

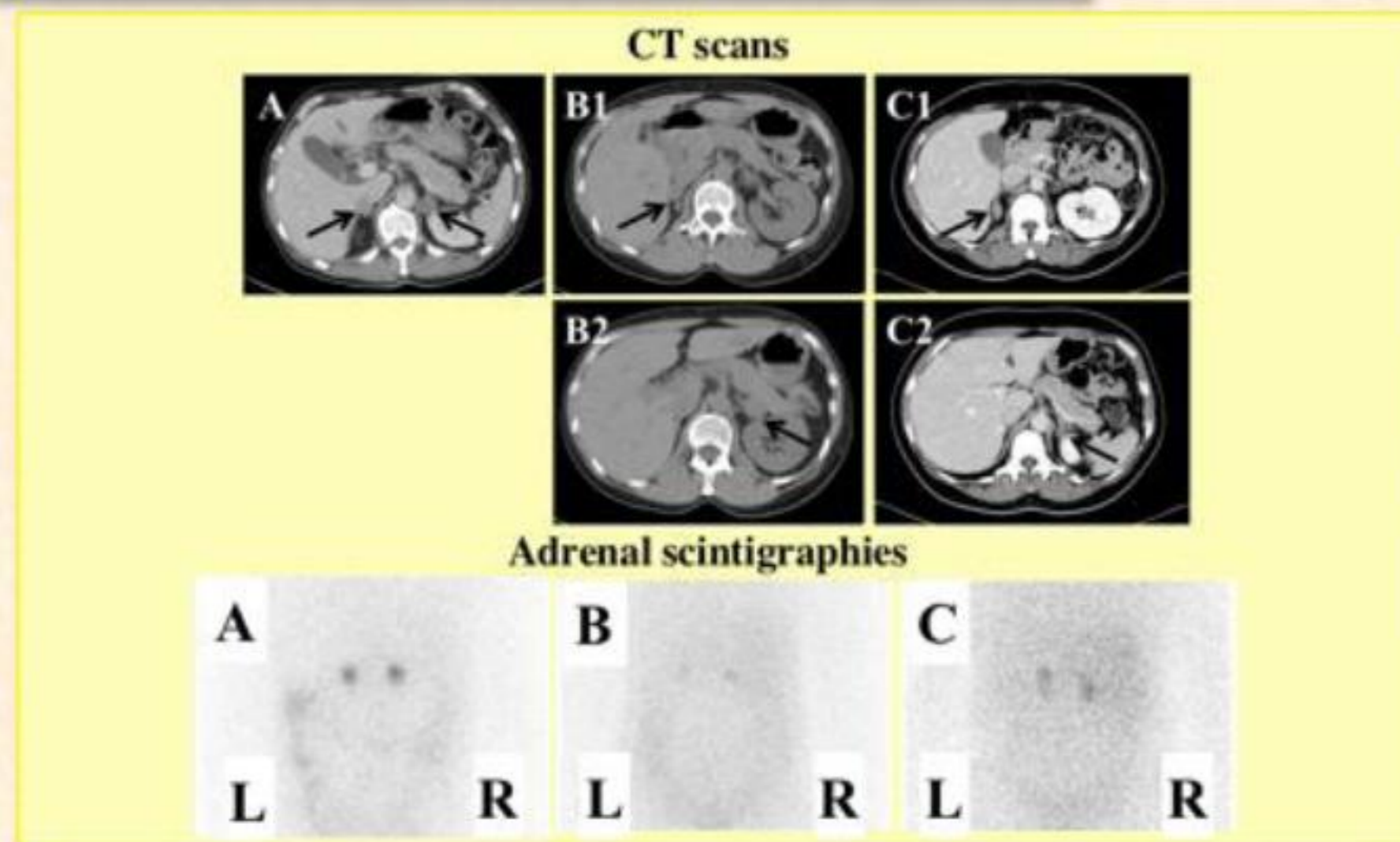
Adrenal venous sampling is useful for a definitive diagnosis in Cushing's syndrome with bilateral adrenal tumors

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CT scans and adrenal scintigraphies



CT scans of the abdomen showed bilateral adrenal tumors. Adrenal scintigraphy revealed bilateral adrenal activity.

