ORIGINAL RESEARCH ARTICLE

An epidemiological analysis of benign pelvic tumors

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Abstract: This study aims to expand the general understanding of benign pelvic tumors and improve their diagnosis via an analysis of their epidemiological and radiological features. Data from 201 internal patients diagnosed with benign pelvic tumors and treated from July 1958 to October 2011 were analyzed. The age and sex of patients were recorded. The age of disease onset and male-to-female ratio were analyzed. Pathological data were reviewed to determine the type of tumors whereas radiological data were examined to determine the anatomic sites and radiological features of the tumors. Based on the aforementioned data, the epidemiological features of all benign pelvic tumors were analyzed via the statistical analysis of sex, age, tumor types, locations and radiological features. The study group consisted of 114 males and 87 females, with the male-to-female ratio being 1.31:1. The disease onset age was between 5 and 72 years old, with a median and mean age of 28 and 30 years old, respectively. Pathological results showed that there were 59 giant cell tumors (GCTs), 53 osteochondromas, 17 simple bone cysts (SBCs), 15 aneurysmal bone cysts (ABCs), 14 osteofibrous dysplasias and 13 chondroblastomas. The tumors frequently occurred around the acetabulum. GCTs of bone and ABCs were more invasive, often involving multiple partitions. This disease has a high incidence and prevalence in individuals <40 years old. A comprehensive knowledge of epidemiological and radiological features is beneficial in early diagnosis of benign pelvic tumors.

Keywords: pelvis; benign tumor; epidemiology


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Introduction

Pelvic tumor accounts for about 4% of systemic primary bone tumors[1]. Its deep location complicates dissection. The tissue origin and pathological types are highly variable. Thus, it is difficult to diagnose and treat. An epidemiological analysis of age, gender, tumor location, tumor distribution and radiological features of pelvic tumor cases would help to increase the understanding of benign pelvic tumors, and improve its level of diagnosis.

Materials and methods

General information

The Department of Orthopedic Oncology in Beijing Jishuitan Hospital treated 798 pelvic tumor cases from July 1958 to October 2011, consisting of 201 cases of benign tumors, 384 cases of primary malignant tumors and 213 cases of metastatic carcinomas. This study specifically analyzed the 201 cases of benign pelvic tumors.

The cases were all identified by clinical observation, biopsy or surgical pathology. In addition, they were confirmed by X-ray, computed tomography (CT) and magnetic resonance imaging (MRI). Recurring cases were not reported. Analyses and discussions were carried out based on the World Health Organization’s (WHO) histological classification of bone and soft tissue tumors (2002)[2]. According to the surgical staging system of pelvic bone tumors, the pelvis is divided into four areas: Areas I, II, III and IV refer to the iliac wing, the peri-acetabular areas, the pubic and sciatic areas, and the...
areas around the iliosacral joint, respectively.[3]

**Research methods**

Pathological data were sorted and the age and sex of patients were recorded. The age group in which pelvic tumors occurred was analyzed and the male-to-female ratio was calculated. The data were reviewed to determine the pathological types of tumors. Radiological data were examined to determine the anatomical sites and radiological features of the tumors. Based on the data, epidemiological features of all benign pelvic tumors were analyzed via the statistical analyses of sex, age, tumor types, positions and radiological features.

**Results**

**Gender and age distribution of patients with benign pelvic tumors**

There were 114 male and 87 female patients, with a male-to-female ratio of 1.31:1. The age range was 5–72 years old, with a median age of 28 years old and a mean age of 30 years old. The patients were categorized into 5 groups based on their age: ≤20, 21–30, 31–40, 41–50 and ≥50 years old. Figure 1 shows the number of patients: 58 (28.86%), 52 (25.87%), 54 (26.87%), 21 (10.45%) and 16 (7.96%), listed according to the aforementioned age groups.

**Pathological features of benign pelvic tumors**

Among the 201 patients, there were 59 cases of giant cell tumors (GCTs) of the bone, 53 cases of osteochondromas, 17 cases of simple bone cysts (SBCs), 15 aneurysmal bone cysts (ABCs), 14 cases of osteofibrous dysplasias, and 13 cases of chondroblastomas. The record also included 9 cases of Langerhans cell histiocytoses, 8 cases of bone hemangiomas, 7 cases of osteoid osteomas, 3 cases of benign fibrous histiocytomas, 1 case of parosteal lipoma, 1 case of osteoma, and 1 case of desmoplastic fibroma (Figure 2).

