Percutaneous treatment of symptomatic intra-osseous ganglion cysts by injection of calcium phosphate cement.

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Purpose

Intraosseous ganglion cysts (IOGC) are relatively uncommon comparing to other ganglia. They are located in the subchondral bone adjacent to a joint and most frequently involve the hip, the ankle, the knee and the carpal bone(1) (2) (3). Most authors consider such cysts as an extrusion of synovium through a defect in a wall of the joint (1). For others, it is an intraosseous synovial metaplasia (1) (4). According to this second hypothesis the communication with articular space is not required (1). IOGC are filled with a viscous mucoid jelly-like material (1). They are surrounded by a fibrous membrane of variable thickness resembling synovium on imaging but a true continuous synovial layer is uncommonly found on pathological findings (1) (5).

Trauma and degenerative disease facilitate cyst growth and development. Nevertheless, IOGC are usually symptomatic in young people (1) without advanced degenerative disease. Pain is generally of mechanical origin (elevation of pressure, edema, synovitis, fracture). It is of increasing intensity and poorly relieved by analgesics.

Radiographs could show the cyst if it is large enough. CT is the technique of choice because of its higher resolution. On radiographs and CT, IOGC appear as well-defined oval or circular osteolytic area usually situated eccentrically at the end of long bone (FIG. 1). They are generally located close to the subchondral layer of the cortex which is often thin and sometimes expanded. The cyst is usually outlined by a thin rim of sclerotic bone (2). Large cysts are often multilocular (FIG. 2). Arthrography may demonstrate a communication between the cyst and the articular space (FIG. 3). In this purpose, late acquisition and high pressure applied to the articulation are sometimes required. CT can show additional degenerative joint disease and rarely gas content within a cyst (FIG. 4).

On MRI, typical findings include increased T2 signal intensity and low to moderate T1 signal intensity. No enhancement is seen within the cyst with contrast infusion, but can be present around the cyst (4). Some reports note low intensity on T2 images due to blood products or calcium within the cyst (FIG. 5 and 6).

Other para-articular cystic lesions could be: degenerative cyst (geodes), unicameral bone cysts, aneurismal bone cysts, post-traumatic cyst, rheumatic cyst (4). It is also very important to recognize as possible differential a giant cells tumor, metastatic disease, plasmocytoma or a cartilaginous lesion like chondroblastoma (1) (2). The final diagnosis of IOGC could generally only be obtained by pathological analysis. Biopsy or curretage is often non-diagnostic (2).
IOGC are generally asymptomatic. A cyst could be defined as active if: subsequent radiographic studies reveal an increase in its length or width, the patient has functional pain, there is edema around the cyst on MRI (FIG. 7), or pathological fracture (extremely uncommon) (5).

Symptomatic IOGC are classically managed with non steroidal anti inflammatory medication and a marked decrease in activities. Surgical management is indicated when the lesion remains symptomatic, if it is close to cortical articular bone with significant fracture risk (localization, size) or if the cyst is active (3). The surgical treatment depends on the age of the patient, his activity and motivation. Open curettage with autologous bone grafting is typically performed (evacuation, curettage and grafting) (2) (6).

Percutaneous injection of acrylic cement has been described in the literature to successfully treat bone lesions including lytic metastases (7) (8) (9); as well as vertebral compression fractures caused by osteoporosis and vertebral hemangiomas (9).

In addition, interesting results have been reported following percutaneous procedures with calcium phosphate bone cement injection or bone substitute injection for the treatment of others bone lesions: unicameral bone cysts (10), femoral neck lesion (11), amyloid bone cysts (12), aneurysmal bone cysts (13), solitary calcaneal cyst (14).

The purpose of this study was to describe the treatment of painful IOGC by percutaneous injection of CPBC under CT and fluoroscopic control in five patients and to evaluate clinical outcomes.
Fig. 0: Coronal CT of the hip before procedure: there is a well-defined circular osteolytic area close to the thinned cortex with focal defect. The defect is close to the subchondral layer of the affected bone and is outlined by a thin rim of sclerotic bone.