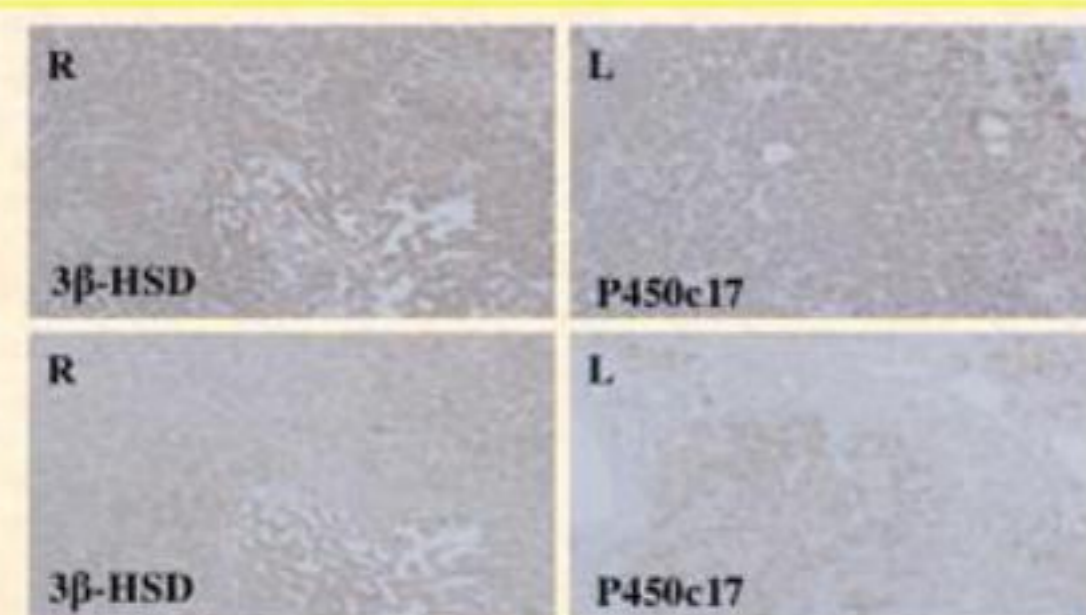
Case A

Diagnosis

CS due to bilateral adrenal tumors

Treatment

To preserve adrenal function, the left adrenal gland was totally resected, whereas the right adrenal gland was partially resected laparoscopically.



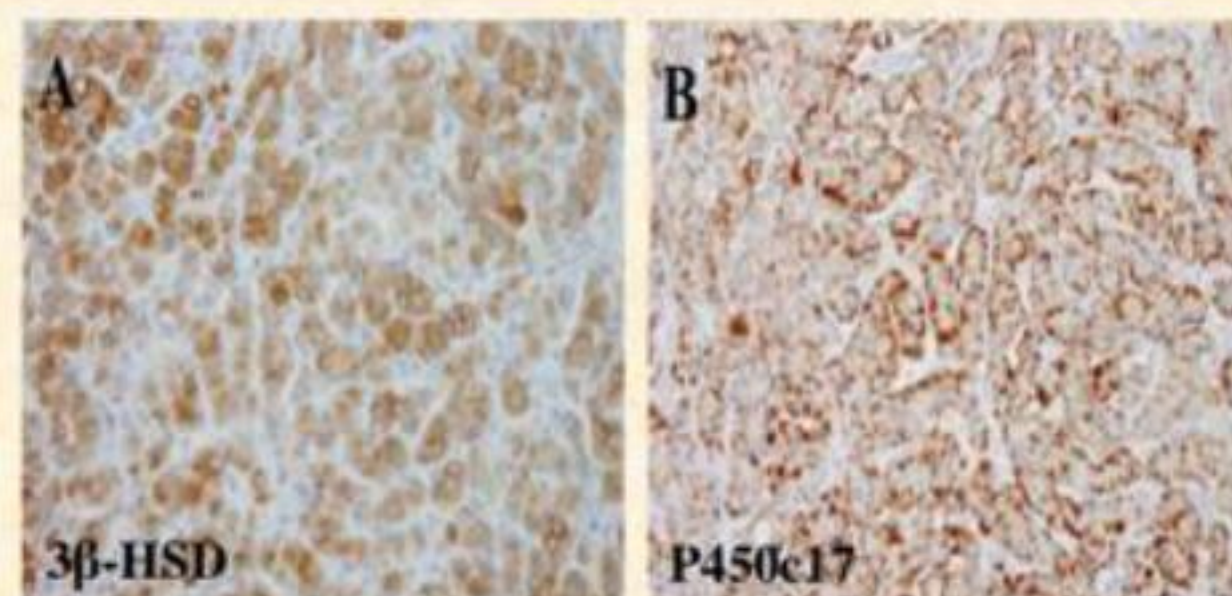
Case B

Diagnosis

CS caused by the right adrenal tumor and PA caused by both adrenal glands

Treatment

We performed a laparoscopic right total adrenalectomy for the treatment of CS and offered medical therapy for the treatment of primary aldosteronism (PA).



Case C

Diagnosis

PA caused by both adrenal glands and subclinical CS caused by both adrenal tumors

Treatment

This patient has no risk factors for cardiovascular disease such as hypertension, obesity, diabetes mellitus or dyslipidemia. Thus, we are observing her without medical therapy.

Concluding remarks

We presented three cases of CS with bilateral adrenal tumors. When bilateral adrenal tumors are encountered, the differential diagnosis is difficult, especially in the functioning bilateral adrenocortical adenoma. Adrenal scintigraphy, which has become a standard technique to determine the laterality of excessive hormone secretion, showed bilateral adrenal activity in all cases. However, AVS distinguished three unique hormone-excess patterns. Based on these findings, we could select adequate treatment for each case. Thus, AVS is necessary to obtain a definitive diagnosis and optimal therapy in CS with bilateral adrenal tumors.

