Depot testosterone in boys with anorchia or
gonadotrophin deficiency: effect on growth rate and
adult height

B Moorthy, Maria Papadopolou, D G Shaw, D B Grant

Abstract
Eleven teenage boys with bilateral anorchia and 12 with gonadotrophin deficiency were
treated by injections of testosterone ester (enanthate) at an initial dose of 100 mg every
six to eight weeks, rising to 250 mg every four weeks after three to four years. In the anorchic
boys average adult height was 177-1 cm, compared with a mean mid-parental height of
174-4 cm, and mean predicted adult heights of 177-0 cm (Tanner-Whitehouse method) and
178-0 cm (Bayley-Pinneau method). In the patients with gonadotrophin deficiency, mean
adult height was 176-9 cm, compared with a mean mid-parental height of 176-1 cm, and
mean predicted adult heights of 174-0 cm (Tanner-Whitehouse method) and 177-3 cm
(Bayley-Pinneau method). We conclude that this testosterone regimen allows achievement
of full growth potential in such patients.

During the last 20 years treatment with depot
testosterone by intramuscular injection has
become well established in the management of
boys with different disorders of puberty. Initially
introduced for the management of
anorchia, testosterone has been widely used
in the management of constitutional delay of
puberty,12 and gonadotrophin deficiency either
as an isolated defect or as part of a wider range
of anterior pituitary failure.256 Though early
reports suggested that testosterone treatment
might be associated with some reduction in
adult height because of rapid advancement in
bone age, it is now believed that treatment with
low doses of testosterone has no ill effect on ulti-
mate height. Most of the studies supporting this
view, however, have been in patients receiving
relatively short term courses of testosterone.

The present retrospective study on the effects
of testosterone on boys with anorchia or gonad-
otrophin deficiency was carried out to confirm
that the testosterone regimen that had been
used had had no significant ill effects on adult
height. The study also provided an opportunity
to compare two different methods of assessing
bone age and predicting adult height.

<table>
<thead>
<tr>
<th>Table 1 Mean (range) height and weight before treatment and age at start of treatment, in 11 boys with anorchia and 12 with gonadotrophin deficiency, together with mean height, weight, and age when last measured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boys with anorchia</strong></td>
</tr>
<tr>
<td>(n=11)</td>
</tr>
<tr>
<td><strong>Age at start of treatment (years)</strong></td>
</tr>
<tr>
<td><strong>Height at start of treatment (cm)</strong></td>
</tr>
<tr>
<td><strong>Weight at start of treatment (kg)</strong></td>
</tr>
<tr>
<td><strong>Age when last measured (years)</strong></td>
</tr>
<tr>
<td><strong>Height when last measured (cm)</strong></td>
</tr>
<tr>
<td><strong>Weight when last measured (kg)</strong></td>
</tr>
</tbody>
</table>
was increased to 100 mg every four weeks, and after another one to two years it was increased further to 250 mg testosterone ester every four weeks. For the purpose of this study the dose of testosterone has been expressed in mg/m² surface area. Mean doses for the first, second, and third years of treatment are given in table 2.

**Table 2** Mean growth velocity and weight velocity in 11 boys with anorchia and 12 with gonadotrophin deficiency before starting testosterone and during the first three years of treatment. The mean dose of testosterone for each period is also shown

<table>
<thead>
<tr>
<th></th>
<th>Before treatment</th>
<th>First year's treatment</th>
<th>Second year's treatment</th>
<th>Third year's treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorchia (n=11):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean growth velocity (cm/year)</td>
<td>5-4</td>
<td>8-2</td>
<td>6-9</td>
<td>6-4</td>
</tr>
<tr>
<td>Mean weight gain (kg/year)</td>
<td>3-0</td>
<td>7-2</td>
<td>6-6</td>
<td>5-9</td>
</tr>
<tr>
<td>Mean body mass index</td>
<td>19-1</td>
<td>19-1</td>
<td>19-7</td>
<td>20-1</td>
</tr>
<tr>
<td>Mean dose of testosterone (mg/m²/month)</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Gonadotrophin deficiency (n=12):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean growth velocity (cm/year)</td>
<td>4-8</td>
<td>7-1</td>
<td>5-9</td>
<td>5-8</td>
</tr>
<tr>
<td>Mean weight gain (kg/year)</td>
<td>5-0</td>
<td>6-3</td>
<td>5-5</td>
<td>5-6</td>
</tr>
<tr>
<td>Mean body mass index</td>
<td>20-6</td>
<td>21-2</td>
<td>22-6</td>
<td>23-0</td>
</tr>
<tr>
<td>Mean dose of testosterone (mg/m²/month)</td>
<td>Not applicable</td>
<td>50-5</td>
<td>73-3</td>
<td>85-5</td>
</tr>
</tbody>
</table>

**METHODS**

Radiographs of the left hand and wrist were available for all the patients before treatment, and they were all scored by BM and MP working together using the Tanner et al RUS (radius, ulna, and short bones) method. To assess the reproducibility of the method, the films were then reassessed by BM and MP without knowledge of the patient or the diagnosis, and the results compared. The radiographs were also assessed without knowledge of the diagnosis by DGS using the Greulich and Pyle atlas and the results compared with the initial Greulich and Pyle rating that had been carried out when the patient was first seen.

