumors of the dorsum of the foot, inguinal and pelvic lymph node metastases occur on the ipsilateral side. Contralateral metastases are observed only in advanced and incurable cases where central blocking of the normal lymphatic pathways has occurred. After intralymphatic injection of

From the Departments of Plastic Surgery, Surgery II, Radiation Physics, Diagnostic Radiology II and Clinical Pathology, Sahlgrenska Sjukhuset, S-413 45 Gothenburg, Sweden. Supported by grants from Assar Gabrielsson's Fund for Clinical Cancer Research, the Swedish Cancer Society No. 71: 194, 558-B71-O1P and Förenade Liv (Mutual Group Life Insurance Company). Submitted for publication 21 October 1976.

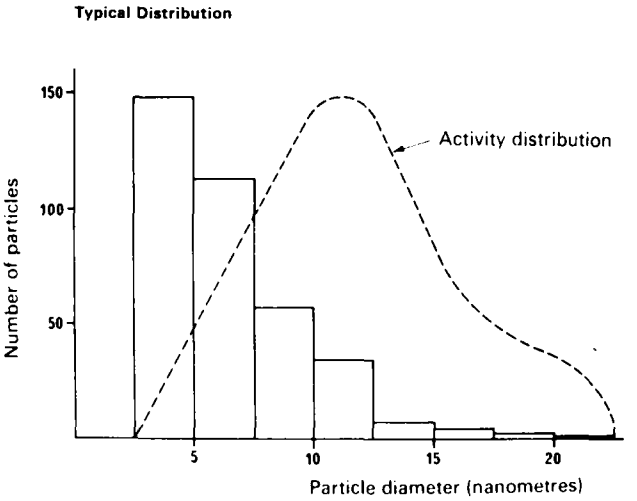


Fig. 1. Particle diameter and activity distribution of ^{198}Au in colloidal suspension, stabilized with gelatin (20 mg/ml) and glucose (200 mg/ml).

Lipiodol Ultra Fluide into the dorsum of the foot, often used in lymphography, contralateral inguinal lymph nodes are not demonstrated, suggesting that the normal lymph flow from the foot is diverted to lymph nodes in the ipsilateral groin, with no crossing over to the opposite side at this level.

The different modes of lymphatic spread from malignant tumors of the vulva and from tumors of the foot are not fully understood. Therefore, the lymph drainage from both regions was investigated by comparing the distribution of a colloid suspension of metallic ^{198}Au, either injected subcutaneously into the labium majus or into the dorsum of the foot, and Lipiodol injected intralymphatically into the dorsum of the foot.

Material and Methods

The series comprised seven women with vulvar tumors, six squamous cell carcinoma and one malignant melanoma. The TNM-classification was T1–T3, N0–N1a (UICC 1968). The ages ranged between 26 and 70 years.

Injection of tracers. The colloidal suspension of metallic ^{198}Au (GCS.IP, The Radiochemical Centre, Amersham, England), has a particle size and an activity distribution as shown in Fig. 1. Forty-eight hours before surgery 4 mCi ^{198}Au were injected into 5 patients (case 1–5) subcutaneously at the centre of one of the labia majora (Fig. 2) to prevent per continuitatem spread to the two commissures. In 4 of the 5 patients (cases 2–5) Lipiodol Ultra Fluide 38 % was also injected intralymphatically into the dorsum of the foot 24 hours later, in 3 patients (cases 2, 3, 5) in the contralateral foot and in one patient (case 4) in the ipsilateral foot, as compared with the ^{198}Au injection in the vulva. In 2 patients (cases 6, 7) ^{198}Au was injected sub-

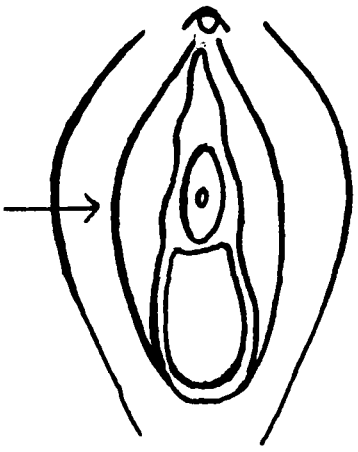


Fig. 2. Injection site in one of the labia majora (central part).

cutaneously into the dorsum of the foot, without any tracer injection into the vulva (Table 1).

