Acta orthop. Scandinav. 39, 161 170, 1968

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SURGICAL PROBLEMS IN HEMIPELVECTOMY

By

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Received 16.vi.67

By hemipelvectomy is meant an amputation in which the plane of resection runs in principle from the symphysis to the sacro-iliac joint, half the pelvis and the extremity being amputated. Synonyms are hindquarter amputation and interpelvi-abdominal amputation.

The first hemipelvectomy was performed in 1889 by *Billroth* but with a fatal outcome. The first successful operation, by Girard, came in 1895 (*Pringle* 1916). A total of 138 hemipelvectomies had been reported by 1946 (*Wise* 1949), though "with a high operative mortality". Several large series have been published since, for instance by *Gordon-Taylor & Monro* (1952) and *Pack & Miller* (1964), and the operative mortality in these is considerably lower, only 2 per cent in the latter. This progress is chiefly ascribable to improved anesthesia and shock therapy. The indications for hemipelvectomy have been extended as knowledge of the biology and classification of the mesenchymal tumours has increased. Prosthetic improvements, moreover, have helped to reduce the functional invalidity resulting from the operation.

Experience has thus shown that this major surgery can be undertaken without undue risk. The purpose of the present paper is to discuss the surgical principles, including the pre- and postoperative assessments, involved in hemipelvectomy. Our series of 13 cases is briefly reported at the same time.

INDICATIONS

The main indication for hemipelvectomy is the presence of a malignant mesenchymal tumour in the vicinity of the hip-joint, with dissemination within the pelvic or the gluteal region. Among the bone tumours, chondrosarcoma in the pelvis is the most common indication (Figures

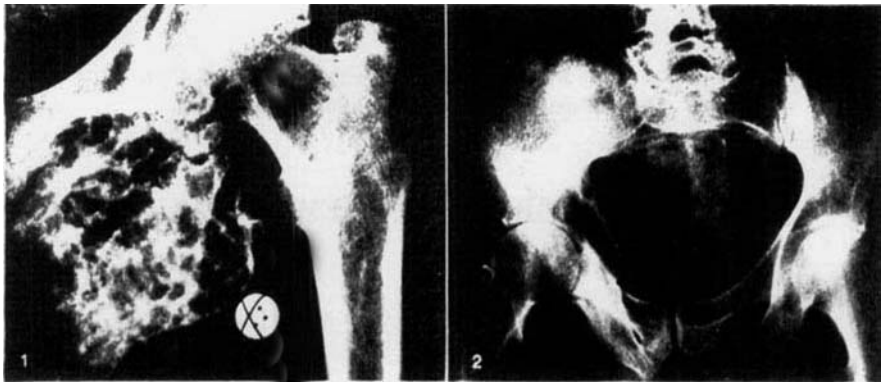

Figure 1. Chondrosarcoma in the region of the ischial tuberosity.

Figure 2. Chondrosarcoma emanating from the deep surface of the acetabulum and displaying pronounced intrapelvic expansion.

1 and 2), fibrosarcoma being the most common among soft-tissue tumours. If the tumour lies distal to the inguinal ligament but proximal in the thigh, hemipelvectomy may be necessary in order to ensure a sufficiently radical resection. Moreover, since there is little functional difference between an exarticulation and a hemipelvectomy prosthesis, the more radical measure can be recommended if it makes complete removal of the tumour more certain. Hemipelvectomy can also serve as a palliative measure if intrapelvic expansion caused by the tumour elicits compression symptoms from urinary tract, intestine or lumbar plexus. *Pack & Miller* also list skin tumours (melanoma) as an indication for hemipelvectomy. The use of this operation for pelvic osteomyelitis has been reported earlier but not in recent years, no doubt owing to improvements in antibiotic therapy. We have no personal experience of the last two indications.

PREOPERATIVE ASSESSMENT AND EXAMINATION

A correct diagnosis is obviously of fundamental importance for the surgical procedure. As for bone tumours in general, this calls for close cooperation between pathologist, roentgenologist och orthopedic surgeon. We prefer surgical exploration, a biopsy always being performed so that the tissue samples for histopathological diagnosis are as representative as possible. The examination may be supplemented by needle biopsy for a cytological diagnosis.

