Ultrasound Measurement of Corporeal (Penile) Length in Newborns

O A Khairil, MMed*, A Zulfiqar, MMed*, C R Thambidorai, FRACS**, J Mohd Nizam, MPH***, J T Ahmad, MPH***, M A Jamil, MOG****

*Department of Radiology, **Department of Surgery, ***Department of Community Health, ****Department of Obstetrics & Gynaecology, Faculty of Medicine, Universiti Kebangsaan Malaysia

Summary

In the initial clinical examination of a child with ambiguous genitalia an accurate measurement of the corporeal length is needed. Most often the corporeal length is measured with a ruler from the symphysis pubis to the tip of the glans of a stretched penis. More recently, ultrasound has been successfully used to measure corporeal length. This study aimed to (i) establish normal values for corporeal length in normal male newborns using ultrasound measurement, (ii) compare these measurements to stretched corporeal measurements, (iii) compare the corporeal length of newborns of different races, and (iv) determine the relationship between corporeal length and birth weight, birth length and head circumference. This was a prospective study of 141 newborns. Ultrasound imaging was done in an oblique parasagittal plane such that the corpus could be included in a single image and measured. Stretched corporeal length was measured with the penis stretched alongside a wooden spatula and the length from the pubic bone to the tip of the glans was marked on the spatula and measured. By ultrasound measurement the mean corporeal length of the normal newborn was 3.18 ± 0.56cm. There was no significant difference in the mean corporeal length when determined by ultrasound and by stretched corporeal measurement. There was no significant difference in the mean corporeal length of the different races when the length was determined by either ultrasound or stretched corporeal measurement. There was a positive correlation between ultrasound length and birth weight and birth length. However, there was no correlation between ultrasound length and head circumference. There was no significant correlation between the stretched length and either birth weight, birth length or head circumference.

Key Words: Corporeal length, Ultrasound, Ambiguous genitalia

Introduction

The management of a patient with ambiguous genitalia is a complex problem as it involves diverse aetiological factors that include genetic, hormonal, developmental and idiopathic factors. A full definition of the underlying aetiology is needed at the earliest age in order to devise a plan to achieve maximal appearance and function of an individual[1].

The clinician is faced with a difficult dilemma when managing a patient with the ambiguous genitalia. Problems of genital malformation should, in principle, be managed by a team of specialists in order to reach a prompt and correct diagnosis[2]. It is important that a definitive diagnosis be determined as quickly as possible so that an appropriate treatment plan can be established to minimize medical, psychological, and social complications. The crucial decision on gender assignment should be considered in early infancy.

The initial clinical evaluation of the ambiguous genitalia that is considered an important examination includes an accurate measurement of the corporeal length [3]. Most of the corporeal length determination to date is by measurement from the symphysis pubis to the tip of the glans of a stretched penis using a ruler. This direct measurement of corporeal length can be extremely difficult in patients with severe chordee, deep pubic fat pad or scrotal encroachment.

More recently, the use of ultrasound in corporeal length measurement has been successfully demonstrated [4]. This study attempts to establish normal values for corporeal length in normal male newborns by using ultrasound measurement, to compare these measurements to stretched corporeal length measurements, to compare the corporeal length of newborns of different races, and to determine the relationship between corporeal length and birth weight, birth length and head circumference.

Materials and Methods

Population
This was a prospective study. A total of 141 male neonates born in HUKM over a period of 4 months were evaluated. Of the 141 subjects, 80 were Malays, 49 were Chinese and 12 were categorised as others (5 Indians, 3 Ibans, 2 Kadazans and 2 Thais). Full term male newborns within 72 hours of life, with normal external penile anatomy and palpable descended testicles, with birth weight of more than 2.5 kg, and with consent of parents were included. Newborns with dysmorphic features, known syndromes, small for gestational age, multiple congenital anomalies or any significant medical illness were excluded.

Corporeal length by ultrasound measurement
Ultrasound (using Aloka SSD-1200 ECHO CAMERA, by Aloka Corporation of Japan) was done with patient supine and hips abducted. With the penis cradled on the median raphe of the scrotum between the testes, a 7.5 MHz mechanical convex transducer was placed on the dorsal aspect of the flaccid penis. An oblique parasagittal plane of scan was chosen, such that the crural and pendulous portions of the corpus were included in a single image (Fig. 1). The scan plane was also tilted slightly caudad to improve visualisation of the crus posterior to the pubic arch in the perineum.

