Non-Traumatic Tile Type B3 Pelvic Fracture Combined With Garden Type III Femoral Neck Fracture Caused By Hypocalcaemia-Induced Convulsions

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Research Article

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Abstract

BACKGROUND Non-traumatic fractures caused by convulsions are relatively rare and are often overlooked due to the lack of obvious evidence of injury. Non-traumatic fractures due to convulsions are diverse, but the concomitant of pelvic and femoral fractures has not been reported previously.

CASE SUMMARY A 47-year-old woman with a no significant medical history, was taken to the nearest hospital after one episode of generalized tonic-clonic seizure that had occurred during sleep. After the postictal phase, the patient regained consciousness and experienced diffuse pain in the inguinal regions bilaterally with inability to stand or walk. The entire attack was witnessed by the family members who confirmed that there was not external trauma. Blood investigations revealed high creatinine and uric acid levels, along with a low calcium level. Conventional radiograph of the pelvis was performed to detect the cause of pain. The patient was noted to have a pelvic fracture and unilateral fracture of the neck of the femur. She was then transferred to our hospital for further management. The patient was diagnosed as having Tile type B3 pelvic fractures combined with a Garden type III femoral neck fracture on three-dimensional computed tomography (3D-CT). In view of her blood results, nephrology consultation was sought. The patient was identified as having a stage 5 chronic kidney disease (CKD), hypocalcemia, and hyperphosphatemia. However, neurological examination showed no abnormalities. No surgical intervention was adopted for her pelvic fractures. In addition to complete bed rest, closed reduction and percutaneous cannulated screw fixation was performed for the treatment of the right femoral neck fracture. An arteriovenous fistula was created for maintenance hemodialysis on the tenth postoperative day. At follow-up, twelve months follow-up after the operation, the patient had a normally gait and was satisfied with the outcome.

CONCLUSION Patients who present with convulsive seizures especially patients with ion metabolism disorder should be examined thoroughly to ensure that no injury is missed.

Introduction

Patients are seldom assessed for motor system injuries after convulsive seizures in the absence of trauma, but this could lead to possible oversight of injuries. Herein, we have reported a rare case of nontraumatic Tile type B3 pelvic fractures combined with Garden type III femoral neck fracture caused by hypocalcemia-induced convulsive seizures. The patient's underlying renal disease resulted in hypocalcemia that affected bone density, with the possibility of nephrogenic bone disease. This case highlights the importance of comprehensive inspection to prevent inadvertently omission of the diagnosis of fractures and to treat the primary disease actively, by enhanced monitoring to reduce the risk of fractures. Fractures can easily be missed because of a lack of history of trauma. A high index of suspicion and thorough clinical and radiological examinations should be performed to prevent delays in diagnosis. We report a rare case of pelvic fracture and unilateral femoral neck fracture due to seizure activity.

Case Presentation

A 47-year-old woman developed sudden-onset generalized tonic-clonic seizures with transient syncope during sleep. After regaining consciousness spontaneously, she complained of short-lived diffuse pain. However, she continued to have persistent groin pain bilaterally that was associated with a limitation of hip movement bilaterally (more on the right side). There was no history of fall from the bed or any other trauma. She was taken to the nearest hospital for further evaluation of the same. A conventional radiograph that was performed revealed a rare abnormality. She was noted to have a pelvic fracture along with a right femoral neck fracture. In addition, a routine urine examination revealed evidence of chronic kidney disease (CKD) that had not been diagnosed previously. She was then referred to our hospital for further management. No additional trauma occurred during transit.

A comprehensive physical examination was performed at admission. The electroencephalogram was normal with no anomalies detected on brain CT. She denied any previous experience of similar events and had no known family history. Sonography revealed that her kidneys were small and contracted bilaterally. Nephrology consultation identified the woman to be stage 5 chronic kidney disease (GFR 3.5 ml/min), hypocalcemia (1.05mmol/L) and hyperphosphatemia (1.85mmol/L). The marked elevation of PTH (596.3pg/ml) indicated severe secondary hyperparathyroidism due to hypocalcaemia. Suboptimal smears had unsatisfactory RBC count and hemoglobin level, a prolonged prothrombin time was found(15.2sec) (Table 1). A 3D-CT of the pelvis was performed that showed Garden type III fracture of the right femoral neck and Tile type B3 pelvic fracture (**Fig. 1**).

Table 1 Initial biochemistry and coagulation profile.