Predictions of adult height were calculated from the RUS scores allocated before treatment by the method of Tanner-Whitehouse, together with the scores derived from the initial Greulich and Pyle rating and those derived from the Bayley and Pinneau tables.

**Results**

The mean growth velocities of all the patients before treatment are shown in table 2, which also gives the mean growth velocities during the first three years of treatment, mean weight velocities, and body mass index.

In the anorchic boys, mean growth velocity during the first year of treatment increased from 5-4 cm/year to 8-2 cm/year and then fell to 6-9 cm/year and 6-4 cm/year during the second and third years of treatment, respectively. Weight gain increased from 3-0 kg/year to 7-2 kg/year during the first year of treatment, and then fell to 5-5 kg/year and 5-6 kg/year over the next two years, respectively. Body mass index (weight/height m²) rose from 18-1 to 20-3 after three years of treatment.

In the boys with gonadotrophin deficiency, mean growth velocity increased from 4-8 cm/year to 7-1 cm/year during the first year of treatment, and then fell to 5-9 cm/year and 5-8 cm/year over the next two years, respectively.

**Table 3** Mean adult height (cm), mid-parental height, and predicted height at start of treatment calculated by Tanner-Whitehouse and Bayley-Pinneau methods in 11 patients with anorchia and 12 patients with gonadotrophin deficiency

<table>
<thead>
<tr>
<th></th>
<th>Anorchia (n=11)</th>
<th>Gonadotrophin deficiency (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult height</td>
<td>177-1</td>
<td>176-9</td>
</tr>
<tr>
<td>Mid-parental height</td>
<td>174-4</td>
<td>176-1</td>
</tr>
<tr>
<td>Predicted height:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanner-Whitehouse</td>
<td>177-0</td>
<td>174-0</td>
</tr>
<tr>
<td>Bayley-Pinneau</td>
<td>178-1</td>
<td>177-3</td>
</tr>
</tbody>
</table>

Weight gain increased from 5-0 kg/year to 6-8 kg/year, and then fell to 5-5 kg/year and 5-6 kg/year over the next two years, respectively. Body mass index increased from 20-6 to 23-0 during the first three years of treatment.

The adult stature achieved by the two groups of patients is compared with mid-parental height and predicted adult height using the Tanner-Whitehouse and Bayley-Pinneau methods (table 3). Mean adult height (177-1 cm) for the patients with anorchia was slightly less than mean predicted height using the Bayley-Pinneau method (178-1 cm) and almost exactly the same as the mean height obtained by the method of Tanner-Whitehouse (177-0 cm). Mean adult height in these patients was 2-6 cm above mean mid-parental height.

In the patients with gonadotrophin deficiency the mean adult height was 176-9 cm, compared with a mean mid-parental height of 176-1 cm. The mean predicted height using the Bailey and Pinneau method was 177-3 cm and using the method of Tanner-Whitehouse was 174-0 cm, 2-9 cm less than the height attained.

**Discussion**

Testosterone treatment is well established in the management of delayed or absent male puberty. In an early paper, Ainsley-Green et al described the beneficial effect of treatment in a group of boys with anorchia. Since then there have been many accounts of its use in boys with constitutional delay of puberty and in chronic medical disorders which are associated with delayed puberty, such as cystic fibrosis. In addition, short term treatment with testosterone has been recommended for differentiating between constitutional delay in puberty or gonadotrophin deficiency and growth hormone insufficiency. Treatment with testosterone is also the main method of inducing secondary sexual development in boys with hypopituitarism that is caus-
ing growth hormone deficiency associated with gonadotrophin deficiency.²

Our results also provide some information on the use of the Tanner-Whitehouse and Bayley-Pinneau methods of predicting adult height in hypogonadal boys. Zachman et al found the method of Tanner-Whitehouse superior to the Bayley-Pinneau method in normal children and in children with familial tall stature, whereas it overestimated adult height in various types of short stature.¹³ Similar observations were made by Lenko in normal Finnish children and children with growth delay.¹⁵ In our patients with anorchia the two methods gave similar height predictions, but the method of Tanner-Whitehouse underpredicted mean adult height in the boys with gonadotrophin deficiency.

In summary, our findings provide further evidence of the safety of testosterone replacement treatment in male hypogonadism but we suggest that an initial dose of 100 mg every six to eight weeks may result in rather rapid growth. A lower dose of testosterone might be more appropriate in cases in which treatment is started at the age of 11 to 12 years.