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Case Studies

Neurocysticercosis

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Introduction

Cysticercosis is caused by the larval stage of *Taenia solium* (*T. solium*).[1] Clinical syndromes related to this parasite are divided into neurocysticercosis (NCC) and extraneural cysticercosis (ECC). NCC, in turn, is divided into parenchymal and extraparenchymal forms. Tissue cysticerci develop from onchospheres, which are invasive larvae transformed from Taenia eggs, over a period of three to eight weeks following ingestion of T. solium. Cysticerci typically remain in this stage for many years.

The Taenia species has a number of very sophisticated mechanisms to evade destruction by the human body including production of serine proteases. Symptoms develop when the body eventually attacks the cyst and kills it. In general, parenchymal cysts are associated with seizures and headache, while extraparenchymal cysts are associated with symptoms of elevated intracranial pressure (e.g., headache, nausea, and vomiting) and may be accompanied by altered mental status.

Neurocysticercosis is a leading cause of seizures in developing countries. Persons with a history of living in or traveling to endemic areas or those living in close association to persons known to have cysticercosis deserve further evaluation of this as an etiology of a seizure or psychiatric disorder. Limited study exists on neuro-psychiatric manifestations. However, there appears to be high psychiatric morbidity in untreated cases.

Case Report

A 44-year-old, right-handed, employed, married, Hispanic, solely Spanish speaking male presented to the emergency room of a community hospital with a headache and seizure-like activity. The patient had intermittent headaches over the past two years, but they had become more frequent in recent weeks. On the day of presentation to the emergency room, the patient developed a severe headache that atypically did not resolve. He attributed the headache to paint fumes he inhaled while painting his house that day. Over the course of the day, his wife noted that he was having difficulty finding words, was increasingly somnolent, and confused. He experienced two generalized tonic clonic seizures later that day, each lasting 60 to 90 seconds, and was transported to the local emergency room. Subsequently, he was transferred to a regional medical center for further evaluation.

The patient's medical history was notable for gout, appendectomy, chole-cystectomy, and vasectomy. His family history included diabetes mellitus and hypertension. He was employed at a chicken and beef processing facility in Western Kansas. He had no tobacco, alcohol, or illicit drug use history. The

patient was born and lived in Mexico before moving to the United States about 10 years prior to presentation. He last visited Mexico during the summer less than two years before presentation.

The presenting vital signs included temperature of 97.2° F, pulse of 80 bpm, blood pressure of 110/60 mmHg, height of 5'9'', and weight of 99.7 kg. His Mini-Mental State Examination revealed mild cognitive impairment with a score of 23. He had difficulty concentrating and was unable to spell the Spanish equivalent of "world" backwards. His visual fields were full and central visual acuity was 20/20 OU. Strength and tone in upper and lower extremities were normal. Coordination and fine motor movements were normal. Vibratory and cold sensation and two-point discrimination were normal. His tendon reflexes were not brisk and his plantar responses were flexor.

All blood and urine tests were normal. The cysticercosis IgG antibody was negative. HIV, Strongyloides antibody, TSH, and TB tests were normal. A skeletal x-ray and electroencephalogram were normal. Magnetic resonance imaging of the brain, with and without contrast, revealed a 19.5 mm x 12.5 mm x 16.5 mm left posterior temporal cyst with small nodule (see Figures 1a and 1b). Vasogenic edema was noted with the margins measuring approximately 3 cm in average diameter. The characteristics of the lesion suggested cysticercosis. A diagnosis of neuro-cysticercosis was made. The patient's history of being from an endemic area, exposure to poor sanitation, and the characteristics of the clinical presentation helped form the diagnosis.

Initially, the patient was given IV dexamethasone and loaded with fosphenytoin because of the seizure episodes and brain edema. His mental status rapidly improved. He was discharged from the hospital after three days. He was given a course of albendazole and an oral prednisone taper upon hospital discharge. He was scheduled for a repeat MRI two months later and was followed by an infectious disease specialist.