**Positions of benign pelvis tumors**

Table 1 shows the distribution of benign pelvic tumors of 201 patients based on tumor locations. There were a total of 79 tumor cases associated with Area I. The most common tumor was osteochondroma with 35 cases, followed by 15 cases of GCTs of the bone. SBCs and osteofibrous dysplasias each recorded 8 cases. For Area II, a total of 14 tumor cases were recorded with 5 cases of osteochondromas, followed by GCTs of bone (3 cases) and chondroblastomas (2 cases). There were 29 tumor cases associated with Area III, i.e., 17 cases of osteochondromas, 2 cases of GCTs of bone and 2 cases of chondroblastomas. Besides that, the occurrence of benign pelvic tumor was identified in more than one location. For Area 1 + II, there were a total of 24 tumor cases, with 6 cases of SBCs, 5 cases of ABCs and 4 cases of osteofibrous dysplasias. However, there were only 8
cases of GCTs and 1 case of ABC for Area I + IV. Meanwhile, there were 34 tumor cases associated with Area II + III, with the highest number attributed to GCTs of the bone (20 cases), followed by ABCs (6 cases) and chondroblastomas (3 cases). Moreover, 7 cases of GCTs of bone, 1 case of ABC and 1 case of chondroblastoma were identified in Area I + II + III + IV. There were 2 tumor cases in Area I + II + III + IV, with 1 case of ABC and 1 case of GCT.

**General radiological features of benign pelvic tumors**

Osteochondromas occurred as lesions growing outside the bone, while the other tumor types were lesions within the bone. Calcification shadows of the cartilage matrix could be seen via X-ray. A part of chondroblastomas, osteoid osteomas and osteomas were shown as bone lesions in osteogenesis, while GCTs, SBCs and ABCs were shown as osteolytic lesions.

**Clinical features of each common pelvic tumor**

**Giant cell tumor (GCT):** There were 59 cases of GCTs comprising of 23 male and 39 female patients, with a mean age of 37 years old. A total of 34 cases were located around the acetabulum and the tumors in 39 patients invaded 2 or more areas. It was shown as osteolytic lesions in radiology images and easily changed to a “soap bubble” state; edges damaged by the lesions changed to mesh shape and the hardening of the edges was not obvious. In 16 cases, the tumor broke through the bone cortex and spread through the bone. Particularly, 7 cases involved the ilium, acetabulum and pubeischium and another 8 cases extended through the sacroiliac joint, involving the sacrum. One case involved the ilium, sacrum, acetabulum, pubis and ischium. A single GCT case had an unclear lesion edge and the lesion strengthened significantly in contrast-enhanced CT.

**Osteochondroma:** There were 53 cases of osteochondromas consisting of 40 male and 13 female patients, with a mean age of 27.6 years old. The most frequent locations involved the ilium (35 cases) and pubeischium (17 cases), though not many areas were involved in the tumor formation. Bony prominences were observed on the outer surface of the bone cortex. Cortices with tumors merged with the host’s bone cortices and medullary cavities, as well as tumors connected to the host’s marrow cavities.

**Simple bone cyst (SBC):** There were 17 cases of SBCs involving 10 male and 7 female patients, with a mean age of 29.8 years old. All cases had single lesions. Among the 17 cases, 14 cases occurred in Area I or Area I + II. Osteolytic lesions with clear edges were observed. Some cases had hardened edges, while some had obvious bone swelling. However, CT scan suggested that liquidity and lesions were not obvious.
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Aneurysmal bone cyst (ABC): There were 15 cases of ABCs comprising of 10 male and 5 female patients, with a mean age of 21.1 years old. A total of 13 tumor cases occurred around the acetabulum. All cases had osteolytic damages and expansive growths. Smooth fluid was also observed. In 14 cases, the tumor invaded two or more areas and changed into a “soap bubble” state. Bone trabecula spacing could be seen inside the lesions and the edges were slender. In CT and MRI scans, lesions and clear fluid levels were observed.