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**Fig. 0:** Axial CT of the knee (tibial plateau): the cyst is multilocular with septas.

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**Fig. 0:** Coronal CT of the knee with intra-articular injection of contrast agent: communication of the cyst with the articular space through focal chondropathy.

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Fig. 0: Coronal CT of the ankle before the procedure: there is a well-defined circular osteolytic area close to the thinned cortex with focal defect. The defect is close to the subchondral layer of the affected bone and is outlined by a thin rim of sclerotic bone.

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Fig. 0: Coronal T1 MRI of the hip before procedure: the cyst appears with low T1 signal intensity.

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Fig. 0: Coronal T2 MRI of the hip before procedure: the cyst appears with high T2 signal intensity.

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**Fig. 0:** Coronal dp fatsat MRI of the knee: edema around the multilocular cyst of the tibial plateau.

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Methods and Materials

Patients

From July 2003 to July 2009, five patients with a diagnosis of active and painful IOGC were referred to our center (3 men, 2 women, mean age of 35 years). The treatment was explain to the patients. There was no history of focal trauma (except one patient number 3 without direct relation between the trauma and the cyst) and pre-existing inflammatory condition. The diagnosis was based on characteristic radiographic, CT and MRI features. These exams eliminated other cause of pain. All the patients had functional pain. The cysts involved the hip in one case (acetabular cup), the knee in one case (tibial plateau), and the ankle in three cases (tibial pilon, talus and calcaneum). Data were retrospectively collected regarding age, sex, anatomic location, symptoms, pain (analogic visual evaluation of pain (AVE)), duration of symptoms, medication, history of trauma or articular inflammatory disease, size (length, width and volume on CT reconstructions). Radiographic, CT and MRI findings and laboratory findings were noted (table 1).

Technique

All procedures were performed under neuroleptanalgesia or rachianesthesia. A 10-gauge needle of vertebroplasty (Optimed, Ettlingen, Germany) was placed into the cysts under fluoroscopic and CT control (SOMATON Definition AS, Siemens, Erlangen, Germany). The access route of the needle was decided on CT multiplanar reconstructions (FIG. 1 and 2). Cystograms with contrast material (Visipaque 270, GE healthcare, Carrigtohill, Ireland) diluted to 50% with sterile saline solution prior to injection never revealed a communication with the articulation (FIG. 3). Cystogram is difficult to obtain and a guide-wire could be used to check if there is septa on the cyst (FIG. 4).

A fluid aspiration was difficult to obtain because of the typical myxoid-appearing content and negative pressure inside. In one case, a biopsy was made using a bone biopsy needle (Ostycut, BARD angiomed, Karlsruhe, Germany) into the cyst and its wall.

A spacer (curette, Kyphon, Sunnyval, USA) was used in three cases to create a cavity and to destroy any septa (FIG. 5). One centimeter balloon (Kyphon, Sunnyval, USA) was inflated at 400 PSI inside the cyst in two others cases (FIG. 6). In the last case, a double needle technique was used (Bonopty penetration set, RADI Medical Systems, Uppsala,
Sweden): injection of a saline solution into the first needle should be associated with the immediate efflux of solution from the second needle (FIG. 7).

After irrigation or after spacing techniques, the cyst was refilled with contrast material to monitor injection of cement.

The injection of cement was performed under fluoroscopic and CT control. Acrylic cement was used in the second case (Osteopal V, Heraeus Medical, Wehrheim, Germany) and CPBC (JectOS+, Kasios, Launaguet, France) in the other four cases (FIG. 8 and 9).

Follow-up

All the five patients had a physical examination few weeks after the procedure. Data were retrospectively collected regarding pain, range of motion, fewer, medication, time pain down.

Two patients (number 3 and 4) had CT and MRI after the procedure (details below).

