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ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

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## Flank approach adrenalectomy A diachronic procedure

**OBJECTIVE** The surgical approach to the adrenal glands is always a matter of concern. Although laparoscopy is becoming ever more popular, the open approaches have specific indications. The flank approach for adrenalectomy remains a reliable choice. **METHOD** In this Department the flank incision was performed as an alternative approach in open surgery of the adrenal glands. Over a period of 3 years 6 patients were operatively treated with flank approach adrenalectomy. The results were analysed and compared to those of other approaches. **RESULTS** Data assessment showed that all 6 patients were satisfied with the procedure and the reported operative results show that this approach constitutes a very competitive choice in adrenal surgery. **CONCLUSIONS** Flank approach adrenalectomy remains a safe, successful and competitive surgical option.

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Η με πλάγια προσπέλαση  
επινεφριδεκτομή – Μια διαχρονική  
διαδικασία

Περίληψη στο τέλος του άρθρου

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Tumors of the adrenal cortex are reported in 2% of all autopsies, with the most common lesion being a benign adenoma. The pathologic entities of the adrenal gland that require surgical intervention are primary hyperaldosteronism<sup>1</sup> (Conn syndrome), Cushing syndrome,<sup>2</sup> pheochromocytoma,<sup>3</sup> neuroblastoma, and adrenocortical carcinoma.<sup>4</sup> In addition, many adrenal glands are removed en bloc as part of a radical nephrectomy for renal cell carcinoma. Rarely, metastatic adrenal lesions and symptomatic adrenal cysts necessitate adrenalectomy.<sup>5,6</sup>

Although the laparoscopic approach has largely replaced all other open procedures,<sup>7,8</sup> open surgery remains the basis of treatment in the case of adrenalectomy. Apart from cases where an open approach is predecided, the need to convert a laparoscopic adrenalectomy to an open approach occurs quite often, due to local conditions and tumor characteristics.<sup>9</sup>

The surgeon has the possibility to gain access to adrenal glands from any one of four directions.

In the anterior approach, a uni- or bilateral Chevron incision is performed. Sometimes a midline incision provides a better approach, especially if both adrenal glands are involved or exploration of the peritoneal cavity is indicated.<sup>10</sup>

In the posterior-lumbar approach, the incision runs just beneath the rib cage. If both glands are to be removed, an incision is made on each side of the body. This approach is the most direct route to the adrenal glands, but it does not provide quite as clear a view of the surrounding structures as the anterior approach.<sup>11,12</sup>

In the flank approach, which will be further analysed here, the incision is made over or along the chosen rib (11th or 12th) towards the umbilicus. This is particularly useful in massively obese patients. If both glands need to be removed, the surgeon must remove one gland, repair the surgical wound, turn the patient onto the other side, and repeat the entire process. An extraperitoneal, extrapleural 11th or 12th rib flank approach as used for a radical nephrectomy provides excellent exposure for right or left adrenalectomy.<sup>10,12</sup>

The latter approach involves an incision into the chest cavity, either with or without part of the incision into the abdominal cavity.<sup>13</sup> This procedure is rarely used and only when the surgeon anticipates a very large tumor, or if the surgeon needs to examine or remove nearby structures as well.

## MATERIAL AND METHOD

Six patients who underwent flank approach adrenalectomy during the last three years (tab.1) were included in the study. Two of them were operated on because of adrenal metastases from lung cancer, two for pheochromocytoma (one of which was malignant), one for a cortisol producing adenoma and the sixth had an adrenal neoplasm of undefinable origin. Four of the resected adrenal glands were on the right and the other two on the left side.

The two cases of adrenal metastases were identified during follow-up imaging after lung lobectomy due to lung cancer.

