Juvenile blount disease related to obesity
In a 6-years-old girl

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ABSTRACT

Blount disease is a rare growth disorder of the medial aspect of the proximal tibial physis, with abrupt medial angulation leading to varus angulation of the proximal tibia and medial rotation of the tibia. Multiple factors such as ethnicity, genetics, and mechanical stress are thought to be contributing elements to this disease. Treatment depends on the age of the patient and severity of the condition. A diagnosis of Blount disease is based on clinical, laboratory and standing alignment of x-ray. The natural history of untreated Blount disease is progressive and non-resolving varus deformity which produce joint deformity and growth retardation. Proper management of patient with obese and Blount disease is nutritional and surgical procedure. Hereby we presented a six year old girl with juvenile blount disease related to obesity.

Keywords: Juvenile, Blount disease, obesity


INTRODUCTION

Blount disease (tibia vara) is a rare growth disorder that affects children, causing the legs to bow outwards just below the knees. Blount disease is defined as a growth disorder of the medial aspect of the proximal tibial physis, with abrupt medial angulation leading to varus angulation of the proximal tibia and medial rotation of the tibia.1 Multiple factors such as ethnicity, genetics, and mechanical stress are thought to be the contributing elements to this disease. Treatment of this disease depends on the patient age and severity of the condition.2 Throughout childhood, the knee joint compensates for rapid growth and various stresses placed on it. At birth, tibio-femoral angle of 15° varus is common. This angle is formed by intersection of long axis of the femur and the tibia. As a child grows, the varus angle decreases, reaching a neutral point at 14-22 months of age. Thus, the knee becomes increasingly valgus, peaking at an angle of 10° at the age 3-4 years, before it stabilizes to an adult level of approximately 6° valgus at the age 6 or 7 years.3

Children affected by Blount disease rarely show any signs or symptoms of disorder before they began walking. However, after ambulation, most of these children were examined due to a bowleg deformity which worsen as they grow and bear more weight. Bilateral presentation mostly occur, especially in infants, yet it is not unusual to have unilateral-affected limbs.4

The exact etiology of Blount disease remains unclear. Multiple factors were assumed to be the contributing elements to this disease. These factors are ethnicity or race, which its rate are higher for children of African origin; gender, which is more
common in female, genetics, early walker (less than 1 year of age); mechanical stress, and obesity or increased body mass index (BMI). For susceptible individuals, obesity greatly increased medial compartment pressure and worsened the development of Blount’s disease.\textsuperscript{1,2}

**CASE ILLUSTRATION**

MNA, a 6-year-old Javanese girl, referred from orthopaedic and traumatology department to nutrition pediatrics outpatient clinic with a diagnosed Blount’s disease on her right-left knees. The patient parents complained that their daughter knees has been bowing since a year ago. This bowing was worsened by pain, especially when she walked. From birth until 5 years old, her knee was still normal. History of the midwife labour was normal, spontaneous, with a weight of 3.5 kg newly born. Her language and milestone were normal. Growth development was also normal. Until she reach 4 years old, her body weight has increased significantly, where it has now reached 42 kg. Through observation, with a height of 126 cm, her ideal body weight should be 25 kg, with body mass index (BMI) of 26.5 kg/m\(^2\). She has started walking without support at the age of 13 months. No similar complaints in the family or past history of trauma has been found. On 24 hours of food recall, the patient consumed almost 2550 kcal every day; which according to the Recommended Daily Allowance (RDA), the patient should only need 2000 kcal/day.

On general examination, the child was found to have normal contour of the head without any facial dysmorphism. Anterior fontanelle was closed. Clinical signs of rickets were absent, such as the widening of wrist, frontal bossing, rachitic rosary, double malleoli, etc. Her vital sign was stable. Her language and milestone were normal. Her right and left knee, we found varus deformity (waterlow 168\%). Based on local examination on assessment, we realized that the patient is obese which has exceeded 95 percent. Based on anthropometry percentile and the body mass index for this age is p90-p95, where weight for stature was above 95 percentile and the body mass index for this age has exceeded 95 percent. Based on anthropometry assessment, we realized that the patient is obese (waterlow 168\%). Based on local examination on her right and left knee, we found varus deformity without swelling, erythema surface and tenderness. We still feel the pulsation of artery dorsalis pedis dextra and sinistra.