Operative procedures. In all patients the surgery consisted of total vulvectomy and bilateral superficial and deep inguinal lymph node dissection including the node of Cloquet. In 3 patients (cases 2, 3, 4) the operation was combined with bilateral

Table 1

Site of tumor and of tracer injection

Case	Site
1	Primary tumor in the right labium majus
	^{198}Au injection into the left labium majus
	No injection of Lipiodol
2	Primary tumor in the anterior commissure
	^{198}Au injection into the right labium majus
	Lipiodol injection intralymphatically into the left foot
3	Primary tumor in the left labium majus
	^{198}Au injection into the right labium majus
	Lipiodol injection intralymphatically into the left foot
4	Primary tumor in the anterior commissure
	^{198}Au injection into the right labium majus
	Lipiodol injection intralymphatically into the right foot
5	Primary tumor in the right labium majus
	^{198}Au injection into the left labium majus
	Lipiodol injection intralymphatically into the right foot
6	Primary tumor in the anterior commissure
	^{198}Au injection subcutaneously into the dorsum of the left foot
7	Primary tumor in the posterior commissure
	^{198}Au injection subcutaneously into the dorsum of the right foot

Table 2

Distribution of colloid ^{198}Au after local injection into the central part of the labium majus

Case	Location of primary tumor	Tumor size (mm)	Injection site	Uptake in ipsilateral inguinal lymph nodes	Uptake in ipsilateral low pelvic lymph nodes	Uptake in contra-lateral inguinal lymph nodes	Uptake in contra-lateral low pelvic lymph nodes
1	Right labium majus and minus	12 × 25	Left	18/24	—	8/16	—
2	Anterior commissure	14 × 15	Right	8/9	15/15	3/10	7/8
3	Left labium majus	10 × 15	Right	5/10	2/2	6/10	3/6
4*	Anterior commissure	20 × 35	Right	6/10	5/5	1/10	0/5
5**	Right labium majus and minus	15 × 20	Left	8/8	—	9/13	—

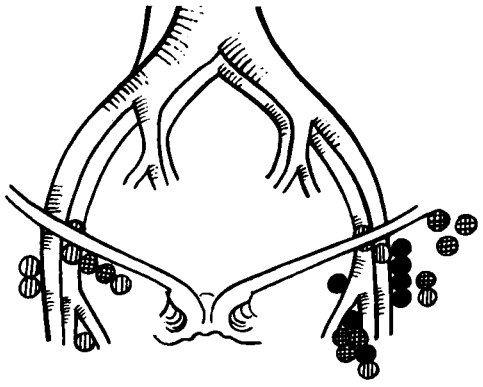
* Microscopy demonstrated a large lymph node metastasis in the ipsilateral inguinal region.
** Microscopy demonstrated two micrometastases in the contralateral inguinal region.

Table 3

Lymphatic distribution of colloid ^{198}Au after local subcutaneous injection into the dorsum of the foot

Case	Location of primary tumor	Tumor size (mm)	Injection site	Uptake in ipsilateral inguinal lymph nodes	Uptake in ipsilateral low pelvic lymph nodes	Uptake in contra-lateral inguinal lymph nodes	Uptake in contra-lateral low pelvic lymph nodes
6*	Anterior commissure	10 × 8	Left	1/6	8/8	0/8	0/11
7	Posterior commissure	22 × 13	Right	10/10	8/9	0/11	0/5

* Along common iliac vessels on ipsilateral side 4 lymph nodes were found, all containing ^{198}Au. On this side in the para-aortal group of lymph nodes 2 nodes were found, both containing ^{198}Au. On the contralateral side along the common iliac vessels 6 lymph nodes were found, none containing ^{198}Au but in the para- och precaval groups of lymph nodes on the same side 5 lymph nodes were found, all containing ^{198}Au.



