

Normal Puberty & Adolescence

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Summary: The transition period between carefree childhood and responsible adulthood is probably a key factor in determining the future health of the girl. An understanding of the special needs of this special group should be based on a clear knowledge of the physiology, which is discussed in this article. It is now thought that puberty is not simply turned on by a controlling centre in the brain, but rather is a functional confluence of all factors.

Introduction

The transition period between carefree childhood and responsible adulthood is probably a key factor in determining the future health of the individual, taking health to mean a state of complete physical, mental and social well being, and not merely an absence of disease or infirmity (WHO 1979). The Oxford Dictionary has defined "normal" as "conforming to standard, regular, usual, typical; free from mental or emotional disorder" (The Concise Oxford Dictionary, 1983). Anyone who has dealt with adolescents knows that there is no such entity as a "normal" adolescent. The year 1999 has been dedicated by FOGSI to the Adolescent Girl and this issue of the journal means to highlight various problems faced by her. It is important to have an overview of what is termed as "normal" puberty and adolescence to understand the problems which may come up during this phase.

Normal Puberty

Puberty is a rendering of the Latin word Pubertas, meaning "grown up." (Foster 1992) Puberty is the physiological changes which result in the development of secondary sexual characteristics and the ability of the girl to undertake reproductive function. (Chamberlain 1995). It is a major step in the process of adolescence and includes maturation of the menstrual cycle for the first time in association with gradual changes in secondary sexual characteristics which usually precede the menarche. Normal puberty starts by age 8 to 12 years in Indian girls and development of secondary sexual characteristics is completed in 3-4 years (Shah 1991).

Physical Features

The general timetable of events that occur during puberty are shown in Table 1. (Chamberlain 1995, Shah 1991, Sheil & Turner 1997). The order of appearance of these changes is, however variable. In about 50% of girls, the first sign of puberty is the enlargement of the breast buds (thelarche), followed by development of pubic hair about a year later along with a growth spurt. It is at this time that girls are usually taller than boys of comparable age (Chamberlain 1995, Sheil & Turner 1997). Despite variable onset of other features, what is reasonably constant is that menstruation commences after the maximum growth spurt (which can be 6-11 cm per year). There is also a relationship between skeletal maturity and onset of menstruation. As the peak height velocity of girls is reached early in puberty prior to menarche, they have limited growth potential following menarche (Rebar 1996).

Assessment of bone age by x-rays of the non dominant hand, knee or elbow and using standards for comparison such as the Greulich and Pyle atlas is useful in assessment of pubertal delay. It is unusual for menstruation to begin before a bone age of 12.5 years or after 14.5 years (Sheil & Turner 1997).

Factors affecting time of onset of puberty

Undoubtedly, the major influence is genetic, as shown by concordance of the age of menarche in mother-daughter pairs, between sisters and ethnic populations. (Tanner 1962) Other factors such as nutritional state, general health, geographic location, exposure to light,

Table 1
Puberty events

(Chamberlain 1995, Shah 1991, Sheil & Turner 1997)

Physical feature	Age range (yrs)
Thelarche	8-13
Public Hair	9-13
Axillary Hair	10-14
Growth in height	10-14
Menarche	11-15 (Means 12.9)

and psychologic state also play a role. Typically the age of menarche is younger in children with moderate obesity (upto 30% above ideal body weight), whilst delayed menarche is common in those with severe malnutrition (Rebar 1996).

The precise role of total body weight and composition on the age of menarche is debated. The critical body weight suggested by Frisch in 1985, prior to menarche was 47.8 kg. However the increase in body fat to 23.5% from the typical pre-pubertal 16% is thought to be the important factor, influenced by nutrition. (Sternleib & Munan 1972) Leptin is a peptide secreted in adipose tissue that circulates in the blood and acts on the CNS regulatory neurons that regulate eating behaviour and energy balance. Leptin levels increase during childhood until the onset of puberty, and the higher the level of leptin, the earlier the age of menarche. (Matkovic et al 1997). It has been suggested that there is communication between the CNS and body fat in the process of puberty with leptin serving as the messenger (Speroff et al, 1999).