Test	Result	Reference range
Total Calcium	1.05mmol/L	2.1–2.6
Phosphorus	1.92mmol/L	0.81–1.55
Procalcitonin	0.12ng/ml	0-0.05
UREA	27.6mmol/L	1.7–8.3
CREA	854mmol/L	45–97
Uric acid	541 mmol/L	143–339
Prothrombin Time	15.2sec	9.4–12.5
TSH	5.23uIU/ml	0.24–4.2
PTH	596.3 pg/ml	15–65
NT-BNP	5544.64pg/ml	0-300
CK	298U/L	26–192
LDH	427U/L	135–214
α-HB	298U/L	72–182
HGB	57G/L	115–150
RBC	1.95*10 ¹² /L	3.8–5.1

A central venous catheter was temporarily inserted in the internal jugular vein for correcting the electrolyte levels during inpatient admission. The patient provided consent for closed reduction and percutaneous cannulated screw fixation for treatment of the femoral neck fracture after a detailed discussion on the tenth day after admission. Under spinal anesthesia, closed reduction was performed using a traction table and confirmed using fluoroscopic imaging. Percutaneous insertion of three parallel 7.0 mm hollow screws arranged in a triangular shape created a stable construct. Immediate postoperative radiographs demonstrated a good plate position (Fig. 2a and b). The indication for surgery was an unstable pelvic ring^[1]. Surgery was a prerequisite for stable fixation and early functional rehabilitation. However, a fibrous callus was observed to pass through the fracture of the pubic rami and residual apposition precluded the need for surgical treatment. She was advised strict bed rest. On the tenth day after the operation, an arteriovenous fistula was created for subsequent hemodialysis. She achieved good recovery following initiation of calcium, vitamin D3 supplements, and other supportive therapy. The patient was discharged on the third day after creation of a fistula. She underwent rehabilitative therapy for four months at home and was regularly followed up. At review in the clinic 12 months later, radiographic results revealed good alignment and apposition, and bone healing (Fig. 2c-e). She perceived no abnormal pain or numbness

and could walk with full weight bearing and perform physical exercises normally. She was satisfied with the results of the surgery.

Discussion

Several studies have evaluated the fracture rate in those with epilepsy. According to the study by Finelli and Cardi, fracture incidence was 1.1% in 2800 cases of seizures^[2]. Among these, 0.3% of the fractures were directly associated with convulsive seizures and without additional trauma. Frey et al. analyzed 411 patients between 2007 and 2019 at epilepsy centers in Frankfurt and Marburg, where 6 patients sustained fractures with no obvious injuries^[3]. Salas-Puig et al. observed 406 patients with generalized seizures; the rate of accidental fracture associated with generalized seizures was 3.9%^[4]. A meta-analysis of 3145 articles on generalized convulsive seizures conducted by Grzonka P et al. screened 39 publications reporting on fractures in patients with convulsive seizures^[5]. Their findings indicated that fracture is an uncommon complication of seizures, which was also the same stance of Michael Tan, who further stated that fractures are extremely rare in the absence of trauma^[6].

Grzonka P et al. determined that bilateral posterior fracture-dislocations of the shoulder were the most common injuries and the incidence of bilateral femoral fractures was the lowest among all fractures following convulsive seizures. There is no mention about the incidence of pelvic fractures combined with femoral fractures^[5]. Our case is an example of a rare Garden type III femoral neck fracture with Tile type B3 pelvic fracture caused by seizure activity. To the best of our knowledge, this is the first case of a non-traumatic, convulsive seizures -induced Garden type III femoral neck fracture and Tile type B3 pelvic fracture with dissociation of the symphysis pubis.

Most general epileptic seizures are electrically induced, although some metabolic diseases such as hypoglycemia or uremia may also be responsible^[7]. Hypocalcemia caused by stage 5 CKD was thought to be the cause of this patient's seizure. CKD is complicated by abnormalities in calcium and phosphorus metabolism, which worsens as the disease progresses. With worsening CKD, electrolyte disturbances in the body lead to a series of serious complications. Among them, disorders of calcium ion metabolism are closely related to bone mineral metabolism and abnormal muscle activity^[8]. Hypocalcemia-induced neurological manifestations include tetany, seizures, and delirium, which indicate the important role of calcium in reducing the threshold for excitability in the central nervous system^[9]. Our patient had stage 5 CKD with renal insufficiency that resulted in poor calcium homeostasis, thus increasing the chances of convulsive seizures compared to that in normal people^[10]. The parathyroid hormone receptor (PTHr) exists in the renal tubule but the parathyroid hormone (PTH) is unable to bind to the receptor when the renal tubules are atrophied and non-functional. Calcium absorption is markedly reduced in the renal tubules. Hence, the calcium-conserving effects of PTH are not achieved and more calcium is excreted. The homeostasis of calcium and phosphate reabsorption is disrupted, resulting in hypocalcemia and hyperphosphatemia. In addition, another common biochemical manifestation is low 1,25-dihydroxyvitamin D levels^[11].