The corpus was identified as an elongated hypoechoeic structure in the dorsal half of the penis. Posteriorly, the crus was identified closely applied to the superior oblique surface of the pubic arch. The blunt, round terminal process of the crus located at or slightly posterior to the inferior border of the pubic arch was used as the posterior landmark. Measurement was done by obtaining the length of the posterior corpus (crus) until the suspensory ligament and from the suspensory ligament to the round conical anterior termination of the corpus (Fig. 1).

Stretched corporeal length measurement
Stretched corporeal length measurement was done using a wooden spatula, which was placed vertically with one rounded end on the pubis (Fig. 2). Pubic fat was then depressed with the spatula and the penis was stretched manually such that the dorsal aspect of the penis was alongside the spatula. Traction was applied till the point of increased resistance along the length of the penis. The corporeal length from the pubic bone to the tip of the glans was then marked on the wooden spatula. The length marked on the spatula was then measured with a ruler.

The ultrasound and stretched length measurements of each newborn were done on the same day. An average of 2 readings was taken for every ultrasound and stretched length measurement. The same radiologist performed the ultrasound measurements while the same clinician performed the stretched length measurements on all the newborns. The radiologist and the clinician were blinded to each other's readings. Other parameters recorded included birth weight, birth height, and head circumference.

Results

The mean corporeal length by ultrasound measurement was 3.18 ± 0.56 cm with a range of 2.1 to 4.7 cm (Fig. 3). The mean corporeal length by stretched corporeal measurement was 3.11 ± 0.41 cm with a range of 1.9 to 4.2 cm (Fig. 4). The paired t-test showed that the difference in mean length when measured by the 2 different methods (Table I) had a p value of 0.126. When measured by ultrasound, the mean corporeal length was 3.23 ± 0.55 cm for Malays, 3.11 ± 0.55 cm for Chinese and 3.19 ± 0.66 cm for others. The one-way ANOVA test showed that the difference in mean length between the races (when the measurement was done by ultrasound) had a p value of 0.467. When determined by stretched corporeal measurement, the mean corporeal length was 3.10 ± 0.39 cm for Malays, 3.07 ± 0.44 cm for Chinese and 3.28 ± 0.41 cm for

others. The one-way ANOVA test showed that the difference in mean length between the races (when the length was determined by stretched corporeal measurement) had a p value of 0.306.

When measured by ultrasound, the corporeal length showed increment with increase in weight, length and head circumference (Fig. 5, 6 & 7). The Pearson correlation coefficient analyses showed that ultrasound length and birth weight correlated with a p value of 0.025 (r = 0.189), ultrasound length and birth length correlated with a p value of 0.028 (r = 0.186), and

ultrasound length and head circumference correlated with a p value of 0.354 (r = 0.079). When determined by stretched corporeal measurement, the corporeal length showed increment with increase in weight, length and head circumference (Fig. 5, 6 & 7). The Pearson correlation coefficient analyses showed that stretched length and birth weight correlated with a p value of 0.561 (r = 0.049), stretched length and birth length correlated with a p value of 0.696 (r = 0.033), and stretched length and head circumference correlated with a p value of 0.516 (r = 0.055).

Table I: Corporeal length ultrasound and stretched length measurement.

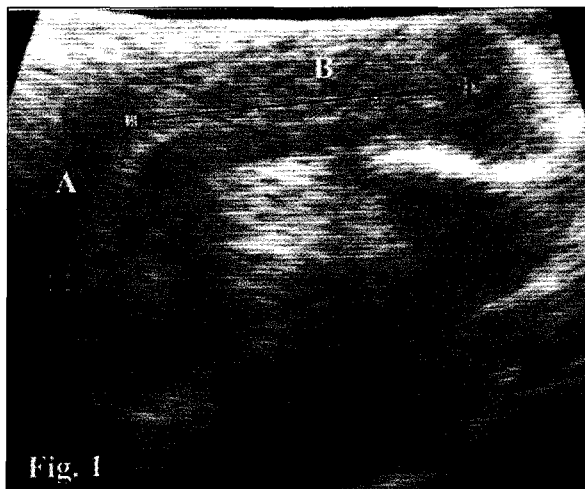|		Ultrasound Length (cm)	Stretched Length (cm)
Number of subjects		141	141
Mean		3.18	3.11
Standard Deviation		0.56	0.41
Percentiles	3rd	2.13	2.30
	97th	4.27	3.90