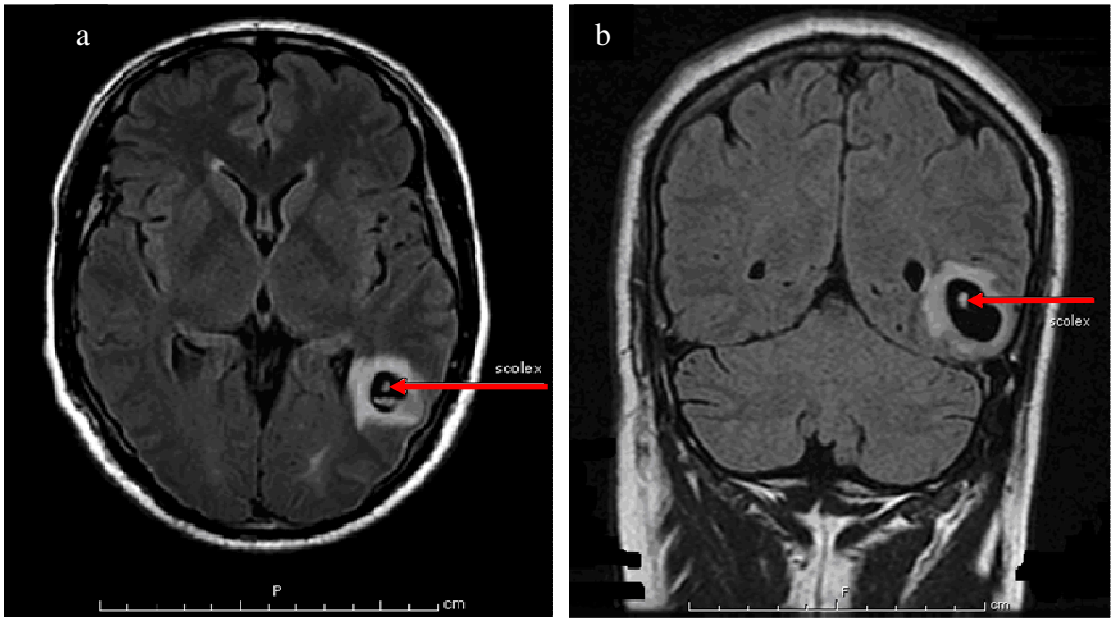

Figure 1. MRI on day of admission. Red arrows note the scolex visible in the cyst.

Discussion

The life cycle of *T. solium*, the tapeworm causing NCC, is complicated and humans are a dead end host with swine as an intermediate host.[2] Poor sanitary conditions in developing countries have been the environment characterized as where the species is endemic, however, that need not be the case. Individuals with no history of pork consumption or travel to endemic areas also can develop NCC. In a report of four cases in an Orthodox Jewish community (whose dietary laws strictly prohibit consumption of pork), infection was transmitted by domestic workers who recently had emigrated from Latin American countries where *T. solium* is endemic.[3]

Pharmaceutical treatments for cysticercosis are most commonly albendazole and praziquantel.[4] Albendazole (15 mg/kg per day ~ 800 mg/day in two divided doses) facilitates the destruction of parenchymal cysticerci. Praziquantel (50 to 100 mg/kg per day in three divided doses) is an alternative to albendazole, but also is used in cases of infection in the gastrointestinal tract and elsewhere aside from the central nervous system.

Psychiatric manifestations have been recognized as depression, psychosis, and cognitive decline.[5] Psychosis may be seen in up to 5% of patients.[6] In a series of studies conducted in Brazil, psychiatric disorders occurred in 65.8%, evidence of cognitive decline in 87.5%, depression in 52.6%, and psychosis in 14.2% of patients.[7]

A point of medical and public health interest is that cysticercosis and neurocysticercosis are not reportable diseases in Kansas or most others states. This case may serve as encouragement for authorities to reconsider the importance of this disease to be added to the list of reportable diseases.

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Failure of Intramedullary Expandable Tibial Nail and Fragmentation During Extraction

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Introduction

The tibial shaft is the most commonly fractured long bone in orthopaedics.[1] Depending on the characteristics of the fracture and the patient, various treatment options have been successful. These include closed reduction and immobilization, intramedullary nailing, external fixation, flexible Ender nailing, compression plating, interfragmentary screwing, and functional braces.[2] Intramedullary (IM) nail fixation of the tibial shaft has become the preferred method of definitive treatment in open and closed diaphyseal fractures.[3] The degree of soft tissue and bony injury must be evaluated as contraindications for IM nailing of open tibial fractures. Interlocking forms of IM nailing with or without reaming have been the most extensively studied and advocated methods of fracture fixation of the tibial shaft.[4-8]

As an alternative to the interlocking forms of IM nail fixation, a more recent nail design that incorporates an expandable chamber for fixation of the humerus, femur, and tibia is now available (Fixion nail, Disc Orthopaedic Technologies Inc, Monroe Township, NJ). To our knowledge, there have been no reports of expandable tibial nail breakage and only one report of humeral nail breakage, in which no complications were noted during removal of the nail.

We present a case of a young male who sustained an open tibial shaft fracture and was treated with an expandable nail. The patient developed a nonunion of the tibia, bending of the IM rod, breaking of tines and fragmentation.