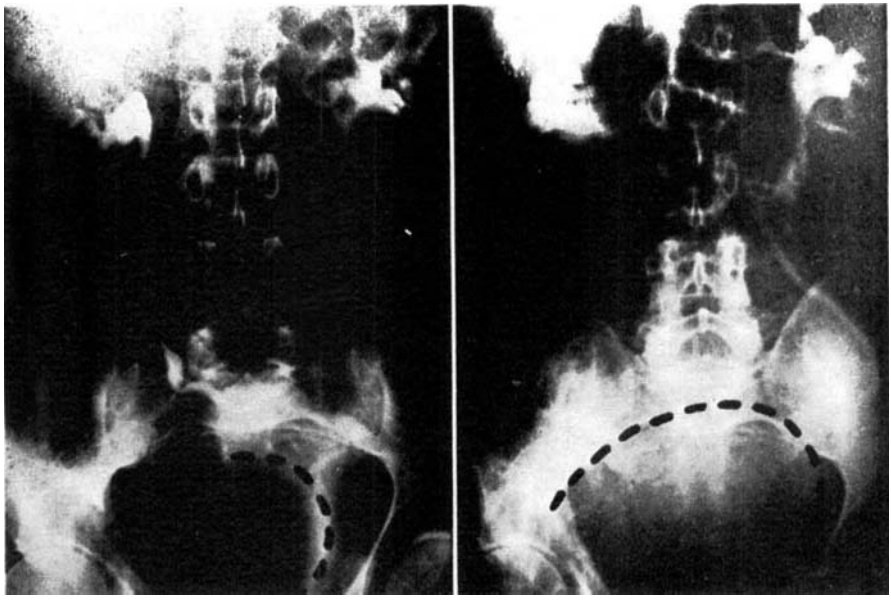

Figure 3. Urography in the same case as in Figure 2. The examinations were performed with an interval of 2 months, the patient having refused treatment after the first one. The righthand picture clearly shows dislocation of the contralateral ureter.

If the tumour has spread within the pelvis, urography and colon x-rays should always be undertaken in order to visualize the topography (Figure 3). One can then plan an extention of the operation in advance. If proliferation of the tumour makes it necessary to resect the ureter, a nephrectomy on the affected side must be done in conjunction with the hemipelvectomy. The urography will also provide preoperative information about renal function. If the colon is invaded by the tumour, a preoperative colostomy may be indicated.

An angiographic survey is often needed, particularly to locate the pelvic arteries. Here it may be noted that the femoral artery on the healthy side should be used for injection of the contrast medium. In several of the cases in which the angiography was performed via the diseased leg's femoral artery, subsequent vascular dissection was complicated by hematoma, oedema or perivascular fibrosis. This difficulty was specially marked in a case in which the external iliac artery had previously been catheterised for perfusion treatment with cytostatics. Angiography via the femoral artery on the healthy side also provides information about the circulation on both sides distal of the aortic

bifurcation. If it is then found, for instance, that the contralateral internal iliac artery displays pronounced arteriosclerotic changes, allowance can be made for this at hemipelvectomy by avoiding ligature of the common iliac artery. Ligation of only the external branch leaves the ipsilateral internal iliac artery unimpaired, thereby guarding against circulatory disturbances in the pelvic organs. It is possible, however, that this danger has been exaggerated. In a case of uterine rupture, bilateral ligation of the internal iliac arteries did not give rise to any complications in the form of circulatory disturbances (*Sjövall* 1966).

The preparations for hemipelvectomy may also include the introduction of a ureteric catheter. If the tumour has expanded into the pelvic cavity, it may be easier to locate the ureter by palpation of the catheter via the ureter wall. A bladder catheter is always introduced if the hemipelvectomy is expected to take a long time.

SURGICAL TECHNIQUE AND COMMENTS

The operation is performed with the patient supine, a small wedge-shaped pad sometimes being placed under the lumbar region on the affected side. We consider this position advantageous because it permits rapid retroperitoneal dissection to the major pelvic vessels, which can then be controlled. The lateral position reported by *Sorondo & Ferré* (1946) does not afford the same advantages.

The incisions are placed according to the tumour's extent, particularly in the dorso-proximal direction. A large anterior incision is generally made first, running along the greater part of the iliac crest to the ventral iliac spine and from there along the inguinal ligament to the pubic tubercle and the symphysis. The abdominal musculature is freed from the iliac crest and the pubic tubercle, the peritoneum and the ureter are retracted medially and the vessels are followed in a proximal direction. The common iliac artery and vein are dissected free independently and fitted with rubber occlusion clamps as a precautionary measure. As pointed out by *Wise* (1948) and others, one then has complete control in principle of major intrapelvic bleeding in the operation field.

Once it has been established that the tumour is operable, the major vessels are ligated and cut. In most cases we have severed the external iliac artery and vein, in 3 cases the common vessels and in 1 case—owing to the anatomical relationships—the external and internal ves-

sels independently. A sufficiently radical excision of the tumour can generally be achieved with severance of only the external vessels. This also avoids the danger of circulatory disturbances arising in the region supplied by the internal iliac artery. This point has been heavily emphasised by *Ravitch* (1949), who holds that only the external artery can be severed with impunity. *Gordon-Taylor & Monro* (1951), *Pack & Miller* (1964) and *Phelan & Nadler* (1964) always sever the common vessels, apparently without adverse effects. In the cases in which we ligated the common (or internal) iliac artery, no necrosis developed in the gluteal region. It would seem that the collateral circulation is sufficient to maintain viability. The femoral nerve and the psoas muscle are cut at the same level as the vessels.