Fig. 1: Ultrasound image of the newborn penis with the measured length from the posterior crus to the anterior corpus. (A) crural segment of corpus. (B) pendulous segment of corpus.
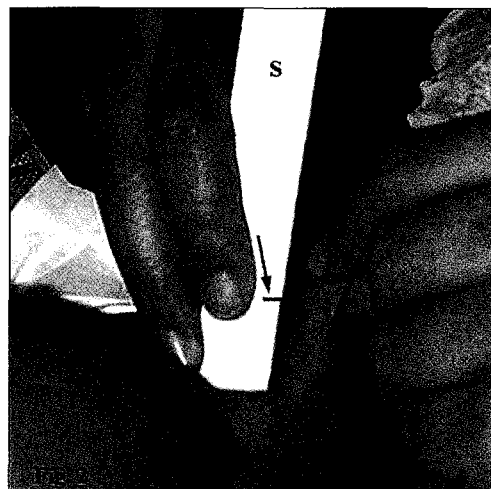

Fig. 2: The penis is held by the foreskin and stretched alongside a wooden spatula (S) that has been pressed against the pubic bone. The length from the pubic bone to the glans is then marked on the spatula (arrow).
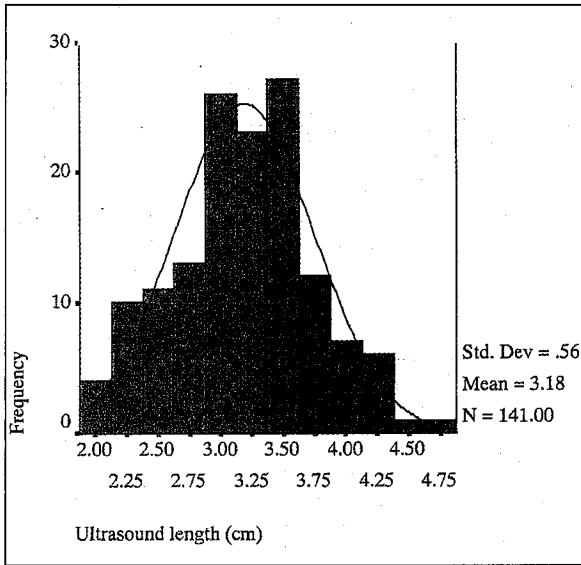
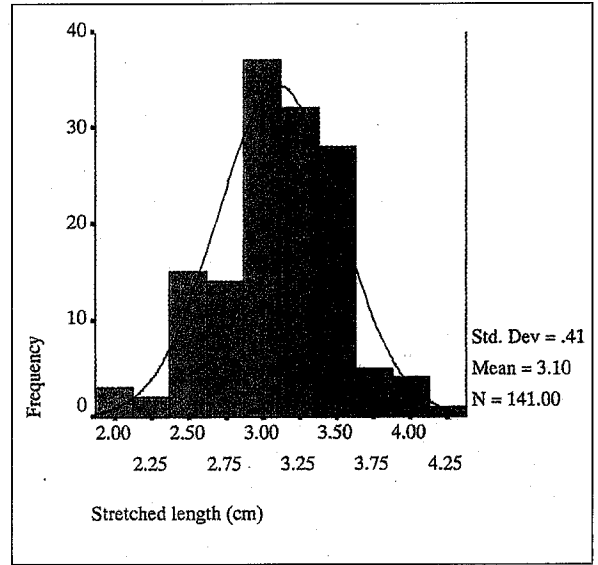**Fig. 3: Histogram and normal distribution curve for ultrasound length.**