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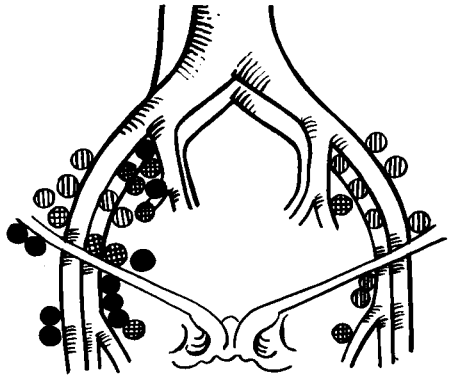

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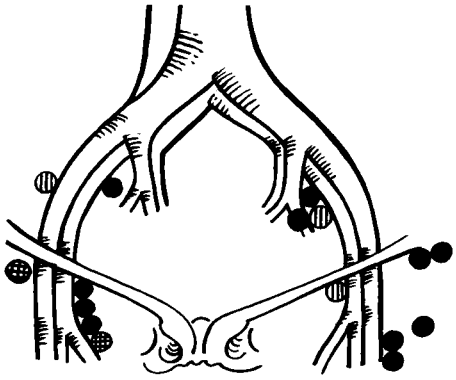

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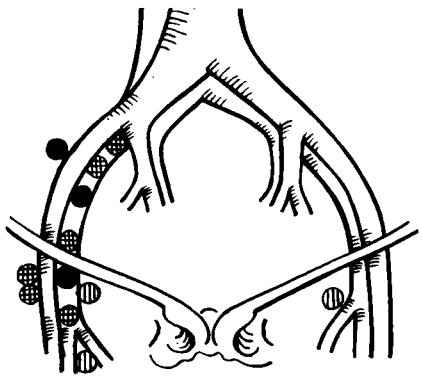

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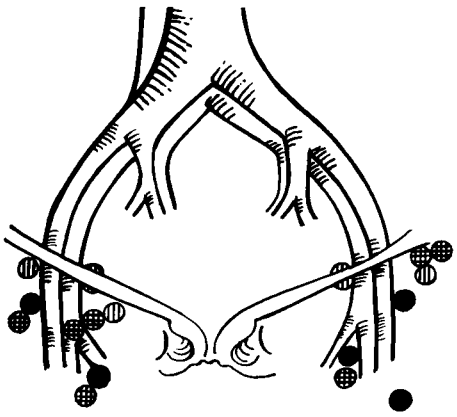

e

Fig. 3. a) to e). Cases 1 to 5. The distribution of ^{198}Au to regional lymph nodes after injection into the central part of the labium majus. Lymph nodes without tracer are not depicted. Solid dots indicate $>10^4$ counts per min, criss-crossed dots 10^4 to 10^3 counts per min and hatched dots $<10^3$ counts per min.

