SHORT COMMUNICATION

Percutaneous computed tomography-guided ethanol injection in aldosterone-producing adrenocortical adenoma

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The feasibility, safety and effectiveness of percutaneous computed tomography-guided ethanol injection (PEI-CT) was investigated in a patient affected by aldosterone-producing adenoma (APA). A 42-year-old male patient with typical features of hyperaldosteronism presented a solitary left adrenal adenoma measuring 2 cm, with a normal contralateral gland, evidenced by both CT scan and adrenal $^{[75]}$Se-$^{[19]}$nor-cholesterol scintigraphy. After normalization of potassium plasma levels, 4 ml of sterile 95% ethanol with 0.5 ml of 80% isothalamate sodium was injected. The procedure was completed in about 30 min. No severe pain or local complication was noted. Five hours after PEI, a fourfold and a twofold increase in aldosterone and cortisol plasma levels were observed, respectively. After 11 days on a normal sodium and potassium diet, normal potassium plasma levels and reduced aldosterone plasma levels were present, with reappearance of an aldosterone postural response. Plasma renin activity and aldosterone plasma levels normalized 1 month later, with reappearance also of a plasma renin activity postural response and maintenance of normal potassium plasma levels even on a high sodium and normal potassium diet. The patient has remained hypertensive, although lower antihypertensive drug dosages have been employed. After 17 months, normal biochemical, hormonal and morphological findings were still present. Thus, we suggest PEI-CT as a further alternative approach to surgery in the management of carefully selected patients with APA.

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After the first report on parathyroid adenomas (1–3), percutaneous ethanol injection (PEI) has been employed as a safe and effective treatment in the management of renal and hepatic cysts, parathyroid adenoma or hepatic neoplasms (4–6). Recently, ultrasound-guided PEI has been proposed as an alternative therapy to surgery and radioiodine in the management of thyroid cysts and autonomously functioning thyroid nodules, respectively (7–9). To evaluate the feasibility, safety and effectiveness of PEI in pathological situations besides thyroid nodules, we treated a patient affected with aldosterone-producing adenoma (APA) by computed tomography-guided PEI (PEI-CT).

Subject and materials

A 42-year-old male patient with arterial hypertension, weakness, fatigue and headache was investigated. Biochemical findings revealed low potassium and high sodium plasma levels, increased aldosterone plasma levels and suppressed plasma renin activity (PRA) without postural stimulation response, all typical features of hyperaldosteronism. Aldosterone, PRA and cortisol were assayed using commercial RIA kits (Bios and Radim, Italy, respectively). Normal ranges of aldosterone were, on a normal sodium diet, <220 pmol/l (supine) and 140–560 pmol/l (standing); the low detection limit was 10 pmol/l; intra- and interassay coefficients of variation (CVs) were 3.5 and 7.2, respectively. Normal ranges of PRA, on a normal sodium diet, were 0.5–2.6 µg·l$^{-1}$·h$^{-1}$ (supine) and 0.98–4.18 µg·l$^{-1}$·h$^{-1}$ (standing); the low detection limit was 0.15 µg·l$^{-1}$·h$^{-1}$; intra- and interassay CVs were 5.4 and 8.1, respectively. The normal range of cortisol was 220–660 nmol/l; the low detection limit was 6.8 nmol/l; intra- and interassay CVs were 3.6 and 6.8, respectively. A CT scan and adrenal $^{[75]}$Se-$^{[19]}$ nor-cholesterol scintigraphy on dexamethasone...
2 mg/die po were performed to identify the source of excessive aldosterone production.

The present experience was conducted in accordance with the Helsinki Declaration and the patient's informed written consent was obtained. The patient was placed on a low sodium diet (10 mEq/die) supplemented with 48 mEq/die KCl po until the normalization of potassium plasma levels was reached. After preoperative medication with 0.5 mg of atropine, 5 mg of diazepam and 1 mg of fentanyl iv, anesthesia of the area over the lesion was obtained with 7 ml of 2% lignocaine. Using a 22 G-5.5" needle, 4 ml of sterile 95% ethanol was injected into the adrenal adenoma using a CT-guiding device, adding 0.5 ml of 80% iothalamate sodium (Angioconray 80%, Bracco, Italy) to visualize ethanol distribution. The procedure was completed in about 30 min. A fully equipped operating room was on stand-by should it be required.

The patient remained under observation for 5 h and was asked about the duration and severity of pain. There was no need for analgesics and no local complications were observed. Both biochemical and hormonal parameters were monitored.

Results and discussion

Primary hyperaldosteronism accounts for less than 1% of the hypertensive population (10–13) but represents the most common form of endocrine hypertension. Aldosterone-producing adenoma is diagnosed in 60–75% of patients with primary hyperaldosteronism. The recognition of this form of hypertension is important because it is curable. The occurrence of a malignant lesion is reported rarely, representing about 3–5% of primary aldosteronism (11). Both endocrine and morphological findings have been proposed to differentiate between benign and malignant lesions, such as the size of the mass, plasma levels of aldosterone, the secretion of hormonal precursors, the aldosterone rhythm of secretion and the course of the disease. In our case, adrenal [75Se-19]nor-cholesterol scintigraphy and CT scan showed a solitary left adrenal mass of about 2 cm and a normal contralateral gland (Figs. 1 and 2). Adenomectomy or, when this is not possible, unilateral adrenalectomy are the preferred treatments of APA. However, as PEI-CT is a well-established treatment in various neoplastic lesions
Fig. 2. Computed tomography (CT) scan imaging of the patient affected by aldosterone-producing adenoma: (A) before percutaneous ethanol injection (PEI); (B) during PEI; (C) after 4 months; (D) after 17 months. The arrow indicates the position of adrenal aldosterone-producing adenoma.