Osteofibrous dysplasia: A total of 14 cases of osteofibrous dysplasias were recorded for 3 male and 11 female patients, with a mean age of 29.7 years old. The lesions were frequently observed around the ilium or acetabulum. In 8 cases, the tumor had invaded the ilium, while 6 cases involved two or more acetabulum-centered areas. All lesions showed cystoid transparent areas and expansive growths. Some lesions changed into “ground glass” states, appearing as shallow layers on the bone cortex.

Chondroblastoma: There were 13 cases of chondroblastomas consisting of 5 male and 8 female patients, with a mean age of 22.8 years old. The most frequent disease location was around the acetabulum and 5 cases involved two or more areas. The images were nearly circular or oval osteolytic lesions with clear edges and thin sclerotic margins. Calcifications inside the tumors were not obvious via X-ray, but typical calcifications could be seen via CT.

Langerhans cell histiocytosis: There were 9 cases of Langerhans cell histiocytes involving 7 male and 2 female patients, with a mean age of 27.4 years old. Frequent disease locations were in the region of the acetabulum or near the acetabulum. The lesions were circular or oval osteolytic with rapid progress and unclear edges. There was a slender hardened layer around some lesions. However, there was no soft tissue mass observed in both CT and MRI.

Bone hemangioma: There were 8 cases of bone hemangiomas involving 4 male and 4 female patients, with a mean age of 35 years old. Among the 8 cases, 4 cases occurred around the acetabulum. Osteolytic lesions with clear edges were observed via X-ray. Punctate shadows could be seen inside the lesions and the edges were strengthened slightly. Typical latticed bone trabeculae were uncommon and it was clearly observed in 3 cases via the CT scan compared to the X-ray. Lesions could be seen via enhanced CT scan.

Osteoid osteoma: There were 7 cases of osteoid osteomas for 6 male and 1 female patients, with a mean age of 17.9 years old. All patients had frequent confined pain around the acetabulum. Among the 7 cases, 5 occurred in the acetabulum, 1 in the ilium and 1 in the pubis. The lesions were either circular or oval, with a diameter <1 cm in 6 cases and <2 cm in 1 case. In CT scan, dense ossifying shadows were observed in the middle of the tumor with annular hardened belts. These images were clearer than the x-ray images.

Discussion

General situation for the onset of benign pelvic tumors

In comparison to the ratio of primary-to-benign pelvic tumors treated in our department (19.1:1), Unni and Inwards reported a ratio of malignant-to-benign tumors of 2.4:1 [4]. The incidence of benign pelvic tumors in the present study include GCTs, osteochondromas, SBCs, ABCs, osteofibrous dysplasias and chondroblastomas, while those reported by Unni and Inwards [4] were osteochondromas, GCTs, chondroblastomas, osteoid osteomas and osteoblastomas. Both reports are generally similar, but the number of reported GCT cases in this study were more than those of Unni and Inwards [3].

Age distribution for the onset of benign pelvic tumors

There were 164 patients aged <40 years old, accounting for 81.6% of the total number of patients. The peak age for the GCT incidence was between 30 and 40 years old, which is in accordance with the study by Unni and Inwards [4]. It is known that the peak age for the incidences of chondroblastomas, osteoid osteomas and ABCs is about 20 years old. Dahlin and McLeod reported that about 60% of chondroblastomas occurred between age 10 and 20 years old, and about 76% of osteoid osteomas occurred between age 5 and 24 years old [5]. Other researchers have also previously observed that 80% of ABC patients are within 20 years old [5,6]. The current data are relatively consistent with previous reports. The mean age of SBCs was 29.8 years old, higher than that of the previous study [7]. This might be attributed to the fact that the present group only included pelvic cases and the peak age for the incidence of pelvic bone cysts was >20 years old.

Meanwhile, the peak age for Langerhans cell histiocytes and osteofibrous dysplasias was about 30 years old, which is also higher than previously reported [2]. This might be a result of younger patients being treated separately at the Department of Pediatric Orthopedics.
Moreno et al. reported that the peak age for the incidence of bone hemangiomas was between 30 and 50 years old\(^8\). In our study, the mean patient age for this disease was 35 years old, which is consistent with the aforementioned report\(^8\). Patients with osteochondroma had stable symptoms and the age of incidence was closely related to the age at which the patient began treatment. Thus, the age of incidence had little significance in the diagnosis.