The evaluation of the patients presenting with hypertensive crisis included ultrasound (U/S) triplex of heart and kidney vessels, computerized tomography (CT) and magnetic resonance (MR) imaging of the abdomen. The diagnostic laboratory examination of all non-metastatic identified adrenal masses includes the following investigations: Evaluation of 24h-urine metanephrines and catecholamines, vanillylmandelic acid (VMA) in urine, low dose dexamethasone suppression test, estimation of plasma aldosterone and dehydroepiandrosterone (DHEA) concentrations.

### Operative technique

The patient (for right adrenalectomy) is placed in the flank position with the right side facing up. The bed is placed in maximal flexion, and the kidney rest is deployed to accentuate the space between the costal margin and iliac crest. Palpation is used to identify the course of the 11th rib. The skin and fat overlying the 11th rib are incised, and the fascia and muscle overlying the rib are divided (figures 1, 2).

Once the anterior surface of the rib is exposed, the anterior periosteum is cauterized and the periosteal elevator is used to



**Figure 1.** Flank incision.

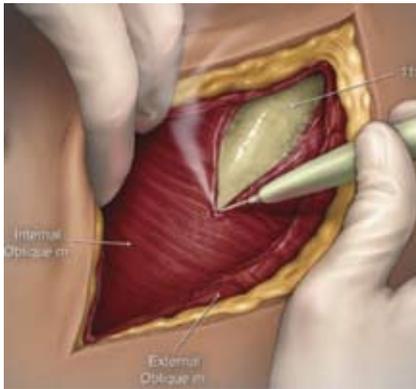
scrape it off the anterior rib surface. The periosteal elevator is used to develop a plane between the posterior rib surface and the posterior leaf of the periosteum. The Doyen instrument and surgical cautery are used to strip the periosteum off of the rib from the tip of the rib back toward the paraspinal muscles. With the rib cutter, the 11th rib is excised (fig. 3). A rongeur can be used to remove any sharp remnants on the rib stump. Cautery or bone wax can be used to render the marrow hemostatic.

Next, the neurovascular bundle is identified and freed with sharp and blunt dissection to avoid injury during subsequent dissection and closure (fig. 4). The lumbodorsal fascia is entered sharply with Metzenbaum scissors, and blunt dissection is used to dissect the peritoneum off of the transverse fascia anteriorly. The flank muscles and their accompanying fasciae are divided anteriorly – the external oblique, internal oblique and transverse abdominal muscles. Next, the posterior muscle diaphragmatic attachments are divided with cautery. The pleura is sharply and bluntly dissected off the superior edge of the 12th rib.

The plane between Gerota's fascia and the peritoneum can be started with the cautery or sharp dissection. Once it is identified, this plane can be maximally developed with blunt dissection. The peritoneum needs to be freed from the superior aspect of Gerota's fascia as well. Once the peritoneum is mobilized, on the right side, the vena cava can be visualized, and with cephalad dissection, the adrenal gland and renal vein can be seen as well. Placement of a self-retaining retractor is essential for maximal exposure to be obtained.

**Table 1.** Features of all six clinical cases of adrenal tumor.

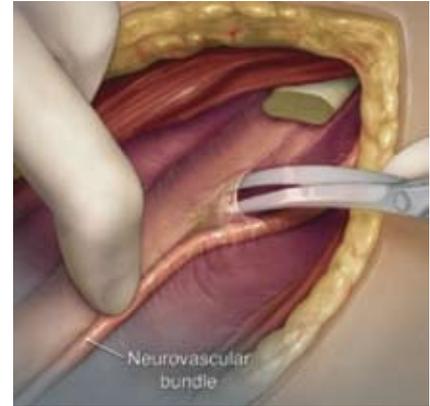
Pt	Age/Sex	Underlying pathology	Tumor size (cm)	Diagnostic evaluation
1	56 f	Borderline carcinoma	5.4×2.2×1.3	Incidentaloma
2	40 m	Pheochromocytoma	8×5×3	Hypertensive crisis evaluation
3	63 m	Lung cancer metastasis	3×2×2	Follow-up abdominal CT after lung lobectomy
4	74 f	Lung cancer metastasis	4.2×3×1.8	Follow-up abdominal CT after lung lobectomy
5	55 m	Cortisol producing adenoma	6.1×4.2×2.1	Routine adrenal mass evaluation
6	46 m	Pheochromocytoma	6.5×3.5×3	Hypertensive crisis