On investigation, electrolytes were normal, ALP 296.17 mg/dL, blood sugar 91.7 mg/dL, total cholesterol 135.59 mg/dL, HDL 38.08 mg/dL, LDL 96.68 mg/dL, trygliceride 80.59 mg/dL. Level of C- reactive protein and vitamin D was normal. Radiograph of both lower limb revealed varus angulation of upper tibial metaphysis with metaphyseal-diaphyseal angle (TMDA) that was around 180 on the right side, and 200 on the left side, beaking and lucency of medial tibial metaphysis, widented and irregular medial physis, and also medially sloped and irregularly ossified medial tibial epiphysis indicated as tibia vara (Figure 2).

The patient was provided with nutrition counseling to reduce her weight. She was advised to decrease her daily intake, around 500 kcal per weeks. In addition, we promote healthy eating patterns by offering nutritious snack, such as vegetables and fruits and low fat dairy foods. The physician also promote physical activity and limitation of television and video time to a maximum of 2 hours each day.

The patient has also performed osteotomy left proximal tibia and fibula + open reduction internal fixation plate screw with the pinning and insertion of a drain. After the treatment completed, we found no complication in the patient; like compartment syndrome, deep venous thrombosis or pulmonary embolism. She planned to conduct surgery on the other spot of her leg after six months. After the following six months, it showed that the patient had full correction of varus deformity.

**DISCUSSION**

Blount disease is an uncommon disorder of the postero-medial proximal tibial physis. Leg bowing is a common problem for a child. This case may be physiological or pathological. Physiological bowing will develop as the child grows without treatment, while pathologic bowing will tend to grow worse over time without treatment. A child is born with about 15\(^{\circ}\) of varus at the knee. As they grow older, varus gradually decreases until the tibia-femoral angle neutralizes between 14 and 22 months old. The increasing valgus at the knee will then develop, which reach its peak around 100\(^{\circ}\) at the age of 3–4 years old. Subsequently, the alignment normalizes to an adult level at around 6–7 years old (Figure 5).

Tibia vara (Blount disease) is characterized by progressive bowed leg and tibial torsion. It is a result of inhibited growth on the medial proximal tibial growth plate due to the case of bearing excessive weight. The epidemiology of Blount disease is not well documented. A lot of patients with Blount disease indicate that the estimated prevalence is less than 1% in the United States.\textsuperscript{5,6,7}
There are two clinical forms of Blount disease: (a) early-onset or infantile form, which appears before the age of 3 years old and (b) adolescence or late-onset form, which appears in children older than 10 years old. Late-onset Blount disease has been further subcategorized into juvenile, occurring at age 4-10 years, and adolescent, occurring at older than 10 years.\textsuperscript{2,8} Bilateral involvement is a common case and most likely occur in infantile form. The infantile form affect girls and boys equally. When normal physiologic varus that is seen in an infant has progressed to physiologic valgus, it must be distinguished from physiologic bowing. Clinical features of Blount disease mention several complaints of knee pain or instability and leg bowing that gradually increased in severity.\textsuperscript{9}

A diagnosis of Blount disease is based on clinical, laboratory and standing alignment of x-ray. The criteria includes abnormal varus, right below the proximal tibial physis line, irregular physeal line, breaking in medial metaphysis with the presence of radiolucent islet of cartilage and the presence of irregularly ossified epiphysis slanting (wedge-shape) toward the medial.\textsuperscript{12} In this case, the parents of a patient of 6-year-old Javanese girl reported that their daughter knees has been bowing and in pain since a year ago. The patient complained her inward bowing of lower extremities. Her radiograph of both lower limb revealed bowing and abnormality at the medial aspect of proximal tibia with metaphyseal-diaphyseal angle (TMDA), which was around 18° on right side and 20° on left side, beaking and lucency of medial tibial metaphysis, widented and irregular medial physis, and also medially sloped and irregularly ossified medial tibial epiphysis. We revealed normal laboratory result. Based on the onset, clinical result, we diagnose it as a late presentation of infantile Blount disease (Figure 2).

The etiology of infantile Blount disease remain unclear. The main predisposing factors include races, genetics, walking age and obesity. Radiographs are necessary for diagnosis.\textsuperscript{5,6} The studies have identified a linear correlation between infantile Blount disease and body mass index (BMI). There has been an increase in the incidence of this disease, which in parallel to the rise of obesity rates in children. In children and adolescents, a BMI in the 85 up to 95 percentile or a 25-30 kg/m\textsuperscript{2} is considered overweight, whereas a child above the 95 percentile or with a BMI greater than 30 kg/m\textsuperscript{2} is also considered obese.\textsuperscript{13}

