Total Knee Arthroplasty in a Patient With Pseudopseudohypoparathyroidism

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Abstract

Pseudopseudohypoparathyroidism (PPH) is a rare genetic disorder characterized by multiple musculoskeletal anomalies and normal serum calcium, phosphate, and parathyroid hormone levels. Although the musculoskeletal manifestations of PPH are well known, little has been reported on the management of orthopedic problems. We report a case of total knee arthroplasty (TKA) performed in a patient with PPH. To our knowledge, this case is not only unique to the arthroplasty literature but is the first report of its kind. This report illustrates the unique pathoanatomy of PPH, the medical and surgical management required, and a previously unreported musculoskeletal abnormality associated with PPH: synovial osteochondromatosis of the knee.

Common musculoskeletal anomalies associated with PPH include shortening/bowing of long bones; shortening of metacarpals, metatarsals, and/or phalanges; exostoses; calcification/ossification of subcutaneous and/or periarticular soft tissues; a thickened calvarium; microcephaly; bony coalitions of the hand; vertebral column abnormalities; cubitus valgus; radius/ulna curvus; coxa vara; coxa valga; and genu valgum. This case is the first to report an association of synovial osteochondromatosis with PPH. Because synovial osteochondromatosis and PPH share a common disorder of soft tissue calcification/ossification, as well as abnormal bone formation, this clinical finding does not seem merely coincidental.

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Figure: Preoperative AP (A) and lateral (B) radiographs of the right knee showed valgus alignment with tricompartmental arthritic changes. Intra-articular calcific densities were apparent, especially within the suprapatellar pouch. Diffuse dystrophic calcification of subcutaneous and periarticular soft tissues was also apparent (C).
Pseudopseudohypoparathyroidism (PPH) is a rare genetic disorder characterized by multiple musculoskeletal anomalies and normal serum calcium, phosphate, and parathyroid hormone levels.1–3 Pseudopseudohypoparathyroidism is clinically similar to but biochemically different than pseudohypoparathyroidism. Although much has been written describing the musculoskeletal manifestations of PPH, little has been reported on the surgical management of orthopedic problems in this population.

To raise awareness and improve orthopedic management of patients with this rare condition, we report a case of a patient with PPH who underwent total knee arthroplasty (TKA). This report illustrates the unique pathoanatomy of PPH and highlights the relatively conventional medical and surgical management required. In addition, a previously unreported musculoskeletal abnormality associated with PPH, synovial osteochondromatosis of the knee, is described. In April 2008, the patient underwent TKA. Knee exposure was performed with a standard medial parapatellar arthrotomy. Numerous osteocartilaginous bodies were found within the joint. Histopathologic analysis suggested synovial osteochondromatosis (Figure 3), and a thorough synovectomy was performed.

**Case Report**

A 76-year-old woman with PPH presented with right knee pain, swelling, and deformity. On physical examination, the patient’s height was 4’10” tall and her weight was 139 lbs. The remainder of the physical examination was remarkable only for features of PPH including a round face and brachydactyly (Figure 1).

Knee examination revealed a fixed varus-flexion deformity. Knee range of motion measured 15° to 115°. Knee radiographs showed diffuse calcification, valgus alignment, and tricompartmental arthritis (Figure 2). Laboratory studies disclosed normal calcium and phosphate levels (9.4 and 3.6 mg/dL, respectively).

Intraoperative photograph (A) showing intra-articular osteocartilaginous nodule. Nodules, which were both free floating and attached to the synovium, were white-gray, translucent hyaline cartilage and ranged in size from 1 to 3 cm. Photomicroscopy (B and C) revealed focal islands of disorganized and hypercellular hyaline cartilage metaplasia in synovium consistent with synovial osteochondromatosis (hematoxylin-eosin, original magnification ×4 and ×20, respectively).

Postoperatively, the patient’s rehabilitation required pediatric appliances including a continuous passive motion machine and wheeled walker to accommodate her short stature. Two
years postoperatively, her Knee Society score was 95, reflecting a deduction of 5 points for limited motion (5\(^{-}\)110\(^{+}\)). Her functional score was 90, reflecting a deduction of 10 points for climbing or descending stairs using the rail. Radiographs confirmed a well-fixed prosthesis without evidence of osteochondromatosis (Figure 5). The patient continues to undergo annual follow-up.