The posterior and medial parts of the skin incision form the next step. The leg is adducted and rotated strongly inwards, the posterior incision being placed in a wide arc from the posterior superior iliac spine to the greater trochanter, from where it turns down the gluteal fold towards the ischial tuberosity. From there it runs on the medial aspect along the pubic arch to the cranial border of the symphysis.

In the gluteal region we aim at retaining the gluteus maximus muscle so that, after the amputation, it can be sutured to the abdominal musculature and form a cover over the amputation field, giving a stump of suitable consistence and strength. For this reason we sever the muscle at its attachment in the gluteal tuberosity and the fascia lata. In only 1 of our cases was the muscle resected, the defect being replaced with a tantalum net. Neither in this nor the other cases has hernia developed in the amputation stump.

The myotomies are followed by subperiostal exposure of the region for the osteotomies at the symphysis and ilium. We generally make the anterior osteotomy through the pubic bone about 1 cm lateral of the symphysis in order not to risk injury to structures in the urogenital trigonum. A Gigli saw is used for the osteotomy. The pubic angle is extremely acute in some men, making it difficult to pass the saw round the bone. In such cases the anterior cleavage of the pelvic girdle had to be done through the symphysic cartilage.

With respect to the posterior osteotomy, prosthetic function and cosmetic considerations call for a resection plane that saves as much of the ilium as possible. The location of the tumour may, however, necessitate a very dorsal osteotomy, in the sacro-iliac joint or even through the lateral part of the sacrum. If the osteotomy is made through the ilium, the plane of resection coincides with the greater sciatic notch.

The presence of the superior gluteal artery and vein must then be born in mind when performing both the external and the internal subperiostal dissection, since as pointed out by *Gordon-Taylor & Monro* (1951–52), these vessels are easily damaged where they run close to the bone in the vicinity of and through the suprapiriform foramen. Severe hemorrhage may then arise, even though resection of the piriform muscle improves the field of vision. Surprisingly enough, bleeding from the superior gluteal artery is only slightly checked by occlusion of the common iliac artery; presumably there is a well-developed collateral circulation from the contralateral internal iliac artery. It is still more troublesome, however, to cope with profuse bleeding from the superior gluteal vein.

In order to be in a position to bring any hemorrhage under control, we now perform the two osteotomies in rapid succession, starting with the anterior one. Once the pelvic girdle has been severed, the part to be resected can be folded outwards, making it easy to reach the superior gluteal vessels from inside the pelvis should ligature be necessary.

In this context it may be noted that even very large tumours which expand intrapelvically from the bone can be mobilised and thereby become operable after the pelvic osteotomies. The tumour must, however, be encapsulated and have a well-defined base. A case in point was a chondrosarcoma that extended right across to the contralateral sacroiliac joint. After the osteotomies, the tumour could be freed from the peritoneum by blunt dissection. When the half of the pelvis was displaced laterally and twisted, the tumour and its base followed suit. In this way it could be "dislocated" from its deep intrapelvic site. The size of growth in relation to the acetabulum is indicated by Figure 4.

After the osteotomies there is usually no difficulty in completing the hemipelvectomy. The levator ani muscle is severed from the obturator internus at the tendinous arch of the fascia of pelvic muscles. The obturator vessels are ligated and cut and the obturator nerve is severed. The sciatic nerve is cut just distal to the lumbar plexus. Finally, when the sacrotuberal and sacrospinal ligaments have been cut, the hemipelvectomy is complete and the specimen can be removed (Figure 5).

The technical problems facing the surgeon in a hemipelvectomy can be commented briefly as follows:

1. The possibility of temporary occlusion of the common iliac artery reduces the danger of hemorrhage.

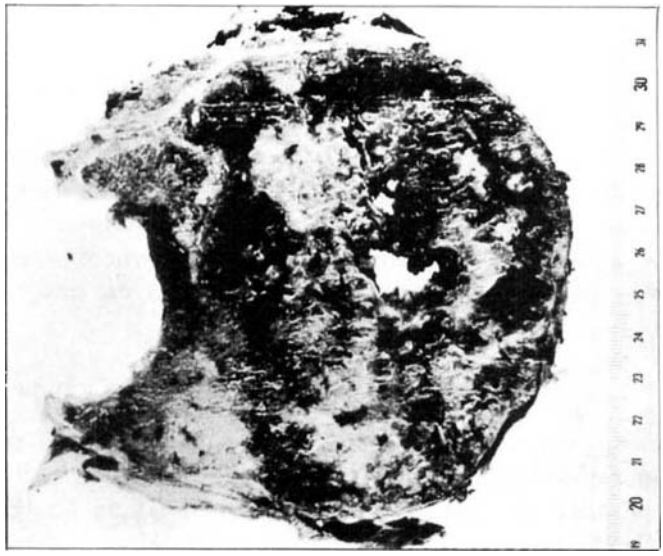

Figure 4. Frontal section of the condrosarcoma in Figure 2. The small incisure to the left is the acetabulum, from the base of which the tumour, measuring 11 × 11 cm, is proliferating.