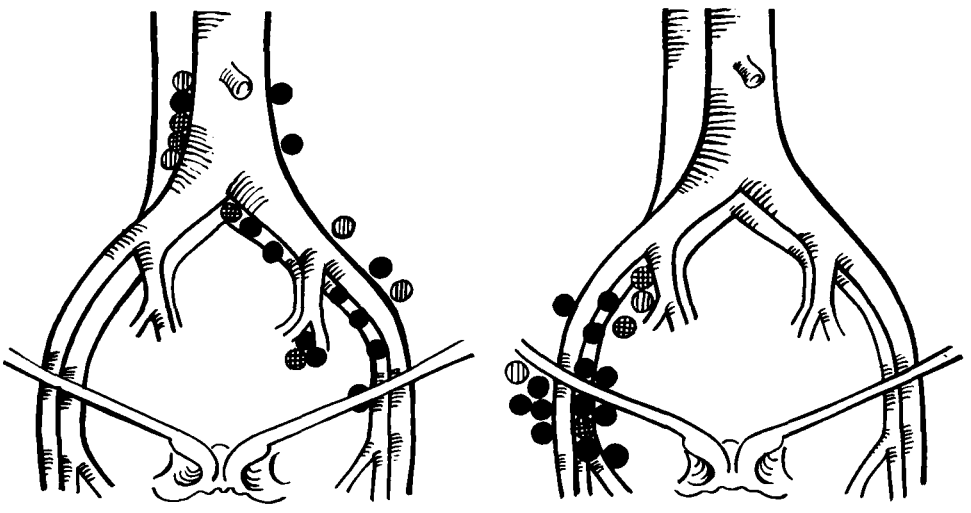

Fig. 4. a, b). Cases 6 and 7. Distribution of ^{198}Au to lymph nodes after subcutaneous injection into the dorsum of the foot. Lymph nodes without tracer are not depicted. No crossing over of the tracer. Solid dots indicate $>10^4$ counts per min, criss-crossed dots 10^4 to 10^3 counts per min and hatched dots $<10^3$ counts per min.

external and interiliac, i.e. low pelvic lymph node dissection, according to JOHANSON & LEWIN (1963) and in one patient (case 6) the lymphadenectomy was extended to include high pelvic and lumbar lymph nodes as well.

Radiography and microdissection of the specimen. The operative specimens were examined using a special soft tissue technique (HULTBORN et coll. 1970) and the lymph nodes were carefully dissected out and arranged in a key-diagram for proper identification.

Determination of Lipiodol content. The distribution of Lipiodol in the lymph nodes was determined both by radiography and by microscopy.

Measurements of activity. The contents of tracer were assayed quantitatively by means of a scintillation detector (Picker Autowell sample changer, with a well crystal, 7.6 cm (3 inches) in diameter). The lower level discriminator was set at 350 keV and the channel width was 130 keV. The activity was also demonstrated by autoradiography of the slides of the lymph nodes according to a simple contact method (HULTBORN et coll. 1970).

Pathology of the specimen. The location of the primary tumor and its size appear in Tables 1 to 3 as well as the site of tracer deposit. In cases 2, 4 and 6, the primary tumor was situated in the anterior and in case 7 in the posterior commissure. In