Hormonal Changes during Puberty

The endocrine events at puberty had been thought of as an awakening, a beginning. However, endocrinologically puberty is not a beginning, but just another stage in a development that began at conception. Remarkable levels of FSH and LH, similar to postmenopausal levels, can be measured in the fetus, and peak in the circulation at 28 weeks of intrauterine life (Speroff et al 1999). However, beginning at mid-gestation, there is an increasing sensitivity to inhibition by steroids and a resultant decrease in gonadotrophin secretion. After the postnatal rise, gonadotrophin levels reach a nadir during

early childhood (1-2 years age in females) and then rise slightly between 4 and 10 years. This childhood period is characterised by low levels of gonadotrophins, little response of the pituitary to GnRH, and maximal hypothalamic suppression of the hypothalamo-pituitary-gonadal axis prior to puberty is due to two forces

1. A CNS inhibitory force suppressing GnRH pulsatile secretion. This must be the dominant mechanism, as shown by studies on gonadal children who show the same decline in gonadotrophins from age 2-6 years and then a rise in gonadotrophin levels at puberty (Rose et al 1983, Speroff et al 1999).
2. A very sensitive negative feedback of gonadal steroids (6-15 times more sensitive before puberty) The precise signal that initiates the events of puberty in the blood is unknown. The first steroids to rise in the blood are dehydroepiandrosterone (DHEA) and DHEAS beginning at 6-8 years of age, shortly before FSH begins to rise until 10-12 years of age. Increased gonadotrophins are responsible for follicular growth and development in the ovary and increased sex steroid levels. The rising estrogen contributes to achieving an adult pattern of pulsatile GnRH secretion, finally leading to cyclic menstrual patterns (Speroff et al 1999).

Mechanisms

The essence of puberty can be viewed as the process of maturation of the neuroendocrine control system that initiates and maintains pulsatile secretion. (Foster 1992). During childhood, GnRH production by the hypothalamus is totally quiescent. The changes of puberty are due to a gradually increasing secretion that takes place due to a decrease in the sensitivity of the hypothalamic centres to the negative-inhibitory action of gonadal steroids. Gradually, pulses of GnRH begin to be produced, initially at night only and infrequently. These pulses of low amplitude and low frequency increase during the subsequent years and as this occurs, ovarian response is initiated. Eventually the ovary begins to respond in a mature way as GnRH production becomes pulsatile every 90 minutes. However, irregularities in

pulsatile GnRH secretion in the first few years of menstruation are common hence many early cycles are anovulatory with no follicular development at all. This gives an appearance of small multicystic structures in the ovary, which may be seen upto 3 years before menarche. It may take as long as 5 years after menarche for complete maturation of the hypothalamo-pituitary axis and appropriate control of menstrual cycles (Chamberlain 1995)

Adolescence

Although WHO has defined adolescence as the period between 10-20 years there is no statutory legal age limit of when adolescence begins and ends (Sheil & Turner 1997). Probably developmental changes rather than age limits or physical milestones are the better markers. There is a marked acceleration of physical and emotional development between age 13-18, usually to which the adolescent must adjust. There is an urgent need for us as gynaecologists to be aware of the need for special care and sensitivity in handling adolescents problems, not only physical, but also emotional and psychological. The teenager expects of the attending doctor understanding, friendliness and personality. (Sternleib & Munan 1972). Establishing special adolescent gynaecology clinics has been found to provide an environment that is friendly, not intimidating, and private and is well received by youngsters. (Sheil & Turner 1997) An awareness of the subject of adolescent gynaecology is coming up in the recent years and has been spearheaded by FOGSI for the year 1999. It is upto each of us to take this up as a personal commitment and do our bit as FOGSI members for the cause of protecting the health of the adolescent girl in India.

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