

# Melatonin treatment in an institutionalised child with psychomotor retardation and an irregular sleep–wake pattern

G Pillar, A Etzioni, E Shahar, P Lavie

## Abstract

**An institutionalised 13 year old girl with psychomotor retardation suffered from an irregular sleep–wake pattern. Multiple measurements of urinary sulphatoxy-melatonin (aMT6) concentrations were abnormally low, without any significant day–night differences. Administration of exogenous melatonin (3 mg) at 18:00 resulted in increased nocturnal urinary aMT6 concentrations and improvements in her sleep–wake pattern. Melatonin may help disabled children suffering from sleep disorders.**

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Keywords: melatonin; psychomotor retardation; sleep disorders; learning disability

Melatonin is a neurohormone produced by the pineal gland exclusively during darkness. It has been implicated in the regulation of the mammalian circadian system.<sup>1</sup> There is evidence of its involvement in reproductive rhythms<sup>2</sup> and in sleep regulation.<sup>3</sup> Experimental evidence supports its role in immune functioning.<sup>4</sup> Nocturnal serum melatonin concentrations are significantly lower in elderly insomniacs compared with age matched controls.<sup>3</sup> They are even lower in institutionalised insomniacs compared with patients living independently in the community.<sup>3</sup>

Sleep disturbance is common among institutionalised learning disabled children,<sup>5–8</sup> and there is indirect evidence that this may be related to alterations in melatonin secretion. Some children not responding to hypnotics

and sedatives have been reported to respond to light treatment, which modified melatonin secretion.<sup>8</sup> Exogenous melatonin has been shown to improve sleep in institutionalised learning disabled children.<sup>9</sup> In none of these studies was endogenous melatonin investigated.

We investigated endogenous melatonin secretion and treatment with exogenous melatonin in an institutionalised learning disabled child with an abnormal sleep–wake pattern.

## Case report

An institutionalised 13 year old girl with psychomotor retardation suffered from an irregular sleep–wake pattern. She slept intermittently (with approximately equal durations of sleep) during both day and night. This abnormal sleep–wake pattern had existed for at least one year before referral. She was barely able to communicate, unable to read or write, unable to control urine or faeces, and could not walk without help. Caregivers complained that she was noisy at night and disturbed the sleep of other children. As she was frequently asleep during the day, she ate irregularly and slept with a nappy as she was not toilet trained.

## Methods

Sterile urine was collected via a Foley catheter for 24 hours before and after treatment. Urine volume was measured every two hours and urinary sulphatoxymelatonin (aMT6) was measured by radioimmunoassay.<sup>10</sup> Her sleep–wake pattern was assessed with an actigraph (AMI Ltd; Ardsley, New York, USA) attached to her right wrist for seven days before and one month after melatonin treatment. The actigraph is a self contained microcomputer housed in a 6 × 8.5 × 1.8 cm lightweight case. It comprises a piezoelectric accelerometer with a lower limit of sensitivity of approximately 0.1 g, which translates movements into electrical signals. Movements are sampled at a constant rate of 10 Hz, and any suprathreshold movement is registered continuously in the actigraph's 16 kbyte memory in one minute epochs for the duration of the recording period. Actigraphic data were analysed automatically by an algorithm developed and validated in our laboratory.<sup>11</sup> Its validity in sleep disturbed children has been reported.<sup>12</sup> Sleep efficiency (the ratio between minutes defined as sleep and total bedtime); and duration of sleep periods during day or night (night time sleep was defined as any sleep period between lights off until wake up time in the morning;

**Pediatrics Department  
A, Rambam Medical  
Center, Haifa 31096,  
Israel**  
G Pillar  
A Etzioni  
E Shahar

**Sleep Laboratory,  
Gutwirth Building,  
Technion-IIT, Haifa,  
Israel**  
P Lavie

Correspondence to:  
Dr Pillar, MD.

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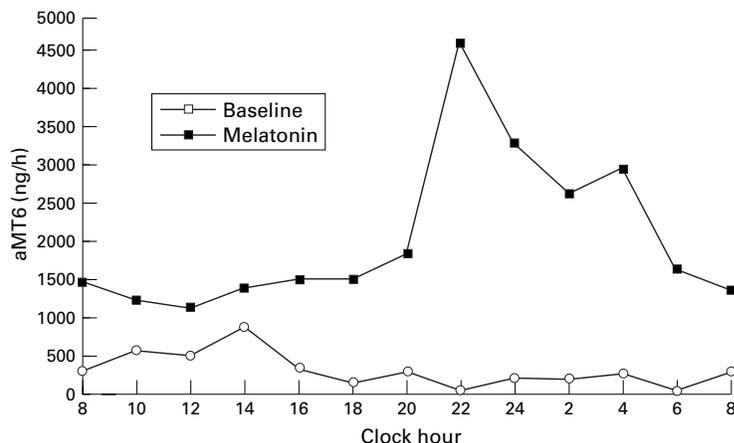


Figure 1 Urinary sulphatoxymelatonin (aMT6) measured every two hours for 24 hours. Administration of exogenous melatonin (3 mg) at 18:00 resulted in increased urinary aMT6 at night, with a peak at 22:00.