Case Report

A 19-year-old male sustained an injury to his right leg in a motocross accident. Upon evaluation by an orthopaedic surgeon, the patient had a comminuted fracture of the diaphysis of the tibia and fibula (Figure 1). A 2-cm laceration was noted over the tibial fracture. A nondisplaced fracture of the medial malleolus also was noted. The patient underwent debridement and irrigation of the open fracture and placed in a long leg cast the day of the injury. Intravenous antibiotics were given postoperatively.

Eighteen days after the injury, the patient underwent removal of the cast and IM nailing of the tibia using the (Fixion) expandable nail. A patellar splitting approach was used and an 8.5mm x 340mm expandable tibial nail was placed after a second incision over the fracture was used to remove interposed soft tissue from the fracture site. The nail was expanded using sterile saline and reduction of the fracture was observed. He continued non-weight bearing activities after surgery.

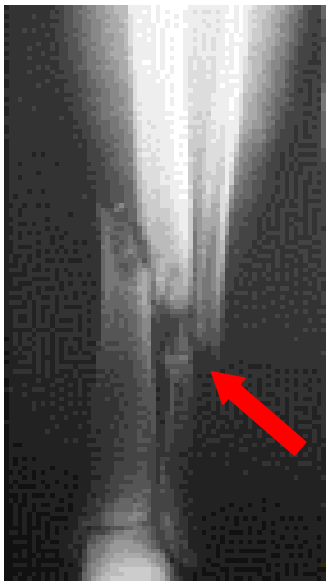

Figure 1. A comminuted fracture of the diaphysis of the tibia and fibula.

Figure 2. Bending of the IM nail and gross motion of the fracture site.

Eight days after the IM nail was placed, the patient was fitted with an air cast splint and continued non-weight bearing. Eleven-week post-operative radiographs showed callus formation at the tibial shaft fracture and weight bearing as tolerated was advised. Twenty-five week post-operative radiographs showed a persistent fracture line. Weight bearing as tolerated was continued and he was advised to avoid high impact activities. Thirty-week post-operative radiographs showed bending of the IM nail and gross motion of the fracture site (Figure 2). He was placed back in an air splint and advised he would need further surgery to obtain union of the fracture.

The patient moved out of state and presented to an orthopedic surgeon (SJH) for treatment of the tibial nonunion. Radiographs revealed that the nail was bent and a tine was broken at the nonunion site (Figure 3). It was elected to proceed with exchange nailing of the tibial nonunion. The previous patellar tendon splitting incision was used and bone was removed over the nail to engage the Fixion extractor. The nail was extracted and examination confirmed that the tines were broken and bent (Figure 4).

Figure 3. Bent nail and a broken tine at the nonunion site.

Portions of the tines were believed to be missing. Fluoroscopic images showed a portion of a tine at the nonunion site (Figure 5). The previous incision over the fracture was used, a portion of the nonunion was debrided, cultures were taken, and the distal tine removed.

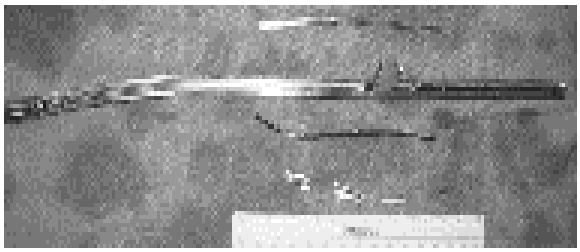

Figure 4. Extracted nail with broken and bent tines.

Figure 5. Fluoroscopic images immediately after surgical removal of the largest pieces of the nail, showing a portion of the tine remaining at the nonunion site.

An incision over the fibula was utilized and an osteotomy of the fibula proximal to the previous fracture was performed to aid in reduction of the tibia. A guide rod was passed down the tibia and a reamed 12mm x 345mm dynamically locked IM nail (Synthes, Paoli, PA) was passed. Reamings were placed at the nonunion site and standard closure was done. Fluoroscopy of the knee showed a tine to be protruding through the lateral tibial plateau and into the lateral femoral condyle (Figure 6). An arthrotomy was made to remove this tine and a small 1mm x 2mm defect in the condyle was debrided of loose cartilage. The lateral tibial plateau was inspected and the lateral meniscus was intact. Tourniquet

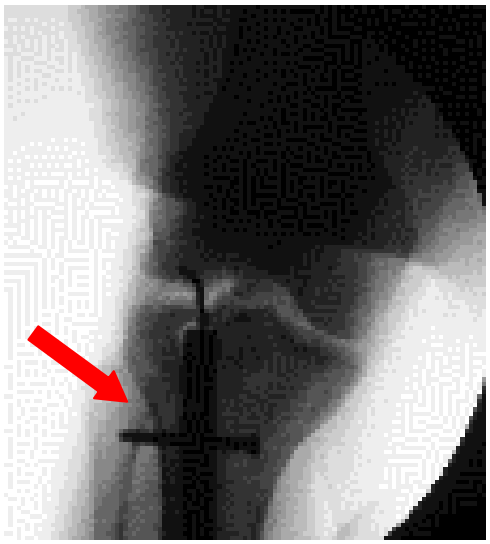

Figure 6. Fluoroscopic images after static locked nail placed, showing a tine protruding through the lateral tibial plateau and into the lateral femoral condyle.

time was 128 minutes and intraoperative cultures showed no growth.