**DISCUSSION**

The term pseudohypoparathyroidism was first used by Albright et al\(^{4}\) in 1942 to describe a syndrome characterized by short stature, round face, brachydactyly, and biochemical features of hypoparathyroidism including hyperphosphatemia and hypocalcemia. This condition was later described by others as Albright’s hereditary osteodystrophy.\(^{5,7}\)

In 1952, Albright et al\(^{8}\) described the first case of PPH in a patient with physical findings of Albright’s hereditary osteodystrophy without apparent parathyroid dysfunction. Subsequently, several similar cases were described in the medical literature. However, the wide array of musculoskeletal abnormalities associated with PPH resulted in the use of complex and often confusing nomenclature including dyschondroplasia and exostoses with metaphyseal dysplasia or congenital skeletal malformations; dyschondroplasia with soft tissue calcification and ossification, and normal parathyroid functions; dys trophy d'Albright Type II; brachymetacarpal dwarfism; dyschondroplastic oligophrenic dwarfism; and cerebro-metacarpo-metatarsal dystrophy.\(^{14}\)

Currently, PPH is well-recognized as part of a spectrum of genetic disorders resulting in dysfunction at various levels of the parathyroid-target tissue axis. Although the precise cause of PPH remains incompletely understood, recent advances in genetic research have shown it arises secondary to an abnormal expression of the G\(_{\alpha}\)a gene.\(^{15,16}\)

Commonly reported musculoskeletal abnormalities associated with PPH include shortening and bowing of the long bones; shortening of the metacarpals, metatarsals, and phalanges; exostoses; calcification or ossification of subcutaneous and periarticular soft tissues; and abnormalities of the skull including a thickened calvaria or microcephaly.\(^{20}\) Less commonly reported musculoskeletal abnormalities include bony coalitions of the hand (ie, congenital fusion between the metacarpopcarpal and radiocarpal bones); vertebral column abnormalities (ie, shortened pedicles, enlarged laminae, and calcified ligaments associated with lumbar and cervical spinal cord compression); cubitus valgus; radius and ulna curvus; coxa vara and valga; and genu valgum.\(^{23}\)

Although the musculoskeletal manifestations of PPH are well-described, little has been reported on the management of orthopedic problems in this population. This case of TKA in a patient with PPH is unique not only to the arthroplasty literature but also is the first report of its kind.

For the orthopedist, although patients with PPH may possess many of the same somatic abnormalities associated with pseudohypoparathyroidism, PPH is relatively medically uncomplicated. Specifically, the signs and symptoms of pseudohypoparathyroidism that result from derangement of metabolism of calcium and phosphorus (eg, osteoporosis, basal ganglia calcification, tetany, cataracts, and dental abnormalities) are uncommon with PPH.\(^{24}\) Excluding the presence of other medical comorbidities, most patients with PPH do not appear to have a reduced life expectancy or any condition-related contraindication to elective orthopedic procedures such as total joint arthroplasty. Another important distinction between PPH and other forms of pseudohypoparathyroidism is intellectual capacity; cognitive impairment and intellectual deficits are not prevalent among patients with PPH.\(^{25}\)

When considering TKA in patients with PPH, good results may be obtained with
conventional techniques and instrumenta-
tion if surgeons plan for the requirements
associated with patients of short stature as
well as the technical issues related to the
specific musculoskeletal pathoanatomy.

Preoperative templating will ensure ap-
propriate implant sizes are readily avail-
able and predict whether extramedullary
alignment guides or navigation will be re-
quired. Intraoperatively, percuticular cal-
cification or ossification of the joint cap-
sule and collateral ligaments may prevent
soft tissue balance of the knee. In our pa-
tient, a varus-valgus constrained implant
was required. Similar difficulty in ligam-
ent balancing has been reported in cases
of TKA for patients with other inherited
forms of dwarfi sm.26,27 For the postopera-
tive phase, arranging for availability of ap-
propriate sized equipment (eg, continuous
passive motion machine or walker) may
prevent delays in rehabilitation.

Although synovial manifestations of
other rare skeletal dysplasias have been
reported, the association of synovial os-
teochondromatosis and PPH has not been
described.28,29 Because synovial osteo-
chondromatosis and PPH share in com-
mon a disorder of soft tissue calcification
and ossification as well as abnormal bone
formation, our clinical finding does not
seem merely coincidental. However, at
this time, no disease-specific reason or
pathogenetic mechanism can be proposed
to explain the relationship, if any, between
the 2 disorders. Although there are reports
of successful TKA in patients with syno-
vial osteochondromatosis, the outcomes
are notable for inferior knee motion and
risk of disease recurrence.30

Although the musculoskeletal mani-
festations of PPH may present challenges
for orthopedic procedures, attention to preopera-
tive planning and postoperative require-
ments, and an operative technique adapted
to address disease-specific pathoanatomic
features. From a medical standpoint, pa-
tients with PPH are essentially physiolog-
ically normal and with no apparent condi-
tion-related health risks for orthopedic
surgery.

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