Introduction

We presented three cases of Cushing's syndrome (CS) with bilateral adrenal tumors. When bilateral adrenal tumors are encountered, the differential diagnosis is difficult, especially in the functioning bilateral adrenocortical adenoma. Adrenal scintigraphy, which has become a standard technique to determine the laterality of excessive hormone secretion, showed bilateral adrenal activity in all cases. However, adrenal venous sampling (AVS) distinguished three unique hormone-excess patterns. Based on these findings, we could select adequate treatment for each case. Thus, AVS is necessary to obtain a definitive diagnosis and optimal therapy in CS with bilateral adrenal tumors.

Case A

Captopril test

Time (min)	0	60	90
PAC (pg/mL)	45.9	39.3	32.6
PRA (ng/mL/hr)	0.4	0.3	0.3
ARR	114.8	131	108.7

Furosemide-upright test

Time (min)	0	120
PAC (pg/mL)	15.6	41.2
PRA (ng/mL/hr)	0.3	0.4

Saline-loading test

Time (min)	0	240
PAC (pg/mL)	34.1	30.2
PRA (ng/mL/hr)	0.3	0.2

The furosemide-upright test was positive, and the other tests were negative.

Case B

Captopril test

Time (min)	0	60	90
PAC (pg/mL)	127	68.8	67.5
PRA (ng/mL/hr)	0.2	0.2	0.2
ARR	635	344	337.5

Furosemide-upright test

Time (min)	0	120
PAC (pg/mL)	185	341
PRA (ng/mL/hr)	0.3	0.7

Saline-loading test

Time (min)	0	240
PAC (pg/mL)	78.0	34.1
PRA (ng/mL/hr)	0.2	0.2

The captopril test and furosemide-upright test were positive, whereas the saline-loading test was negative.

Case C

Captopril test

Time (min)	0	60	90
PAC (pg/mL)	90.7	76.1	84.7
PRA (ng/mL/hr)	2.5	0.4	0.2
ARR	36.3	190.3	423.5

Furosemide-upright test

Time (min)	0	120
PAC (pg/mL)	61.6	166
PRA (ng/mL/hr)	<0.1	0.3

Saline-loading test

Time (min)	0	240
PAC (pg/mL)	44.4	35.3
PRA (ng/mL/hr)	0.5	0.3

The captopril test and furosemide-upright test were positive, whereas the saline-loading test was negative.

Discussion 1

It is well known that AVS provides important information concerning the laterality of excessive aldosterone secretion [1, 2]. However, the use of AVS in patients with CS due to bilateral adrenal adenomas has rarely been reported [3-8].

Adrenal scintigraphy showed bilateral adrenal activity in all our cases. However, AVS demonstrated three different hormone-excess patterns. Based on these findings, we selected a different treatment approach for each case.

Thus, AVS is necessary to obtain a definitive diagnosis and optimal therapy in CS with bilateral adrenal tumors.

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Medical history

Case A

The patient was a 63-year-old man. He was referred to our hospital for the evaluation of bilateral adrenal tumors. His past medical history included diagnoses of diabetes mellitus and hypertension 10 years prior. He had Cushingoid features.

Case B

A 44-year-old woman was referred to our hospital for an evaluation of bilateral adrenal tumors. Her blood pressure was hypertensive, and she was noted to have Cushingoid features.

Case C

A 49-year-old woman was referred to our hospital for the evaluation of bilateral adrenal tumors. Her blood pressure was normal, and she had no Cushingoid features.

Case A

AVS

	F (µg/dL)		PAC (pg/mL)	
	RAV	LAV	RAV	LAV
Baseline	238.3	298.1	1340	441
After ACTH 250 µg	485.9	1523	4910	3930

RAV, right adrenal vein; LAV, left adrenal vein.

These results indicated that excessive aldosterone secretion from both adrenal glands was absent. Additionally, there was no laterality of the cortisol secretion.

Case B

AVS

	F (µg/dL)		PAC (pg/mL)	
	RAV	LAV	RAV	LAV
Baseline	100.3	49.0	6100	1310
After ACTH 250 µg	577.7	299.9	1820	81700

RAV, right adrenal vein; LAV, left adrenal vein.

These results suggested that the right adrenal tumor, compared with the left adrenal tumor, produced excessive cortisol. In addition, both adrenal glands were considered to be secreting excessive aldosterone.

Case C

AVS

	F (µg/dL)		PAC (pg/mL)	
	RAV	LAV	RAV	LAV
Baseline	20.8	25.8	3550	1570
After ACTH 250 µg	1102	894.0	27600	28600

RAV, right adrenal vein; LAV, left adrenal vein.

These results indicated that both adrenal glands produced excessive aldosterone. However, laterality of the cortisol secretion was not present.

Discussion 2

There is no consensus regarding the optimal determination of the laterality of excessive hormone secretion.

Omura et al. demonstrated the criterion of super-selective ACTH-stimulated AVS for the laterality of cortisol secretion in CS (9). This report indicated that the cortisol levels were > 380 mg/dL in both central veins or the tributary veins from the adenomas, and the cortisol levels were < 380 mg/dL in other tributary veins in the case of bilateral cortisol-secreting adenomas.

This criterion may have applied to our cases and may therefore serve as a standard criterion for AVS in CS with bilateral adrenal tumors.