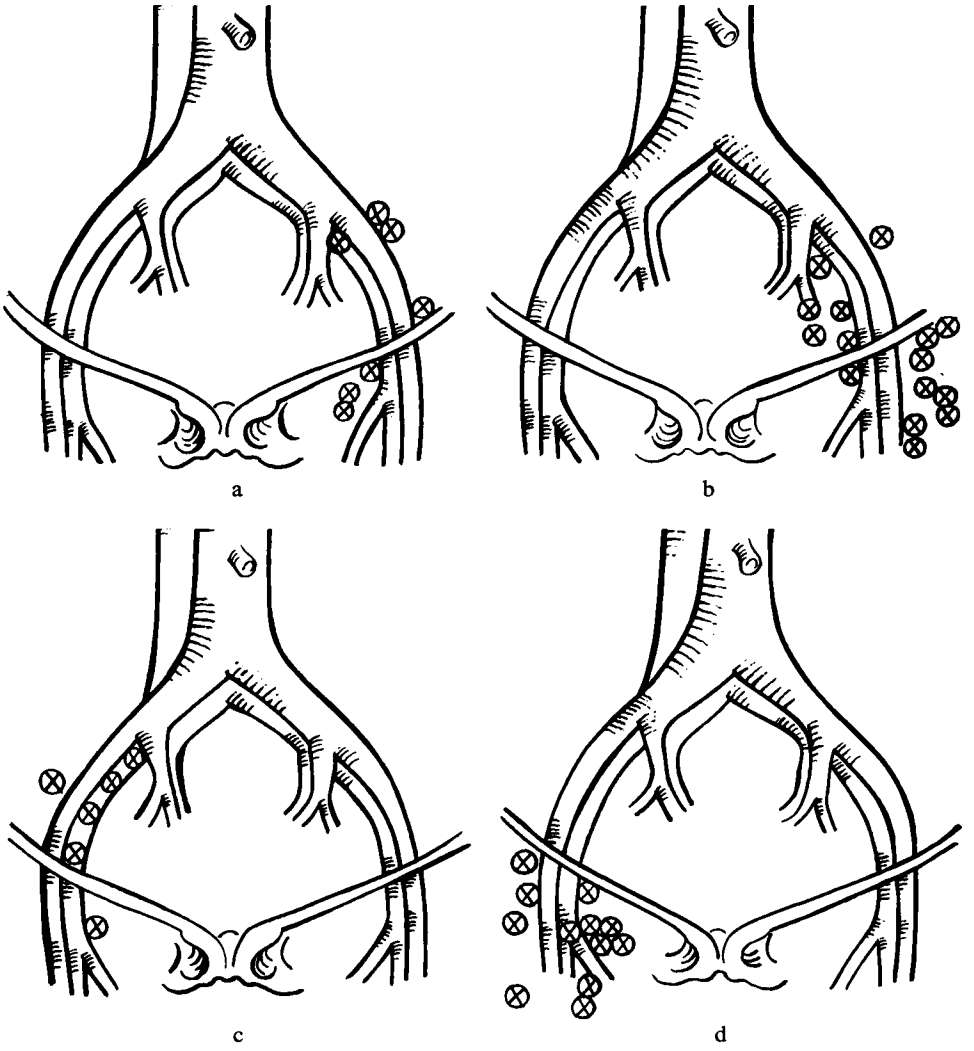

Fig. 5. a) to d). Cases 2 to 5. Distribution of Lipiodol UF to lymph nodes at unilateral lymphography from the foot. Lymph nodes without Lipiodol UF are not depicted. No crossing over of the tracer. Dots indicate tracer in lymph node.

case 4 there was a large lymph node with microscopically confirmed metastases in the deep ipsilateral inguinal region. Case 5 had micrometastases in two contralateral inguinal lymph nodes. None of the other cases had any lymph node metastases.

Results

Distribution of ^{198}Au after local subcutaneous injection into labium majus. The number of lymph nodes, their location and the presence of tracer and metastases is

Table 4

The distribution of Lipiodol UF at unilateral lymphography from the foot

Case	Location of primary tumor	Tumor size (mm)	Site of injection	Uptake in ipsilateral inguinal lymph nodes	Uptake in ipsilateral low pelvic lymph nodes
2	Anterior commissure	14 × 15	Left	3/10	4/8
3	Left labium majus	10 × 15	Left	9/10	6/6
4	Anterior commissure	20 × 35	Right	1/10	5/5
5	Right labium majus and minus	15 × 20	Right	12/13	—

given for both ipsi- and contralateral lymph node regions (Table 2, Fig. 3). Ipsilaterally 45 of 61, and contralaterally 27 out of 59 inguinal lymph nodes contained ^{198}Au. In those cases where an additional low pelvic lymph node dissection was performed, the tracer was found in all of the 22 ipsilateral, and in 10 of the 19 contralateral low pelvic lymph nodes.

Of all activity recorded in inguinal and low pelvic lymph nodes on both sides only a few per cent were located to lymph nodes on the contralateral side, with equal distribution to the inguinal and low pelvic regions. Of all activity registered on the ipsilateral side one-third was located to the low pelvic nodes.

Distribution of ^{198}Au after local subcutaneous injection into the dorsum of the foot. The distribution was strictly confined to the ipsilateral inguinal and low pelvic lymph nodes (Fig. 4). In the 2 patients, ^{198}Au was demonstrated in one patient in all dissected ipsilateral inguinal lymph nodes but only in one of six lymph nodes in the other patient. In both patients all ipsilateral pelvic nodes, except one, contained ^{198}Au (Table 3). Following lumbar lymph node removal in one patient (case 6), tracer was found in nodes situated on both sides of the midline, indicating crossing over only above the pelvic level.