The onset mechanism of Blount disease is not yet fully understood. According to Heuter-Volkmann principle, it is thought that the key mechanism underlying pathogenesis of proximal...
tibial deformity is a growth inhibition caused by increased pressure load. Excessive pressure leads to disruption of ossification and chondrocyte dysfunction, followed by structural anomalies in proximal tibial epiphysis and metaphysis. Obesity significantly increases the pressure on medial compartment, increasing the development of the disease in susceptible individuals. However, the mechanical etiology is inadequate to explain occasional unilateral of the disease, and occasionally observed in non-overweight or non-obese children. In this case, the patient knee was still normal from her birth until she was 5 years old. Her growth development was normal; though until she reach 4 years old, her body weight has increased significantly. The predisposing factors of this patient was an obesity that happened a years ago. Her body weight was 42 kg, while the observed height was 126 cm (ideal body weight for this height is 25 kg) and her body mass index (BMI) was 26.5 kg/m². Based on CDC 2000, we obtained that the weight for this age has exceeded 95 percentile, the height for this age was p90-p95, weight for stature was above 95 percentile and body mass index for this age has exceeded 95 percentile. Based on anthropometry assessment, we conclude that the patient is obese (waterlow 168%).

Obesity is associated to significant health problems in pediatric age group. Medical problems are common in obese children and adolescents and may affect cardiovascular health (hypercholesterolemia, dyslipidemia and hypertension), the endocrine system (hyperinsulinism, insulin resistance, impaired glucose tolerance, type 2 diabetes mellitus, menstrual irregularity), and mental health (depression, low self-esteem). Other important complications and associations include pulmonary (asthma, obstructive sleep apnea syndrome), orthopedic (genu varum, slipped capital femoral epiphysis) and gastrointestinal (nonalcoholic steatohepatitis) complications. A different diagnosis of Blount disease should be explained using physiological genu varum, skeletal dysplasia (metaphyseal chondrodysplasia, multiple epiphyseal dysplasia), metabolic disease (rickets, renal osteodystrophy), posttraumatic deformities, and postinfectious sequelae. In this case, the complication of obesity was genu varum (Blount disease) and other complication was excluded by history, physical and laboratory examination.

Overweight/obesity is an important risk factor of vitamin D deficiency in children. Moreover, it has been observed that the increased amount of subcutaneous adipose tissue in overweight children sequesters vitamin D, thus preventing its transference to the blood stream. Vitamin D serves an important role in providing a proper development of the bone and mineralization. In this case, the patient was diagnosed Blount disease on the basis of clinical features and standard radiographic parameters, which were: physiologically has bowing legs, tibia torsion, medial beaking of the proximal tibia metaphysis on plain radiographs, and occasionally laxity of the lateral collateral ligaments. The level of vitamin D and calcium was normal.

The treatment of this disease depends on the patient's age, severity of the deformity, psychosocial factors, and experience of the orthopedist. Early treatment before the age of 3 years old will increase the chance of success. A high rate of relapse is caused by the unclear etiology of this disease or the inability to remove underlying pathological cause. The purpose and goal in treating Blount disease is unloading medial tibial growth plate to prevent multi-planar deformity and degenerative arthritis later on.

In surgical correction of Blount's disease, the pediatrics orthopedist performs an osteotomy, cutting the tibia and fibula as close as possible to the growth plate and realigning the bones. Following this procedure, the surgeon places a fixator on the leg to maintain proper alignment during the healing process. Blount disease that left untreated may not only results in progression of deformity, but also an increased risk of joint arthritis in the knee and other early degenerative changes. In this case, corrective surgical procedure osteotomy left proximal tibia and fibula + open reduction internal
fixation plate screw, were performed on the age of 6 years old to straighten the leg and prevent further slippage of the epiphyses. Radiographs result afterward shows the effectiveness of this treatment as the varus was corrected. After this procedure, we found no complication. The patient was provided nutrition counseling. She was advised to decrease her daily intake, around 500 kkal for every week.

**SUMMARY**

Although clinical presentations of Blount disease are commonly-known, this pathology remains a concern for healthcare professionals as it affects a vital portion of a child's joint: the epiphyseal growth plate. Through displacement or damage of the proximal tibial epiphysis, a progressive outward bowing of the lower limb occurs. Furthermore, formerly unreported symptom of Blount's disease, slippage of the tibial epiphysis without a change in size or shape of the growth plate, have reaffirmed the significance of comprehending signs and indications of this disease. In careful consideration of each patient's unique circumstance, treatment through corrective bracing, growth plate manipulation, or tibial osteotomy can effectively repair the deformity. If left untreated, abnormal tibia vara may eventually lead to multi-planar deformity and degenerative arthritis later in life. Therefore, it is essential that all modalities are employed and all efforts are made to recognize as well as providing education on this disease.

**REFERENCES**