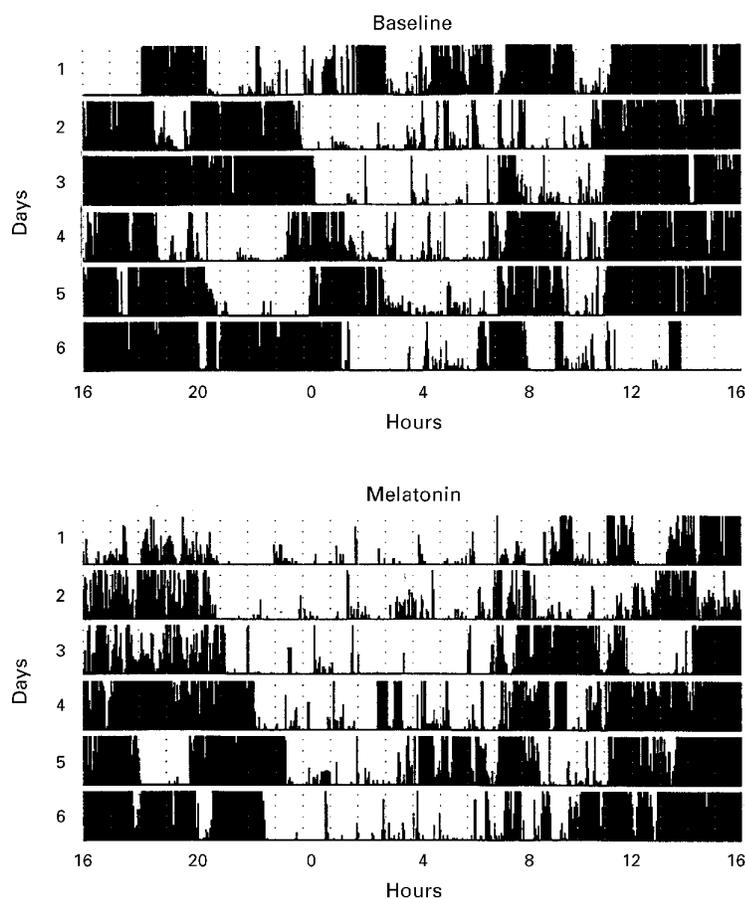


Figure 2 Actigraphic monitoring of sleep-wake cycles before (baseline) and with melatonin treatment. Before treatment the patient slept 5.5 (1.4) hours during the night compared with 7.7 (1.9) hours during exogenous melatonin treatment ( $p < 0.05$ ,  $t$  test). Her sleep efficiency increased from 61.1(15.7)% to 85.2(20.7)% ( $p < 0.05$ ).

daytime sleep was defined as sleep periods during the remainder of the day) were both calculated from the actigraph data.

### Results

The child had low absolute values of urinary aMT6<sup>10</sup> without any significant day-night differences, with an abnormal daytime peak at 14:00 (fig 1). Clinical improvement of sleep and sleep timings was noted by her caregivers almost immediately after the start of melatonin treatment (3 mg at 18:00). Measurements one month after the start of melatonin treatment showed increased nocturnal urinary aMT6 reaching a peak at 22:00 (fig 1). This was associated with a significant improvement in the sleep-wake pattern (fig 2). After treatment, total nocturnal sleep increased from 5.5 (1.4) to 7.7 (1.9) hours ( $p < 0.05$ ,  $t$  test), which resulted in an increase in sleep efficiency from 61.1(15.7)% to 85.2(20.7)% ( $p < 0.05$ ).

There was a concomitant decrease in total daytime sleep from 4.4 (1.3) to 2.8 (1.3) hours ( $p < 0.05$ ). Thus, there was no change in total sleep over 24 hours (9.9 (0.6) before and 10.4 (1.9) hours after treatment).

### Discussion

Our patient had a correlation between an alteration in the circadian cycle of melatonin secretion and disturbances in sleep-wake patterns. In contrast with normal children whose melatonin secretion peaks during the night, hers peaked during the day and was generally abnormally low. Accordingly, sleep was equally distributed during the day and night. Reports that melatonin secretion is closely related to increased sleep propensity in the normal population<sup>13</sup> as well as in blind people<sup>14</sup> suggest that the abnormal melatonin secretion in our patient was responsible for the abnormal distribution of sleep periods. This explanation is further supported by the beneficial effects of melatonin administration, which increased the amount of night time sleep and reduced the amount of daytime sleep without changing the total amount of sleep over 24 hours.

We cannot explain the abnormal melatonin secretion in this child. It may be related to her primary neurological defect, or to the lack of proper exposure to light-dark cycles and insufficient physical activity, or to a combination of all three. Because of poor compliance with light treatment, exogenous melatonin may be a more efficient way of dealing with insomnia in institutionalised disabled children.

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