Distribution of Lipiodol after intralymphatic injection into the dorsum of the foot. A comparable number of lymph nodes from both the inguinal and low pelvic regions was dissected out. The distribution of Lipiodol was strictly confined to the ipsilateral lymph nodes and in none of the dissected contralateral lymph nodes could Lipiodol be demonstrated either at radiography or microscopy (Fig. 5). Lipiodol was demonstrated in 25 out of 43 ipsilateral inguinal lymph nodes and in 15 out of 19 low pelvic nodes (Table 4).

Discussion

The results imply that the lymph flow from the centre of the labium majus, although predominantly diverted to ipsilateral inguinal and pelvic lymph nodes, takes

place also to corresponding regions on the contralateral side. This is in accordance with the findings of TWOMBLY (1953) and also with clinical observations that bilateral inguinal metastases occur even in cases where the tumor is unilaterally restricted, without extension neither to the commissures nor to the clitoris or urethra (TAYLOR & NATHANSON 1942, WAY 1948, 1949, 1952, 1957, 1960, EDSMYR 1962, COLLINS et coll. 1971). Since no less than one-third of the activity registered in ipsilateral lymph nodes was located in the low pelvic nodes, these should also be of importance in the treatment of carcinoma of the vulva. However, in the absence of metastatic involvement of inguinal lymph nodes, the available clinical evidence suggests that pelvic lymph node metastases alone are uncommon (WAY 1948, 1954, 1957, 1960, GREEN et coll. 1958, HOUSE & HESTER 1968, RUTLEDGE et coll. 1970, COLLINS et coll. 1971, BOUTSELIS 1972). ^{198}Au injected into the centre of one of the labia majora is distributed also to contralateral inguinal and pelvic nodes. This implies that a bilateral lymph transport exists also from a point far from the two commissures. The bilateral lymphatic drainage from the vulva is in contrast to the strictly ipsilateral lymphatic drainage from the dorsum of the foot. Both the tracers ^{198}Au and Lipiodol UF injected subcutaneously and intralymphatically, respectively, reflect the strictly ipsilateral distribution from the foot to the regional lymph nodes. Contralateral metastases from malignancies on the dorsum of the foot reflect a central lymphatic blockade by metastases causing an abnormal lymph flow and indicate incurability.

SUMMARY

From the central part of the labium majus the lymphatic transport of ^{198}Au is invariably bilateral to inguinal and pelvic lymph nodes. Thus, bilateral inguinal and low pelvic lymphadenectomy is logical in the treatment of carcinoma of the vulva. ^{198}Au injected subcutaneously and Lipiodol injected intralymphatically in the dorsum of the foot were transported exclusively to ipsilateral inguinal and pelvic lymph nodes. Thus, there is no need for contralateral lymphadenectomy in malignancies on the dorsum of the foot.

ZUSAMMENFASSUNG

Im zentralen Teil des Labium majus injiziertes ^{198}Au wird immer zu den Leisten- und Beckenlymphknoten bilateral drainiert. Deshalb ist bei der Behandlung des Vulvakarzinoms die bilaterale Lymphadenektomie der Leisten- und Beckenlymphknoten indiziert. Subkutan injiziertes ^{198}Au und intralymphatisch in den Fussrücken injiziertes Lipiodol werden ausschliesslich zu den ipsilateralen Leisten- und Beckenlymphknoten drainiert. Es besteht somit keine Notwendigkeit für die kontralaterale Lymphadenektomie bei Malignitäten auf dem Fussrücken.