All the patients were contacted by phone on August 2009 to ask for pain, activities, medication, and last complication (table 1). Three patients had a follow-up visit with physical examination. The periods of follow-up is ranging from 2 to 73 months.

Data were retrospectively collected regarding the time procedure, the number and the kind of needles, the use of a spacer, the volume injected, the pain control during the procedure, the immediate complication, the time of hospitalization (table 1).
Images for this section:

**Fig. 0:** Axial CT of the iliac bone: the vertebroplasty needle of 10 gauges on an anterolateral approach is inside the cyst.

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**Fig. 0:** Axial CT during procedure: the vertebroplasty needle of 10 gauges on an anterolateral approach with a good axis to reach the cyst.

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**Fig. 0:** Axial CT of the iliac bone during the procedure: injection of contrast agent in the cyst by a 10 G needle is difficult.

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**Fig. 0:** Lateral fluoroscopic view of the calcaneum: a guide-wire is used to eliminate any septa inside the cyst.

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**Fig. 0:** Anteroposterior fluoroscopic view of the knee: management of the procedure of cavitation with a spacer on fluoroscopic control.

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Fig. 0: Axial CT of the tibial plateau during procedure: kyphoplasty balloon full of contrast agent in the cyst.

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Fig. 0: Anteroposterior fluoroscopic view of the hip: the two needles are placed under fluoroscopic guidance.

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Fig. 0: Anteroposterior fluoroscopic view of the hip: two needles are placed with fluoroscopic guidance. Full packing of the cyst without leakage.

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Fig. 0: Axial CT of the iliac bone at the end of the procedure: there is full packing of the cyst by CPBC.

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Results

Results

Data are summarized in table 1.

Procedure

The amount of cement that was injected average 2.1 mL (range, 0.6 to 3.5).

There was no immediate complication and no leaking of cement.

Pain and disability - follow up

The mean age of patients is 35 years old (range, 27 to 38). The period of following is from 73 months to 2 months. The average period of following is 25 months (range, 3 to 73).

Two patients were under morphine therapy before procedure. One patient (number 5) kept AINS because of back pain. Before procedure, 3 patients were unable to walk and 2 other patients must stop walking after one hour.

All patients reported complete pain relief at an average of 3 weeks (range, 1 to 4). All the patients recovered full activities. The average time until the patients returned to full, unrestricted activities was 5 weeks (range, 2 to 10). Four patients stopped medics.

One patient (number 3) presented osteopenia around the cyst and cement displacement one year after the procedure.

Another patient (number 4) complained of a different ankle pain 10 months after the procedure, which lasted for three months. There were no significant CT and MRI abnormalities.

Imaging

We could analyze three MRI exams before procedure with edema around the cyst (FIG. 7). The communication between the cyst and the articular space was not seen on MRI.
and CT exams. The greatest dimension of the cysts, as measured on CT, average 16 mm (range, 8 to 30).

Three lesions were completely fulfilled (FIG. 1). Two were partially filled, one because of a doubt of synovial leaking another because of mucoid residual defect. In one patient (number 3) edema and osteopenia of the tibial pilon with CPBC outside the cyst, corresponding to neurodystrophia and cement displacement, were found on CT and MRI realized one year after the procedure (FIG. 2).

New bone formation was observed in one patient (number 4) without mobilization of the CPBC into the cyst (FIG. 3).

**Pathology**

A biopsy was performed on the case number 5. The pathologist found fibrous membrane of thin thickness without synovial layer compatible with a wall of an unicameral bone cyst or an IOGC.

