Effect of Body Mass Index (BMI) On Degree of Angular Knee Deformity in Children with Blount's Disease.

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Summary

The aetiology of Blount's disease remains unknown, but it is generally agreed that weight bearing plays a role in the pathogenesis of knee deformity in these patients. Our aim was to analyze the effect of Body Mass Index (BMI) on the degree of angular knee deformity in children with clinical and radiological features of Blount's disease.

This was a prospective analysis which involved 20 patients (38 knees) with clinical and radiological evidence of Blount's disease. Forty controls (80 knees) without clinical evidence of knee pathology were recruited for comparison. The Body Mass Index (BMI) was determined for each patient using the Johan Van Hespen BMI calculator. The degree of angular deformity in patients with Blount's disease was determined by measuring the intercondylar distance (ICD). Results obtained were subjected to statistical analysis with significance level set at $P < 0.05$.

The mean BMI in patients with Blount's disease was 19.6±6.6. This was higher than the mean BMI (16.91 ± 2.82) for patients in the control group ($P = 0.0468$). The mean ICD for patients with Blount's disease was 15.7±9.07cm. We however found no correlation between BMI and degree of deformity in patients with Blount's disease.

Patients with Blount's disease have significantly higher BMIs than normal patients but this alone does not account for the severity of deformity in these patients.

Key words: Blount's Disease, Body Mass Index, Angular knee deformity

Introduction

Blount's disease is considered by many to be an acquired condition of the proximal tibial physis, epiphysis and Metaphysis. The condition was first reported in 1922 by Erlacher, but it was not until the case series and review by Blount[1] in 1937 that it gained world wide recognition. The aetiology of the condition is still largely unknown, but many theories abound[2-5]. One of the theories that seem to have gained universal acceptance is the effect of weight bearing on the pathology of Blount's disease. The aim of this work is to define the relationship between Body Mass Index (BMI) and the degree of angular deformity of the knee in patients with Blount's disease.

Patients and Methods

Consecutive patients presenting with clinical and radiological features of Blount's disease over an 18 month period (December 2005 May 2007) formed the study population. Forty (40) controls without clinical evidence of knee pathology were selected by systematic random sampling from a primary and secondary school in the same locality for comparison. All measurements were carried out by the first author (AB) assisted by the same clinical assistant to minimize inter-observer variations.

Clinical evaluation

Clinical evaluation included relevant medical history and physical examination. The history included the patient's age, sex, tribe and religion. Other information included family history, age at which deformity was noticed and age at which patient walked. The type of deformity was also recorded.

Physical examination included documentation of the patients' weight, height and examination of the limbs. A bathroom scale was used to measure the weight of all subjects aged 2 years or older. For subjects younger than 2 years, a paediatric weighing scale was used. Weights were measured in kilograms (Kg). The height of each subject was measured using a wall mounted height chart. Each subject aged 2 years or older stood against the wall with the heels, buttocks and occiput against the wall mounted chart. The height was read off the chart. For subjects less than 2 years of age, height was measured in the supine position with a tape measure. Heights were measured in meters (m).

The Body Mass Index was determined using the Johan Van Hespen BMI calculator[6]. Examination of the lower limb was carried out in the standing position for patients older than 2 years with the hips and knees in full extension and in neutral rotation with the ankles touching each other closely. For patients younger than 2 years old, examination was carried out in the supine position with the hips and knees similarly in full extension and neutral rotation and with the ankles touching each other closely. The degree of deformity in patients in the study group only was determined clinically by measuring the intercondylar distance (ICD) using a simple tape measure as described by Heath and Staheli[7]. This measurement was carried out in the standing position for patients older than 2 years and in the supine position for patients younger than 2 years.

This method of assessment was chosen because it is relatively cheap and easy to perform. Further more, it as been documented that clinical Tibio-Femoral Angle (TFA) measurements are unreliable in children younger than 2 years of age and in very obese children and the ICD gives good correlation with the anatomic Tibio-Femoral Angle[7-9].

Radiological evaluation

Standing radiographs of the knees in the anteroposterior and lateral planes were done for all patients aged 2years or older. For younger patients, radiographs were obtained in the supine position. For ethical reasons, only clinical evaluation was carried out for the control group.

Diagnosis

Criteria for the diagnosis of Blount's disease were based on clinical and radiological parameters. Clinical criteria included bowing of the knee associated with internal tibial torsion.

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Radiological criteria included the presence of flattening or fragmentation of the proximal tibial metaphysis and/or the presence of thickening of the medial cortex of the proximal tibia. The tibial metaphyseal diaphyseal angle of Drennan was also measured from the radiographs.

Statistical Analysis

The results obtained were subjected to statistical analysis using a combination of Microsoft excel statistical package and Instat statistical package. The range as a representation of a measure of dispersion was determined. Measures of central tendency, which included the mean, were also determined. The degree of significance of the differences in the results of the study group and control group was determined using the unpaired t-test with Welch correction. For the purposes of correlation, Spearman's rank correlation test was used. Statistical significance was set at $P<0.05$.

Results

Twenty patients whose ages ranged from 2 to 14 years presented with clinical and radiological features of Blounts' disease. The mean age at presentation was 6.2±3.7years. There were 12 females and 8 males giving a male: female ratio of 1:1.5. Seven (35%) of the 20 patients had their deformities noticed at birth while the 13 others (65%) had their deformities noticed after walking had commenced. Eighteen patients (90% of the population) were noticed to have bilateral affectation while 2 (10%) had unilateral affectation giving a total of 38 knees available for evaluation. Half (50%) of the patient population had a positive family history of bowing at the knees.