Fig. 4: Histogram and normal distribution curve for stretched corporeal length.
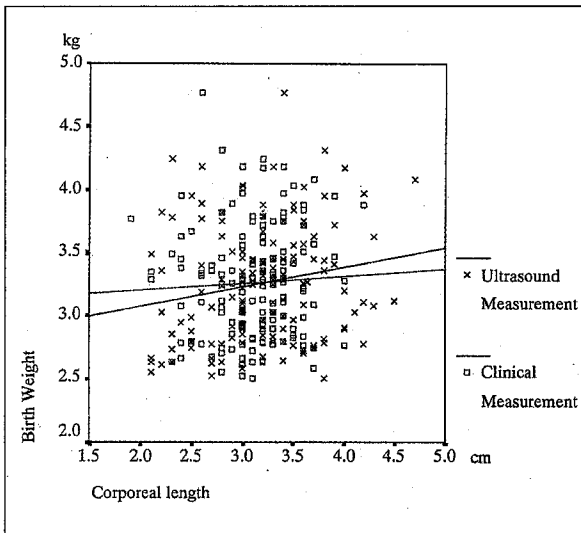

Fig. 5: Correlation between ultrasound length (cross) and stretched length (box) with birth weight.
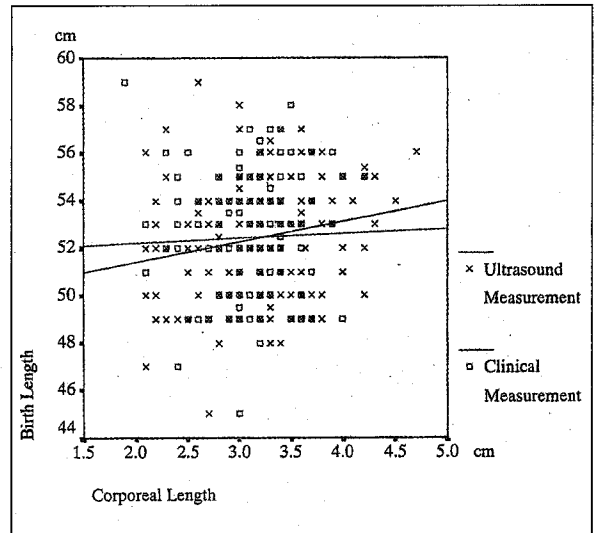

Fig. 6: Correlation between ultrasound length (cross) and stretched length (box) with birth length.
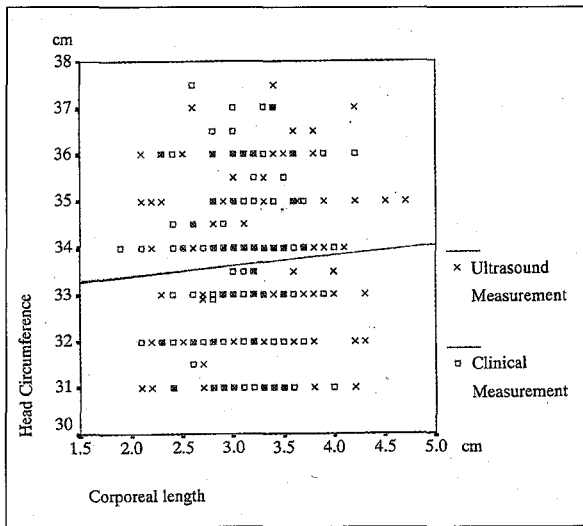
Fig. 7: Correlation between ultrasound length (cross) and stretched length (box) with head circumference.

Discussion

Previous studies on corporeal length of newborns showed a wide variation in mean length with values ranging from 2.86 to 3.55cm [5-9]. All these studies were conducted by stretched corporeal measurement. With the use of ultrasound measurement, our study established the normal corporeal length of 3.18 ± 0.56 cm for normal newborns in the local population. With stretched corporeal measurement, the length of 3.11 ± 0.41cm was shorter by 0.07cm. However, this difference was not statistically significant.