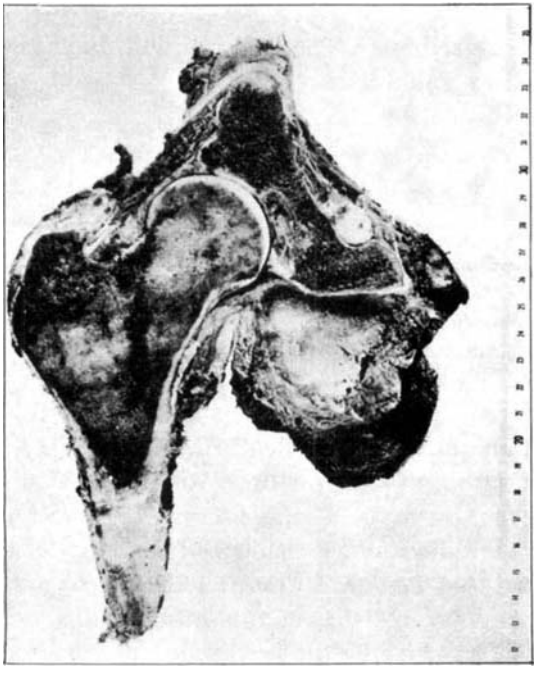

Figure 5. Hemipelvectomy specimen (frontal section) of a synovial sarcoma. The tumour has grown through the obturator foramen into the pelvic cavity.

2. Performing the osteotomies in swift succession facilitates dissection of the tumour and control of bleeding.

3. Encapsulated tumour with an extensive intrapelvic expansion accompany the pelvis after the osteotomies.

4. The gluteus maximus muscle should be spared and used to build up an optimal stump. Resection of this muscle does not, however, necessarily result in insufficiency of the pelvic floor.

5. Owing to the volume relationships, a hemipelvectomy is considerably easier to perform on a child than on musculous or corpulent adults.

POSTOPERATIVE TREATMENT

In our experience the patient is surprisingly unaffected by this major operation. Mobilisation is therefore possible on the 1st or 2nd postoperative day, when the patient is stood up on the remaining limb. Walking exercises with a walking chair or supports are started as early as in the first postoperative week. As a rule, the first prosthesis can be moulded about 3 weeks after the operation.

THE AUTHORS' SERIES

Our series comprises 13 hemipelvectomies. The age, sex and diagnosis for these patients are reported in Table 1.

Table 1. 13 hemipelvectomies.

Female	4	46–68 years
Male	9	11–69 years
Fibrosarcoma		3
Synovial sarcoma		2
Angiosarcoma		1
Chondrosarcoma		5
Osteosarcoma		2

There have been no immediate postoperative deaths. All the patients were discharged from the hospital with a prosthesis and varying degrees of walking function. The shortness of the present observation time—6 months to 4 years—precludes any assessment of the long-term prognosis. It may be mentioned that *Pack & Miller* give the 5-year survival rate after hemipelvectomy for soft-tissue tumours as 26.9 per cent and for bone tumours as 20 per cent. Our results to date are not

unfavourable (see Table 2) but more experience is required for an adequate assessment.

Table 2. 13 hemipelvectomies.
Observation time 6 months–4 years

	I	II
Alive without metastases	4	2
Alive with metastases	1	1
Dead	1	4

I = soft tissue tumour.
II = bone tumour.

SUMMARY

The surgical considerations and technique in hemipelvectomy are discussed in detail, with particular reference to methods for reducing operative complications. In the authors' series presented here—13 cases with a maximal observation time of 4 years—there have been no deaths during or immediately after the operation.

RESUME

Il est discuté en détail des considérations chirurgicales et techniques de l'hémipelvectomie, en particulier par rapport aux méthodes pour réduire les complications opératoires. Dans les séries des auteurs présentées ici – 13 cas avec une période maximum d'observation de 4 ans – il n'y a pas eu de décès pendant ou immédiatement après l'opération.

ZUSAMMENFASSUNG

Die chirurgischen Überlegungen und die Technik bei der Hemipelvektomie werden eingehend und mit besonderer Bezugnahme zu Methoden, die operative Komplikationen herabsetzen, besprochen. In der von den Verfassern hier vorgestellten Gruppe – 13 Fälle mit einer maximalen Beobachtungszeit von 4 Jahren – ereignete sich kein Todesfall während oder unmittelbar nach der Operation.

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