The patient showed radiographic and clinical healing of the fracture without further complications. At last follow-up, the patient had no complaints of knee pain and had resumed all activities.

Discussion

IM fixation of fractures has seen many advances in both technique and implant design since Stimson described IM ivory pegs in an 1883 textbook.[9] Hey-Groves used metallic IM pegs in a femur fracture from a gunshot in World War I.[10] Küntscher popularized IM fixation with metal rods beginning in 1939. Since the work of Küntscher, IM rods have been developed for use in virtually all long bones.[11-13]

IM fixation of tibial shaft fractures has increased in popularity as studies have shown decreased malunion rates, decreased joint stiffness, shorter time to union, and faster return to work.[14] IM nailing of open fractures yields increased time to union and higher incidence of nonunion than IM nailing of closed fractures. At 4-month

follow-up, approximately 23% of open fractures and 60% of closed fractures reach union.[15]

The technique of reaming has gained popularity. An international survey published in 2002 showed 79.7% of surgeons performed some reaming in closed tibial shaft fractures prior to nail insertion.[6] Concerns of reaming the IM canal have ranged from increased distal IM pressure, risk of embolic phenomenon, decreased endosteal blood supply, compartment syndrome, and thermal bone necrosis. Techniques of slow incremental reaming, sharp reamer tips, and release of any tourniquet have decreased the rate of complications from reaming.

Complications of implant failure are widely reported. The most common failure is the interlocking screw breaking from a fatigue fracture. This is more common in unreamed nails with a smaller interlocking screw diameter and has a 10-20% incidence.[17-21] Use of larger diameter reamed nails allows for a larger locking screw and has decreased the incidence of screw breakage to 0-4.5%.[21-24] Fatigue fracture of the IM nail is a much less common complication seen in up to 6% of nails, mostly from smaller unreamed nails in the presence of a nonunion.[25]

The Fixion expandable nail was first used clinically in 1999.[26] The current usage in tibial fractures is for diaphyseal fracture, comminuted diaphyseal fracture, osteoporotic and pathologic fracture, and tibial nonunion. Advantages of the Fixion nail over standard interlocking nails include shorter operative time, decreased fluoroscopy exposure, no risk of reaming, and decreased risk of fracture through a locking screw hole.

The Fixion nail is made of a 316 stainless steel sealed pressure tube with four longitudinal bars connected to four stainless steel membranes (Figure 3). Proximally, the nail has a valve that allows the tube to be inflated with saline to expand the diameter of the rod and allow the four longitudinal bars or tines to abut the endosteal surface and conform to the medullary canal. The rod diameter can be increased up to 65% with expansion. The relative flexibility of the uninflated nail aids in its insertion, and the nail becomes rigid with saline expansion. The nail can be placed with or without reaming and is available with proximal and distal interlocking screws. Nail extraction is accomplished with removing the saline and deflating the nail. The nail resumes its preinflation shape and attachment of an extractor to the proximal cap.[27]

Review of the available human studies on expandable nails resulted in complications of nonunions, anterior knee pain, propagation of fracture lines, fracture shortening, infection, and compartment syndrome.[28-32] Ozturk reported a case of humeral nail breakage, but did not mention any complications in its removal.[33]

Our case report identified a complication with the extraction of the nail due to bending and breakage of the tines in the presence of a nonunion. The nail suffered catastrophic failure during the removal process. Recognition of the tines in the fracture site and lateral femoral condyle allowed careful removal and treatment of the nonunion which went on to an uneventful healing with no apparent sequelae in the knee.

Conclusions

Tibial nonunion and implant failure is a recognized complication of all treatment options for diaphyseal tibial fractures. As designs of IM devices change, new complications are recognized through clinical use. Failure of the expandable tines was a previously unrecognized complication in the literature.

Comminuted diaphyseal fractures may best be treated with locked IM nailing. Placement of a non-interlocked expandable nail in this comminuted fracture pushed the limitations of the device. Perhaps earlier recognition of the nonunion and removal of the nail prior to the tines breaking would have avoided this intraoperative complication. Further clinical use of the Fixion nail may confirm the difficulty in removing the nail in the presence of implant failure.

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Keywords: tibial fractures, intramedullary nailing, intramedullary fracture fixation, case report