Earlier studies done to compare the corporeal length amongst ethnic groups have shown inconsistent results. In a study conducted in Vancouver[9], corporeal length of those of East Indian origin was significantly longer than those of Caucasian origin, and the corporeal length of Caucasians was significantly longer than those of Chinese descent. A study done in Singapore[8] did not show any significant difference between the corporeal length of Caucasian and Asian babies. They however found that there was a small but significant difference between the corporeal length of Indian, Malay and Chinese babies. The Vancouver and Singapore studies used stretched length measurements. Our study using both ultrasound and stretched length measurements did not show any significant difference amongst the ethnic groups.

The Vancouver study[9] showed no significant correlation between either stretched corporeal length and birth weight, or stretched length and birth length. In contrary, the Singapore study[8] reported a significant correlation between stretched corporeal length and birth weight. In our study, when ultrasound measurements were used, there was significant correlation between corporeal length and birth weight, and between corporeal length and birth length. However, there was no significant correlation between either stretched corporeal length and birth weight, or stretched corporeal length and birth length. This is possibly because the pre-pubic fat thickness (which would be more in better nourished babies) would reduce the stretched corporeal length but had no effect on the corporeal length measured with ultrasound.

The stretched corporeal length is influenced by body habitus. It is more difficult to assess the stretched corporeal length in obese subjects due to thick pre-pubic fat pad and in subjects with buried penis. Another factor that should be taken into account when stretched length is being measured is the elasticity of the penile soft tissue and corpus spongiosum. An examiner needs to be consistent in the application of traction until the point of increased resistance. The wooden spatula used for measurement must be properly pressed against the pubic ramus so that the pre-pubic fat is compressed as completely as possible. Either pressure or pain to the pre-pubic area may cause the subject to move, and this may contribute to inaccurate measurement.

Stretched corporeal length measurement is considered as the standard by which the penile length is measured and compared. However, the measurement of the corporeal length by stretched technique can only be accurate if the subjects are cooperative and circumcised. This is due to the ability to stretch maximally a circumcised penis, as it is easier to hold firmly the coronal sulcus of the glans penis. It has been shown that circumcised subjects had significantly longer stretched corporeal length than the uncircumcised subjects[4]. Stretched corporeal length measurement is not always possible in uncircumcised subjects in whom the foreskin is adherent to the glans and may be phimotic. Severe chordee, hypospadias and even ambiguous genitalia may prevent an accurate assessment by stretched length because the corpora cavernosa is short and small. Ultrasound easily identifies the root of the corpus cavernosa and its anterior tip even in uncircumcised subjects, and

ultrasound actually measures the true corpus cavernosal length. More importantly, ultrasound measurement does not involve any penile stretching, thus reducing the error of inconsistent traction. It is also more comfortable for the subject. With less movement of the subject, measurements would be more accurate, consistent and reproducible. Therefore, in the evaluation of abnormal external genitalia, ultrasound measurement is a promising technique that has more advantages than stretched length measurement.

An accurate and consistent measurement of penile length would have distinct advantages in making long-term treatment decisions concerning the affected patient[4]. For all cases of abnormal external genitalia and especially ambiguous genitalia, the question of sex of rearing is of critical importance in the early weeks of life. The size of the penis and the amount of erectile tissue may directly influence the sex of rearing. Therefore, a precise and accurate measurement of corporeal length would help the clinicians to resolve these difficulties. The standard protocol for assessment of the child with ambiguous genitalia includes an ultrasound examination of the pelvis to look for remnant Mullerian structures. A logical sequence of this examination should be an ultrasound measurement for corporeal length.

Ultrasound measurement is recommended because it overcomes the problems of: variation in pre-pubic fat thickness, variations in technique of stretching and measurement, difficulties with uncircumcised babies and those with severely abnormal external genitalia, and difficulties with movement in the uncooperative patient.

Conclusion

By ultrasound measurement, the mean corporeal length of the normal newborn was 3.18 ± 0.56cm. There was no significant difference in the mean corporeal length when determined by ultrasound and by stretched corporeal measurement. There was no significant difference in the mean corporeal length of the different races when the length was determined by either ultrasound or stretched corporeal measurement. There was a positive correlation between ultrasound length and birth weight and also between ultrasound length and birth length. However, there was no correlation between ultrasound length and head circumference. There was no significant correlation between the stretched length and either birth weight, birth length or head circumference.

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