**Figure 2.** Reaching the rib.



**Figure 3.** Excision of the 11th rib.



**Figure 4.** Entering the lumbodorsal fascia.

Dissection of the adrenal gland typically begins along the medial border of the gland with the vena cava. The overlying peritoneum is divided, and blunt dissection is used to expose the plane between the medial surface of the adrenal gland and the lateral surface of the vena cava. The adrenal vein is often difficult to identify until this plane is developed. The adrenal vein is dissected out with a right-angled instrument, such as a Mixer forceps. Surgical ties or clips can be placed to ligate the adrenal vein. In the opinion of this department, surgical ties are more reliable than standard titanium clips. However, locking surgical clips may be substituted for added security. There are numerous arterial branches to the gland that can be ligated and divided individually. Alternatively, many authors attest to the utility of the harmonic scalpel in hemostatically dividing arterial attachments. Once this is done, the psoas muscle is often visible posteriorly. Superior attachments are divided with the aid of surgical cautery or harmonic scalpel. Downward traction on the kidney assists with this dissection. Inferomedial attachments to the kidney are taken with sharp or cautery hook dissection.

Dissection of the left adrenal gland is similar except that the aorta is visualized, and the adrenal vein originates from the renal vein. Other authors have described a supracostal technique with

intentional violation of the pleura. This approach may be helpful for larger tumors.

Closure of the incision consists of a two-layer closure with a running No 1 polydioxanone suture. The deep layer consists of the transverse abdominal muscle and internal oblique muscle and fascia. The outer layer consists of the external oblique muscle and fascia. Skin closure can be completed with surgical staples or absorbable stitches.<sup>14,15</sup> Figures 5 and 6 illustrate characteristic imaging and operative findings of two of our cases.

## RESULTS

During the flank approach adrenalectomy minimal blood loss from the surgical field and absence of postoperative wound serum collections were observed. The duration of the operation was  $80 \pm 30$  min, and the postoperative hospital stay was 3–4 days. As far as postoperative pain can be measured, all 6 patients had minimal demand on analgesia, needed parenteral medication for no more than 48 hours and were mobilized within the first postoperative day. No systemic complications were observed, such



**Figure 5.** MRI images (a, b) and the resected mass of a patient with pheochromocytoma of the right adrenal gland (c).



**Figure 6.** A patient with a left adrenal tumor of borderline malignancy. (a) MRI image. (b) Operation site of adrenal carcinoma. (c) Operation site of adrenal carcinoma.

as injury of other organs (spleen or pancreas), paralytic or obstructive ileus, or complications from the lungs (pleural effusion, atelectasia). Additionally, none of the patients has developed a postoperative hernia.

## DISCUSSION

The choice of the approach in open adrenalectomy is defined and influenced from a number of factors, such as patient's body type, the underlying adrenal pathology and of course the surgeon's preference according to experience. Laparoscopy is a tempting alternative and has widely replaced the open procedures in adrenal surgery.<sup>16</sup>

Primary and metastatic adrenal cancer, with an enormous size of adrenal mass are considered to be absolute indications for open adrenalectomy.<sup>17,18</sup> The secreting tumors should also, according to many authors, be treated with open surgery because of the risk of intraoperative systemic complications as the manipulation of the tumor can lead to hormone hypersecretion.<sup>19</sup>

Obesity and assumed adhesions from prior operations constitute further indications for the open, and especially the retroperitoneal flank, approach. Simultaneous organ resection in a patient with multiple previous abdominal surgeries requires a carefully planned operative approach. Important goals include obtaining optimal exposure, allowing safe resection of multiple organs through a single incision, and minimizing postoperative morbidity and recovery time. Consideration must be given to potential distortion of the normal anatomy from previous operative procedures, which might preclude certain surgical approaches.