RÉSUMÉ

Le drainage lymphatique de ^{198}Au à partir de la partie centrale de la grande lèvre est invariablement bilatéral vers les ganglions lymphatiques inguinaux et pelviens. Ainsi, une lymphadénectomie inguinale et pelvienne basse bilatérale est logique dans le traitement du

carcinome de la vulve. ^{198}Au injecté par voie sous-cutanée et le lipiodol injecté par voie lymphatique sur le dos du pied sont drainés exclusivement vers les ganglions lymphatiques pelviens et inguinaux du même côté. Ainsi il n'est pas nécessaire de faire une lymphadénectomie contro-latérale dans les tumeurs malignes du dos du pied.

REFERENCES

BASSETT A.: De l'épithélioma primitif du clitoris. Rev. Chir. (Paris) 46 (1912), 546.

BOUTSELIS J. G.: Radical vulvectomy for invasive squamous cell carcinoma of the vulva. Obstet. and Gynec. 39 (1972), 827.

BRUHNS C.: Über die Lymphgefässe der weiblichen Genitalien nebst einigen Bemerkungen über die Topographie der Leistendrüsen. Arch. Anat. Physiol. 57 (1898), 57.

COLLINS C. G., LEE F. Y. L. and ROMAN-LOPEZ J. J.: Invasive carcinoma of the vulva with lymph node metastases. Amer. J. Obstet. Gynec. 109 (1971), 446.

EDSMYR F.: Carcinoma of the vulva. Acta radiol. (1962) Suppl. No. 217.

GREEN T. H., ULFELDER H. and MEIGS J. V.: Epidermoid carcinoma of the vulva. Amer. J. Obstet. Gynec. 75 (1958), 834.

— — — Epidermoid carcinoma of the vulva. Amer. J. Obstet. Gynec. 75 (1958), 848.

HOUSE T. E. and HESTER JR L. L.: Radical vulvectomy of the vulva. Obstet. and Gynec. 31 (1968), 739.

HULTBORN A., HULTÉN L., ROOS B., ROSENCRANTZ M., ROSENGREN B. and ÅHRÉN CH.: Evaluation of regional lymph drainage from mammary gland and hand to axillary nodes. Acta radiol. Ther. Phys. Biol. 9 (1970), 489.

JOHANSON B. and LEWIN E.: Cancer of the vulva. Acta chir. scand. 126 (1963), 483.

ROUVIÈRE H.: Anatomie des lymphatiques de l'homme, p. 404. Masson et Cie, Paris 1932.

RUTLEDGE F., SMITH J. P. and FRANKLIN E.: Carcinoma of the vulva. Amer. J. Obstet. Gynec. 106 (1970), 1117.

SAPPEY C.: Anatomie, physiologie et pathologie des vaisseaux lymphatiques considerées chez l'homme et les vertébrés, p. 32. Adrien Delahaye & Emile Lecrosnier, Paris 1874.

STOECKEL W.: Wie lassen sich die Dauerresultate bei der Operation des Vulvakarzinoms verbessern? Zbl. Gynäk. 34 (1912), 1102.

TAUSSIG F. J.: Late results in the treatment of leukoplakic vulvitis and cancer of the vulva. Amer. J. Obstet. Gynec. 40 (1940), 746.

TAYLOR G. W. and NATHANSON I. T.: Lymph node metastases. Oxford University Press, New York 1942.

TWOMBLY G. H.: The technique of radical vulvectomy for carcinoma of the vulva. Cancer 6 (1953), 516.

UICC, International Union Against Cancer. Geneva 1968.

WAY S.: The anatomy of the lymphatic drainage of the vulva and its influence on the radical operation for carcinoma. Ann. roy. Coll. Surg. Engl. 3 (1948), 187.

— Treatment of carcinoma of the vulva. Proc. roy. Soc. Med. 42 (1949), 747.

— The modern treatment of carcinoma of the vulva. Med. Press 227 (1952), 318.

— Results of a planned attack on carcinoma of the vulva. Brit. med. J. 2 (1954), 780.

— Carcinoma of the vulva. *In:* Progress in gynecology, p. 489. Grune & Stratton, New York 1957.

— Carcinoma of the vulva. Amer. J. Obstet. Gynec. 19 (1960), 692.