Urinary Excretion of $\Delta^5$-Pregnenetriol (5-Pregnene-3$\beta$,17$a$,20-triol) in Healthy Children* **

W. M. Teller***, B. Raue****, and S. B. Pal

Center of Pediatrics, University of Ulm, Prittwitzstr. 43, D-7900 Ulm/Donau, Federal Republic of Germany

Abstract. The excretion of $\Delta^5$-pregnenetriol ($\Delta^5$-PT) was determined in 24-h urine samples from 57 children of various ages. The probands were healthy regarding their endocrine states. Six groups of children were selected: Group I: neonates ($n=12\vartheta$, aged 4 to 24 days), group II: infants ($n=11\vartheta$, aged 1 to 8 months), group III: small children ($n=7\vartheta$, 3 $\varrho$, aged 1½ to 6 years), group IV: schoolchildren ($n=4\vartheta$, 5 $\varrho$, aged 6½ to 10 years), group V: preadolescents ($n=5\vartheta$, 4 $\varrho$, aged 10½ to 13 years, developmental stages Tanner 2 to 3), group VI: adolescents ($n=5\vartheta$, 1 $\varrho$, aged 13–15 years, developmental stages Tanner 3 to 4).

The completeness of the 24-h-urine collections was checked by creatinine determinations. The method used for steroid determination consisted of hydrolysis, extraction, Girard-T-reaction, paper chromatography, and photometric end-point determination using the Zimmermann reaction. Dehydroepiandrosterone (DHEA) was determined parallel to $\Delta^5$-PT.

The following results were obtained:

<table>
<thead>
<tr>
<th>Group</th>
<th>$\Delta^5$-PT (mg/24 h)</th>
<th>DHEA (mg/24 h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.01–0.11 mg, mean: 0.07 mg/24 h</td>
<td>0.04–0.12 mg, mean: 0.07 mg/24 h</td>
</tr>
<tr>
<td>II</td>
<td>0.02–0.19 mg, mean: 0.10 mg/24 h</td>
<td>0.01–0.10 mg, mean: 0.05 mg/24 h</td>
</tr>
<tr>
<td>III</td>
<td>0.01–0.07 mg, mean: 0.04 mg/24 h</td>
<td>0.03–0.09 mg, mean: 0.05 mg/24 h</td>
</tr>
</tbody>
</table>

The excretion of $\Delta^5$PT was significantly correlated to the excretion of DHEA ($P<0.001$), which can be explained by a common metabolic pathway for both steroids.

Key words: $\Delta^5$-Pregnenetriol – Dehydroepiandrosterone – Urine – Healthy children.

Introduction

$\Delta^5$-Pregnenetriol (5-pregnene-3$\beta$, 17a, 20-triol) is a metabolite of $\Delta^5$-pregnenolone. It is excreted in small quantities (about 0.5 mg/day) in normal adult urine, where it occurs as a sulfate ester (Roy 1956).

During childhood $\Delta^5$PT has only been reported to be excreted in conditions of adrenocortical dysfunction. It was first described in a child with adrenocortical carcinoma by Hirschmann and Hirschmann (1950). Subsequently other authors confirmed the finding of elevated urinary excretion of $\Delta^5$PT in conditions of altered steroid metabolism (Stein-Leventhal syndrome; adrenocortical tumors; Cushing’s syndrome; congenital adrenal hyperplasia) (Cox and Shearman 1960; Bongiovanni 1961; Wilson et al. 1961; Roy 1956).
Stern and Barwell 1963; Pal and James 1964; Kinoshito et al. 1968; Bongiovanni et al. 1971; Kenny et al. 1971; Stern 1971).

The present study was undertaken to examine the urinary excretion of $\Delta^5$PT in normal, endocrinologically healthy children of various ages. Furthermore the question was raised as to what degree $\Delta^5$PT excretion parallels the excretion of dehydroepiandrosterone (DHEA), because the latter compound is also a direct metabolite of $\Delta^2$-pregnenolone.