A literature based comparison of open versus laparoscopic adrenalectomy reveals superiority of the laparoscopic group in most of control parameters, with exception of that of operative time.<sup>20–22</sup>

In most studies the mean operative time for the laparoscopic approach was 158–220 min versus 85–120 min for open surgery.<sup>23</sup>

Blood loss is, according to all studies, higher in open adrenalectomy.<sup>24</sup> In comparison to the other open procedures, however, the flank approach is associated with minimal blood loss, due to the shorter incision. The duration of operation and the blood loss during adrenalectomy depends also on the nature and the dimensions of the tumor that has to be resected.

The difference in parenteral pain control duration is not statistically significant between the groups undergoing open and laparoscopic adrenalectomy.<sup>25</sup> Although pain is difficult to measure, a flank incision is less painful than a midline or a Kocher incision, and allows earlier mobilisation of the patient.

The postsurgical stay is statistically significantly shorter in the laparoscopic group, with an average postoperative hospitalisation range of 2–5 days versus 5–11 days for the open surgery group.<sup>26</sup> The shorter length of a flank incision, compared to the other open procedures, guarantees a shorter hospital stay.

Comparison of these data shows that with a flank approach adrenalectomy the demand on pain medication, the operative blood loss and the length of postsurgical stay are comparable to those of a laparoscopic approach. The advantages of shorter operative time and anesthesia duration, which are characteristic of all open approaches show, are also maintained with the flank approach, while the postoperative complications associated with a transperitoneal approach are totally absent. It is apparent that the flank approach has advantages over the other open procedures.

In conclusion, the flank approach constitutes a good alternative in adrenal surgery and can be highly recom-

mended as the incision of choice for open adrenalectomy. This preference is much stronger in the case of patient obesity or absence of need for abdominal exploration for further metastases.

This flank incision provides an excellent exposure of the adrenal and its neighbouring structures without violation of the abdominal or chest cavities. It combines the better tolerated advantages of the posterior approach with the

greater exposure gained by the anterior trans-abdominal approach. The kidney, adrenal, and great vessels are exposed, but the greater abdominal cavity is not entered, so there is less pain and a faster recovery.

The final choice of the incision should always depend on pathology, the patient's body type and the surgeon's experience.

## ΠΕΡΙΛΗΨΗ

### Η με πλάγια προσπέλαση επινεφριδεκτομή – Μια διαχρονική διαδικασία

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**ΣΚΟΠΟΣ** Η χειρουργική προσπέλαση των επινεφριδίων αποτελεί αντικείμενο προβληματισμού. Παρόλο που η λαπαροσκόπηση γίνεται ολοένα και πιο δημοφιλής, η ανοικτή επινεφριδεκτομή έχει συγκεκριμένες ενδείξεις. Η πλάγια προσπέλαση παραμένει μια αξιόπιστη επιλογή. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Στην Κλινική μας χρησιμοποιείται η πλάγια προσπέλαση στις ανοικτές επινεφριδεκτομές. Έξι ασθενείς υποβλήθηκαν σε πλάγια προσπέλασης επινεφριδεκτομή την τελευταία τριετία. Τα αποτελέσματα αναλύθηκαν και συγκρίθηκαν με εκείνα των άλλων προσπελάσεων. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Η εκτίμηση των δεδομένων αναφέρει ικανοποίηση όλων των ασθενών από τη διαδικασία, ενώ τα εγχειρητικά αποτελέσματα την καθιστούν ανταγωνιστική επιλογή στη χειρουργική των επινεφριδίων. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Η πλάγια προσπέλασης επινεφριδεκτομή παραμένει μια ασφαλής, επιτυχής και ανταγωνιστική χειρουργική προσπέλαση.

**Λέξεις ευρητηρίου:** Επινεφριδεκτομή, Πλάγια προσπέλαση, Χειρουργικές προσπελάσεις

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