**Frequent location of benign pelvic tumors**

Among the 201 cases in this study, the locations of benign pelvic tumor were distributed around the acetabulum and some GCTs occurred near the sacroiliac joint. The acetabulum and sacroiliac joint inside the pelvis are similar to the metaphyseal long bone in terms of tumor susceptibility\(^9\).

**Clinical features of common pelvic tumors**

GCTs are common in metaphyseal long bone. GCTs occasionally occur in the flat bone and about 5% occur in the pelvis\(^6\). Imaging results showed osteolytic damage surrounded by mature cortical shells. These large lesions could expand to the bone cortex and change into a “soap bubble” state, which could then penetrate into the bone cortex and the soft tissue. In this study, GCTs exhibited a robust invasiveness. Some lesions with unclear edges became larger and grew extensively and they penetrated into joints and spread to other areas.

ABCs often occur in the long bone and vertebral column, which accounted for 60%–70% of the total incidence. ABCs in the pelvis had also displayed a robust invasiveness. One case had penetrated into the sacroiliac joint, involving the sacrum and ilium, while another case involved the ilium, acetabulum and ischium. In addition, 1 case involved the ilium, sacrum, acetabulum, pubis and ischium. The lesions were quite large and were observed as expansive osteolytic lesions. They changed from a “soap bubble” state to GCTs, but fluids were visible inside the lesions. A few blood vessels could be seen around the lesions via angiography, which were different from the tumor vessels of GCTs.

SBCs occurred in the tubular bone of 20-year-old patients. For patients >20 years old, cysts would occur in the ilium (2%) and calcaneum\(^7\). Among the 17 cases in this group, 15 cases had cysts in the ilium or near the acetabulum. Imaging results were relatively typical. Osteofibrous dysplasias occurred mostly in long bones and the ilium as well as the area near the acetabulum were frequent locations observed in this study. A total of 12 osteofibrous dysplasias cases were associated with Area I and another 12 cases in Area I + II. Imaging results showed expansive growths and thin cortices with no periosteal reactions. However, typical “ground glass” change did not occur in all cases. A frequent location of chondroblastomas is the osteoepiphysis of long bones, which accounted for 8.8% of the total cases in this study\(^4\). Lesions were distributed around the acetabulum\(^10\). Imaging results showed either nearly circular or oval osteolytic lesions with clear edges and thin sclerotic margins.

There were tumor calcifications in about half of the cases. Calcification in the pelvis was rarely reported but imaging results in this study were rather typical\(^11\). Langerhans cell histiocytoses mostly occurred in the flat bone of children, including the craniofacial bone or the metaphysis of long bones. Typical radiography has varying results. Fast-growing osteolytic damages were observed with inflammation surrounding them, showing unclear edges when the lesions develop. Lesions were distributed around the acetabulum and invaded a wide area. The edges of lesions were unclear and the lesions were at a development stage.

Bone hemangiomas, which often occur in corpus vertebrae and craniofacial bones, only accounted for 3% of the total occurrence in the present study\(^6\). Imaging results showed slightly expansive osteolytic damages with clear edges, and only 3 cases had a typical network of bone trabeculae. Osteoid osteomas often occur in the long bone and accounted for about 2.3% of the total incidence, with regular pain being a common feature of this disease. Lesions were circular or oval in shape, with lucent areas in the center; their diameters were shorter than 1 cm, surrounded by homogeneous hardened zones. Imaging results were atypical and only 1 case had a diameter of 2 cm.

As this study covered an extensive time period from July 1958 to October 2011, the age distribution of patients may have changed. Some lost patient data may result in unknown changes of the disease’s progression. Through this epidemiological survey, the highest occurrence of benign pelvic tumors was found in patients <40 years old. GCTs, osteochondromas, SBCs, ABCs and osteofibrous dysplasias are predominant tumors. GCTs and ABCs are invasive and may involve more than one area. Awareness towards rare illnesses such as Langerhans cell histiocytoses, bone hemangiomas and parosteal lipomas should be increased to avoid any misdiagnosis. Clinical diagnoses, treatments and research are vital in ensuring cases of bone tumor are registered in a timely manner and accurately. The creation of databases and the
use of statistical analyses would improve our understanding of bone tumors’ epidemiology.

**Conflict of interest**

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

**References**