O'Neill hypothesized that hypocalcemia occurs in the late stages of CKD^[12], but altered mineral metabolism occurs much earlier, mainly as secondary hyperparathyroidism according the study of Levin^[13]. The main reasons for this are decreased synthesis of osteotriol in the kidney, decreased serum calcium concentration, increased phosphate concentration, decreased bone sensitivity to PTH^[14], and reduced calcium-sensitive receptors leading to hyperparathyroidism. Our patient was diagnosed with hyperparathyroidism, which in turn adversely affected bone remodeling, enhanced bone resorption but hindered bone mineralization, and ultimately decreased bone density that led to the occurrence of renal bone disease with weaker and more brittle bone. The potential risk for fractures is, thus, greatly increased. Furthermore, hyperphosphatemia inhibits 25-hydroxyvitamin D 1 α -hydroxylase in the kidney, further reducing the synthesis of 1,25-dihydroxyvitamin D. Low levels of 1,25-dihydroxyvitamin D eventually exacerbate hyperparathyroidism indirectly through decreased intestinal absorption of calcium, leading to the formation of a vicious cycle.

Multifactorial etiologies induce fractures in patients with CKD^[15]. If we evaluate the patient's bone quality indirectly using peripheral quantitative CT or directly using bone biopsy, the histological features of renal osteopathy, comprising bone mass reduction, osteoporosis, or an increase in fibrous bone, may be found. Our patient's poor bone quality was noted during the operation. She neglected performing exercise and spent much time indoors with no exposure to sunlight, leading to loss of appetite; this could have led to the metabolic disorders. Ultimately, all of these accelerated the process of renal bone disease. Muscle groups such as the flexion muscles, the adductor muscles and the abductor muscles, their strong contraction resulted in simultaneous fractures of the right femoral neck, bilateral upper and lower pubic branches, and sacrum although she wasn't strong (**Fig. 3**).

It should be noted, however, that the location, type, and cause of fractures like this are rare. The flexor, adductor, and abductor muscle groups and their strong contraction resulted in simultaneous fractures of the right femoral neck, bilateral upper and lower pubic rami, and right side of the sacrum despite our patient not being muscular.

Conclusion

This case demonstrates that Tile-type-B2 pelvic fracture along with unilateral Garden type III femoral neck fracture can occur in the absence of significant trauma. Our aim was to present the injury and its unusual etiology and to suggest a patho-mechanical rationale for the pattern of injury we observed. It is important to increase awareness of significant pelvic injuries in patients post-epileptic seizures. We raise the following suggestions according to the results of this analytical report. First, hypocalcemia-induced seizures must be paid better clinical attention. Patients who present with seizure or collapse need to be thoroughly examined for signs such as pain, deformity, ecchymosis, and crepitus to ensure that no injury is missed. Second, the levels of calcium ions in patients with renal insufficiency should be monitored to avoid the severe convulsions caused by hypocalcemia. Timely dialysis treatment must be initiated to avoid serious consequences of chronic metabolic disorders. Third, at earlier stages of renal insufficiency, attention should be paid to the prevention and treatment of osteoporosis. Fourth, supportive care to avoid

falls or hitting on hard objects, which could lead to fractures when convulsions occur, need to be improved. Fifth, once fracture occurs, immediate assessment of the need for surgical treatment and prompt anti-osteoporosis measures to promote fracture healing must be initiated.

Declarations

The authors have no conflicts of interest to declare that are relevant to the content of this article. No funding was received to assist with the preparation of this manuscript. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of the Second Hospital of Jilin University. The patient provided written informed consent for participation. Data anonymity was maintained to protect patient privacy. The datasets used and analysed during the current study are available from the corresponding author on reasonable request. All authors consent for publication. Minghan Dou mainly collected data and writes papers. Baoming Yuan and Guangkai Ren were responsible for postoperative follow-up and making pictures. Chuangang Peng and Dankai Wu revised articles and conducted scientific evaluation. No acknowledgements.

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Figures

Figure 1

CT of the pelvis. a: Preoperative sagittal pelvic CT showing a right femoral neck fracture, marked with an arrow. b and c: The right femoral neck fracture (blue arrow) and multiple pelvic injuries (red arrows) are better appreciated on 3D reconstruction of the CT pelvis. d: Separation of the pubic symphysis.

Figure 2

Immediate postoperative radiographic and 12-month follow-up radiographic findings. a and b: Immediate postoperative radiographs of pelvis in anteroposterior and lateral position demonstrated a good plate position (red arrows). c-e: The 12-month follow-up radiographs showing good healing of the right femoral head with no necrosis (green arrows) and proliferative bone healing of the pubic ramus (blue arrows).

Figure 3

Direction of contraction of muscle groups around the hip joint leading to fracture. The green, blue and red arrows represent the direction of contraction of the adductor, abductor, and flexor muscle groups, respectively.