Table 1. Hormonal and biochemical findings in patients affected by aldosterone-producing adenoma and treated with percutaneous ethanol injection (PEI).

<table>
<thead>
<tr>
<th></th>
<th>Before PEI</th>
<th>During PEI (peak value)</th>
<th>After PEI (1 month)</th>
<th>After PEI (17 month)</th>
<th>V.N.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldosterone&lt;sup&gt;a&lt;/sup&gt; (pmol/l)</td>
<td>1248</td>
<td>3310</td>
<td>360</td>
<td>200</td>
<td>&lt;200</td>
</tr>
<tr>
<td>Aldosterone&lt;sup&gt;b&lt;/sup&gt; (pmol/l)</td>
<td>1193</td>
<td>-</td>
<td>527</td>
<td>463</td>
<td>140–560</td>
</tr>
<tr>
<td>PRA&lt;sup&gt;a&lt;/sup&gt; (µg·l&lt;sup&gt;-1&lt;/sup&gt;·h&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>0.3</td>
<td>-</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5–2.6</td>
</tr>
<tr>
<td>PRA&lt;sup&gt;b&lt;/sup&gt; (µg·l&lt;sup&gt;-1&lt;/sup&gt;·h&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>0.3</td>
<td>-</td>
<td>1</td>
<td>1.8</td>
<td>0.98–4.18</td>
</tr>
<tr>
<td>Na (mEq/l)</td>
<td>154.4</td>
<td>-</td>
<td>144.7</td>
<td>142</td>
<td>136–145</td>
</tr>
<tr>
<td>K (mEq/l)</td>
<td>3.3</td>
<td>-</td>
<td>4.4</td>
<td>3.8</td>
<td>3.5–5.0</td>
</tr>
<tr>
<td>Cortisol (nmol/l)</td>
<td>552</td>
<td>1070</td>
<td></td>
<td></td>
<td>220–660</td>
</tr>
</tbody>
</table>

<sup>a</sup> Supine.
<sup>b</sup> Standing.
(1–9), we evaluated carefully the feasibility of PEI-CT in this specific case. To our knowledge, no previous use of PEI-CT or ultrasound-guided PEI as a therapeutic procedure in the management of adrenal mass has been reported. Computed tomography imaging during PEI, with ethanol distribution into the encapsulated lesion and into periadrenal adipose tissue with the subsequent reduced CT density of the mass, is reported in Fig. 2B.

A fourfold increase in aldosterone plasma levels was observed during the 5-h course after PEI, with a maximum peak at 2 h (Table 1). This evidence is related most probably to both ethanol-induced APA cytolysis and stress-induced ACTH stimulation, as suggested by the following twofold increase in cortisol plasma levels, with a maximum peak at 3 h (Table 1). After 11 days on a normal sodium and potassium diet, normal potassium values (4.6 mEq/l) and reduced aldosterone plasma levels (388 pmol/l, supine) were present, with the reappearance of aldosterone postural response (693 pmol/l, standing). After 1 month, also, the PRA postural response reappeared (0.4 µg·l⁻¹·h⁻¹ supine, and 1 µg·l⁻¹·h⁻¹ standing), the potassium plasma levels were still normal (4.4 mEq/l) and aldosterone plasma levels were reduced further (360 pmol/l supine and 527 pmol/l standing) (Table 1). Normal potassium plasma levels also were maintained, even on a high sodium and normal potassium diet (4.4 mEq/l), suggesting the restoration of the physiological mineralocorticoid homeostasis. Normal basal cortisol plasma levels (438 nmol/l) and a normal cortisol response after a 0.25-µg synthetic ACTH injection also were present (maximum peak response 601 nmol/l at time 60; normal peak response >552 nmol/l). Seventeen months after the treatment, biochemical and hormonal parameters were still normal.

The effectiveness of PEI-CT was supported further by abdominal CT scan imaging, performed 4 and 17 months after PEI, revealing a progressive diffuse reduction in density of the adrenal mass, as an expression of coagulative necrosis and fibrosis (Fig. 2C, D). Adhesions to the surrounding structures, due to alcohol extranodular seeping, were not present.

Finally, although our patient remained hypertensive, as frequently occurs even after surgical treatment (10, 12, 14–15), lower antihypertensive drug dosages were employed to control arterial hypertension.

In conclusion, at least in this particular case, PEI-CT has been proved to be less invasive and more cost-effective than surgery, sufficiently well tolerated and with no local complication. Thus, although the application of PEI-CT remains to be examined and further investigations involving a larger number of patients are needed, we suggest this technique as an alternative approach to surgery in the management of APA in strictly specialized departments and carefully selected patients.

References


Received June 20th, 1994
Accepted October 24th, 1994

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