

# Transposition of Pedicled Adrenal for the Treatment of Cushing's Disease

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**Abstract: Objective.** To explore a rational surgical treatment for the Cushing's disease. **Methods.** 68 patients with Cushing's disease were treated in our department with a new operation designed by authors between October 1990 and October 2004. All the patients presented typical Cushing's syndrome. The level of 24 hour urinary excretion of 17-hydroxycorticosteroids (17-OHCS) fluctuated from 40–125  $\mu\text{mol}/24\text{ h}$  ( $62.5 \pm 27.8$ ). The diurnal rhythm of the plasma cortisol level was lost in all cases. In the operation, left adrenal gland was freed from surrounding tissue with the tissues between upper pole of adrenal and diaphragm was saved. Thus, a pedicle about 1.5 cm in width and 4–6 cm in length could be formed and the gland could be transposed into dorsal subcutaneous tissue through 11th intercostal space. Then right total adrenalectomy was performed. Postoperative histological diagnoses were bilateral adrenocortical hyperplasia. Adrenocortical substitution therapy was administered after operation and stopped completely 10 to 14 postoperative days in all patients. **Results.** All of patients recovered well after operation. 56 patients have been followed for six months to nine years. 52 patients were well. In these patients, plasma and urinary cortisol values had returned to normal levels and all clinical signs of Cushing's disease were absent. 42 patients had been followed up more than 3 years. The level of 24 hour urinary excretion of 17-OHCS decreased to  $22.6 \pm 9.2 \mu\text{mol}/24\text{ h}$  ( $P < 0.001$ ) in 3 postoperative years. Hypoadrenocorticism developed in 4 patients and skin hyperpigmentation was observed. The patients required adrenocortical replacement therapy. No recurrent Cushing's syndrome was observed in all patients. **Conclusions.** It's simple to make a vascular pedicle on upper pole of the adrenal and transpose the pedicled adrenal through 11th intercostal space into the dorsal subcutis. Second operation is easy to perform if relapse of syndrome occurs. Nowadays, this procedure may be a rational technique for the treatment of Cushing's disease. [Life Science Journal. 2005;65–67] (ISSN: 1097–8135).

**Keywords:** adrenal; Cushing's disease; surgical treatment

## 1 Introduction

It's well recognized that Cushing's disease is caused by overproduction of cortisol. The majority of cases (85%) are due to bilateral adrenocortical hyperplasia stimulated by overproduction of pituitary adrenocorticotrophic hormone (ACTH). Though many treatments for Cushing's disease are presented, there is no ideal one up to now<sup>[1]</sup>. In the clinical practice, we have found that adrenal vascular and the surrounding tissue are very abundant and the superior adrenal artery and vein with their surrounding tissues can be dissected and formed a vascular pedicle which is about 4–6 cm in length. Therefore, an operation with transposition of pedicled adrenal beneath dorsal subcutaneous was designed. From October 1990 to October 2004, 68 cases of Cushing's disease were treated with this technique and satisfactory results have been achieved.

## 2 Operative Technique

Under extradural anesthesia, 11th intercostal incision is employed. The left adrenal is operated on firstly. The dorsal and upper parts of Gerota's fascia are incised and Gerota's fascia is dissected. The adrenal gland is exposed and explored to demonstrate the hyperplastic adrenal gland. The gland is freed laterally, inferiorly, anteriorly, posteriorly and medially. The tissues between upper pole of adrenal and diaphragm are saved as much as possible for protection of superior adrenal artery and vein that come from inferior phrenic vessels. The freed gland is pulled upwards and laterad. If the medial parts of tissues are felt tense, some of them could be divided. Then, a satisfactory pedicle is formed and sometimes several little vessels that pass into gland or its surrounding tissues can be seen. The pedicle is about 1.5 cm in width and 4–6 cm in length, so the gland can be transposed into dorsal subcutaneous tissue through 11th intercostal space easily. The bases attach to diaphragm as a fan. The way of the transposition ought to be as

short as possible to reduce the pedicle tense. If diaphragm is in the way of transposition, parts of crus of diaphragm should be divided. This procedure makes the transposition way shorter and straighter remarkably. The pedicle is fixed with sutures with nearby intercostal muscle. 10% of adrenal is removed for histological examination. The remained adrenal is fixed beneath the dorsal subcutis. The gland is marked with silver clips for X-ray location. Then right total adrenalectomy is performed. If the transposition on left gland is unsatisfactory or unsuccessful, a transposition on right adrenal could be performed as procedures above, but it's more difficult than on the left due to the proximity of the liver and vena cave. Adrenocortical substitution therapy was administered after operation and stopped completely 10 to 14 postoperative days in all patients.