The mean weight was 24.21±16.17kg, with a range of 10-70kg. The mean height was 107±17.42cm and the mean BMI was 19.6±6.6. The intercondylar distance ranged from 4-35cm with a mean of 15.7±9.07cm. The mean weight, height and BMI for patients in the control group were 30.38 ± 13.28kg, 130.6 ± 20.24cm and 16.91 ± 2.82 respectively. The Body Mass Index (BMI) for patients with Blount's disease was compared with the control group using the unpaired t-test with Welch correction to determine whether or not the results obtained were statistically significant. The results are as shown in table below.

The mean BMI in patients with Blount's disease was higher than the mean BMI for patients in the control group (p-value = 0.0468, Welch approximate t = 1.753 with 22 degrees of freedom). This was found to be only just statistically significant.

Spearman's rank correlation was carried out between BMI and intercondylar distance (ICD) in Blount's disease. Spearman r = -0.03225 (corrected for ties). The two tailed P-value was 0.8926, considered not statistically significant. This relationship is as represented in figure below.

Table. Analysis of BMI using the unpaired t-test with Welch correction

	Blount's Disease	Control
Mean BMI	19.62	16.91
Standard Deviation	6.62	2.82
Number in group	20	40

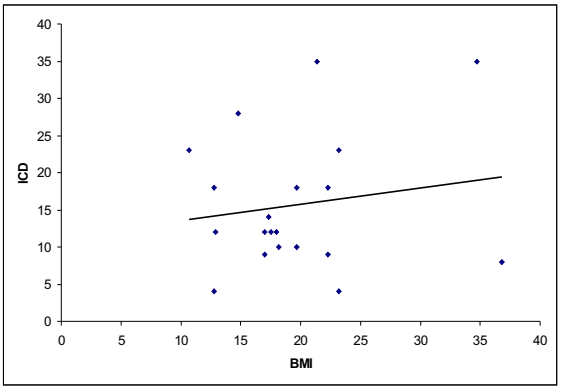

Fig. Relationship between BMI and ICD in Blount's Disease.

Discussion

Blount's disease is considered to be a rare pathology, occurring more commonly among West African and West Indian children and also fairly common among Scandinavians[3, 10, 11].

The aetiology of Blount's disease remains the subject of controversy. It is believed now to be the culmination of a combination of hereditary and developmental factors.

The finding of bilateral knee involvement in 90% of the population in this group of patients lends credence to the opinion that weight bearing plays a role in the development of deformity in patients with Blount's disease. Kessel[2] in 1970 had independently proposed weight bearing as a factor in the natural history of Blount's disease. This finding was buttressed by Cook[5] in 1983 from his observation that Blount's disease does not occur in non-ambulatory patients. Sixty five percent (65%) of patients had their deformities noted after walking commenced while 35% had their deformities noted at birth.

The relatively large number and percentage of patients whose deformities were noted before the commencement of walking, however, suggests that weight bearing is not the only factor responsible for the deformity in patients with Blount's disease. It is tempting to speculate that physiologic bowing of the knee, which is present at birth and in the first 18months of life as documented by previous workers[7-9,12], progresses to pathologic genu deformity in the presence of other factors. This speculation is buttressed by the finding of a high incidence of a positive family history of bowing of the knee (10 out of 20 patients seen or 50% of the group), which in itself suggests a familial component to the disease. This however remains to be ascertained. Perhaps genetic studies may define the place of heredity in the aetiology of Blount's disease. Golding and McNeil-Smith reported a definite racial predilection to tibia vara occuring in blacks and in children from the West Indies and West Africa who are early walkers and commonly have severe bowlegs[3].

The mean BMI in patients with Blount's disease was 19.62±6.62. This figure falls within the normal range for BMI for patients in this age group. In spite of this apparently normal mean BMI however, patients in the control group were found to have a lower mean BMI than patients with Blount's disease when subjected to statistical analysis using the unpaired t-test with Welch correction (p = 0.0468). This suggests that indeed a higher BMI might play a role in the development of angular knee deformity in patients with Blount's disease. It does raise questions however about the role of obesity in the aetiology of Blount's disease. Is weight bearing alone the cause of Blount's

disease or are there other underlying factors which in combination with axial loading lead to the manifestation of the clinical picture of Blount's disease.

Figure is a graphical representation of the relationship between the Intercondylar Distance and the Body Mass Index in patients with Blount's disease. The 'line of Best fit' of the scatter diagram shows a gradual increase in the Intercondylar Distance with increasing BMI. This positive correlation was however not statistically significant (P = 0.8926). Sabharwal[13] et al found a strong correlation between BMI and frontal and sagittal plane deformities in patients with early onset type of Blount's disease but not in the late onset type of Blount's disease. They also found very strong correlation between BMI and degree of deformity, regardless of time of onset of deformity, in extremely obese individuals with a BMI = 40. They concluded that there was a significant relationship between the magnitude of obesity and biplanar radiologic deformities in children with early onset Blount's disease and in children with a BMI = 40.

These conclusions are at variance with the findings of this study. Perhaps the finding of a mean BMI of 19.62± 6.62 in this study is responsible for this, being much lower than their finding of significant correlation at BMIs = 40. In this study also, patients with Blount's disease were not separated into early onset and late onset groups. Again, this may account for the disparity in results since Sabharwal[13] et al did not find significant correlation between BMI and degree of deformity in patients with the late onset type of Blount's disease.

Conclusion

Whereas patients with Blount's disease have a higher BMI than normal patients, this alone appears not to account for the severity of the deformity in these patients.

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