**Flowchart**

1/5 of 24-h-urine; hot hydrolysis pH 7.0  
\[ \downarrow \]
extraction with ether: ethyl acetate  
\[ \downarrow \]
washing; drying; rest hydrolysis with $\text{H}_2\text{SO}_4$  
\[ \downarrow \]
extraction with ether, washing, drying  
\[ \downarrow \]
Girard T reaction  
(ketonic fraction)  
\[ \downarrow \]
paper chromatography  
(Bush A)  
\[ \downarrow \]
Zimmermann reaction  
(DHEA)  
(A$\Delta^5$PT)  
\[ \downarrow \]
 oxidation with metaperiodate  
\[ \downarrow \]
extraciton with ethylene dichloride; washing with Sodiumite, water; drying ($\Delta^5$PT $\rightarrow$ DHEA)  
\[ \downarrow \]
paper chromatography  
(Bush A)  
\[ \downarrow \]
Zimmermann reaction  
(mean recovery throughout the entire procedure: 71%)

**Fig. 1.** Flowsheet of the procedure for determination of dehydroepiandrosterone (DHEA) and $\Delta^5$-pregnenetriol ($\Delta^5$PT) in urine.

**Methods and Materials**

1. **Probands**

57 children of various ages, who had no endocrine diseases, were selected for study and divided into the following groups:

- **Group I:** neonates, $n=12\delta_6$, aged 4 - 24 days
- **Group II:** infants, $n=11\delta_6$, aged 1 - 8 months
- **Group III:** small children, $n=7\delta_3\Omega_6$, aged 1.5 - 6 years
- **Group IV:** schoolchildren, $n=4\delta_3\Omega_6$, aged 6.5 - 10 years
- **Group V:** preadolescents, $n=5\delta_5\Omega_4$, aged 10.5 - 13 years (developmental stages Tanner 2 - 3)
- **Group VI:** adolescents, $n=5\delta_5\Omega_1$, aged 13 - 15 years (developmental stages Tanner 3 - 4)

2. **Urine**

24-h urine specimens were collected from each proband. The completeness of the collection was examined by creatinine determination (Jaffe reaction according to Henry 1964).

3. **III. Determination of $\Delta^5$PT and DHEA**

(according to Pal and James 1964) (Fig. 1)

A 100 ml aliquot of urine from children above 1 year of age, and 50 ml aliquots from those below 1 year were boiled for 6 h at

**Table 1.** Mean values and urinary excretion ranges of $\Delta^5$-pregnenetriol and dehydroepiandrosterone in children of different age groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Sex</th>
<th>$\Delta^5$-Pregnenetriol (mg/24 h)</th>
<th>DHEA (mg/24 h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$x \pm \text{SEM}$</td>
<td>Range</td>
</tr>
<tr>
<td>Group I: Neonates</td>
<td>12 (\delta)</td>
<td>0.075 $\pm$ 0.008 (0.01 - 0.11)</td>
<td></td>
</tr>
<tr>
<td>Group II: Infants</td>
<td>11 (\delta)</td>
<td>0.103 $\pm$ 0.016 (0.02 - 0.29)</td>
<td></td>
</tr>
<tr>
<td>Group III: Small children</td>
<td>10 (7\delta\ 3\Omega)</td>
<td>0.037 $\pm$ 0.006 (0.01 - 0.07)</td>
<td></td>
</tr>
<tr>
<td>Group IV: Schoolchildren</td>
<td>9 (4\delta\ 5\Omega)</td>
<td>0.153 $\pm$ 0.037 (0.02 - 0.37)</td>
<td></td>
</tr>
<tr>
<td>Group V: Preadolescents</td>
<td>9 (5\delta\ 4\Omega)</td>
<td>0.122 $\pm$ 0.022 (0.05 - 0.28)</td>
<td></td>
</tr>
<tr>
<td>Group VI: Adolescents</td>
<td>6 (5\delta\ 1\Omega)</td>
<td>0.217 $\pm$ 0.034 (0.11 - 0.36)</td>
<td></td>
</tr>
</tbody>
</table>