### 3 Clinical Material

We reviewed the records of 68 patients with Cushing's disease treated in our department between October 1990 and October 2004. Cases of pituitary adenomas were excluded. Fifty-three of patients were female and fifteen were male, and their ages ranged from 11 – 50 years (mean 36.5). All the patients presented typical Cushing's syndrome. The level of 24 hour urinary excretion of 17-OHCS fluctuated from 40 – 125 ( $62.5 \pm 27.8$ )  $\mu\text{mol}/24\text{ h}$ . The diurnal rhythm of the plasma cortisol level was lost in all cases. Skull roentgenography and tomography of the sella turcica were performed to exclude the presence of a pituitary tumor. However, no pituitary abnormality was demonstrated. Studies to localize adrenal hyperplasia with tomography were also performed. Postoperative histological diagnoses all were bilateral adrenal adrenal cortical hyperplasia. 56 patients have been followed for six months to nine years. 52 patients were well. In these patients, plasma and urinary cortisol values had returned to normal levels and all clinical signs of Cushing's disease were absent. 42 patients have been followed up more than 3 years. The level of 24 hour urinary excretion of 17-OHCS decreased to  $22.6 \pm 9.2 \mu\text{mol}/24\text{ h}$  ( $P < 0.001$ ) in 3 postoperative years. Hypoadrenocorticism developed in 4 patients and skin hyperpigmentation was observed. The patients required adrenocortical replacement therapy. No recurrent Cushing's syndrome was observed in all patients.

### 4 Discussion

It's well known that the vessels of adrenal are so multiple and variable that it is difficult to dissect

and utilize them. Our experience reveal that it is possible to moderately free superior adrenal artery and vein 4 – 6 cm long. According to literature<sup>[2]</sup>, the superior adrenal artery comes from inferior phrenic artery that is the main blood supply for adrenal and the branches of it form a vascular circle around adrenals with other artery. The venous drainage of adrenal gland is almost exclusively via the inferior adrenal vein. The superior, medial and inferior adrenal arteries all paired by their relative veins. Generally superior, medial veins don't take main role in adrenal vein drainage, but when inferior adrenal vein is obstructed, they can exert drainage function<sup>[2,3]</sup>. Therefore the blood circulation in upper pole of adrenal may be maintained and the necrosis can be avoided providing superior artery and vein are preserved. Between upper pole of adrenal and diaphragm, there are a lot of connective tissues. Superior adrenal vessel passes through them. In order to form a satisfactory pedicle, these tissue should be preserved as much as possible. In this group of patients, the length of pedicle was about 4 cm in children and 5 – 6 cm in adults. In some pedicles there were several vessels to be seen and oozing of blood on severed gland edges was visible in some cases, but these was not obvious in other cases. In the following up the patients, we found that the adrenal function in these patients was similar. Therefore, we realized that it's easy to form a vascular pedicle on the upper pole of adrenal and it's not important for survival and function of transposed adrenal if oozing of blood on severed edges is visible or not, providing the pedicle are thick enough.

It's important for this procedure to form a satisfactory vascular pedicle. An appropriate operative approach is a key. Anterior transabdominal approach was employed on first patient. It was difficult to expose the upper pole of adrenal gland and make a 5 cm long pedicle. When we transposed this pedicled adrenal into dorsal subcutis, the pedicle felt tension as the way is longer. From then on, 11th intercostal incisions were employed routinely. Through 11th intercostal space and external lateral edge of sacrospinal muscle, the transposition way is straight and short for fixing gland into the dorsal subcutis with flaccid pedicles. Therefore, we recommend 11th intercostal incision for this procedure.

About the problems of the amounts of remained adrenal, traditionally 10 – 20% of adrenal are remained in subtotal adrenalectomy and may meet the daily needs of human bodies. In this group, more glands were remained<sup>[4]</sup>. 90% of each

adrenal gland was remained. The reason for this is that we remained 30% of gland in the operation in first several patients and hypoadrenocorticism developed in 2 patients. Thereafter, we try our best to remain more glands. Up to now, we don't find any cases of hyperadrenocorticism. We think the reasonable explanations are that: (1) Media and inferior adrenal vessels are divided completely and superior adrenal vessel is divided partially in the operation. The blood supply to the adrenal is not good, only parts of upper pole gland can survive postoperatively no matter how many glands are preserved. (2) The best place for the development of adrenal is its anatomy location. Dorsal subcutis is not suitable for its development.

In brief, we conclude that it's simple to make a vascular pedicle on upper pole of the adrenal and transpose the pedicled adrenal through 11th intercostal space into the dorsal subcutis successfully. Second operation is easy to perform if relapse of syndrome occurs. Nowadays, this procedure may be a rational technique for the treatment of Cush-

ing's disease.

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