<table>
<thead>
<tr>
<th></th>
<th>Patient number 1</th>
<th>Patient number 2</th>
<th>Patient number 3</th>
<th>Patient number 4</th>
<th>Patient number 5</th>
</tr>
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<tr>
<td><strong>Sex</strong></td>
<td>male</td>
<td>male</td>
<td>female</td>
<td>male</td>
<td>female</td>
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<tr>
<td><strong>Age</strong></td>
<td>35 years</td>
<td>40 years</td>
<td>27 years</td>
<td>38 years</td>
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<tr>
<td><strong>Period of following</strong></td>
<td>73 months</td>
<td>27 months</td>
<td>16 months</td>
<td>8 months</td>
<td>3 months</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>ANKLE / calcaneum</td>
<td>KNEE / tibial plateau</td>
<td>ANKLE / tibial pilon</td>
<td>ANKLE / talus</td>
<td>HIP / acetabular cup</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>Impossible to walk</td>
<td>VAE 9/10</td>
<td>1 hour walking</td>
<td>impossible to walk</td>
<td>half an hour walking</td>
</tr>
<tr>
<td></td>
<td>VAE 9/10</td>
<td>VAE 9/10</td>
<td>VAE 9/10</td>
<td>VAE 8/10</td>
<td>VAE 7/10</td>
</tr>
<tr>
<td><strong>Duration of pain</strong></td>
<td>1 month</td>
<td>12 months</td>
<td>3 months</td>
<td>1 year</td>
<td>3 years</td>
</tr>
<tr>
<td>Medication</td>
<td>NSAI</td>
<td>NSAI</td>
<td>NSAI and morphine</td>
<td>NSAI</td>
<td>NSAI and morphine</td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td>------</td>
<td>-------------------</td>
<td>------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Medical history</td>
<td>none</td>
<td>none</td>
<td>trauma 5 years ago</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>XR (visible)</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>MRI</td>
<td>no MRI</td>
<td>oedema</td>
<td>no MRI</td>
<td>oedema</td>
<td>oedema</td>
</tr>
<tr>
<td>Laboratory findings</td>
<td>normal range</td>
<td>normal range</td>
<td>normal range</td>
<td>normal range</td>
<td></td>
</tr>
<tr>
<td>Greatest dimension of the cyst</td>
<td>25 mm</td>
<td>30 mm</td>
<td>9 mm</td>
<td>8 mm</td>
<td>19 mm</td>
</tr>
<tr>
<td>Time procedure</td>
<td>60 minutes</td>
<td>60 minutes</td>
<td>70 minutes</td>
<td>50 minutes</td>
<td>80 minutes</td>
</tr>
<tr>
<td>Spacer</td>
<td>guide-wire</td>
<td>kypho balloon</td>
<td>kypho balloon 400 PSI 1cm diameter</td>
<td>spacer (septas)</td>
<td>no</td>
</tr>
<tr>
<td>Number of needles</td>
<td>one of 10 G</td>
<td>one of 10 G</td>
<td>one of 10 G</td>
<td>one of 10 G</td>
<td>two needles (one of 10 G and bonoptya)</td>
</tr>
<tr>
<td>Volume injected</td>
<td>3.5 mL CPBC JECTOS+</td>
<td>3.5 mL acrylic OSTEOPALV</td>
<td>0.6 mL CPBC JECTOS+</td>
<td>?</td>
<td>2.2 mL CPBC JECTOS+</td>
</tr>
<tr>
<td>Pain control</td>
<td>Rachi anesthesia</td>
<td>Rachi anesthesia</td>
<td>neurolept analgesia</td>
<td>Rachi anesthesia</td>
<td>neurolept analgesia</td>
</tr>
<tr>
<td>Immediate complication</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no partial packing</td>
</tr>
<tr>
<td>Time hospitalisation</td>
<td>1 day</td>
<td>1 day</td>
<td>1 day</td>
<td>1 day</td>
<td>1 day</td>
</tr>
<tr>
<td>Medication stop</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>2 weeks NSAI</td>
<td>1 week NSAI paracetamol</td>
</tr>
<tr>
<td></td>
<td>0/10</td>
<td>0/10</td>
<td>2/10</td>
<td>0/10</td>
<td>2/10</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------------------</td>
<td>--------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>Pain (VAE)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>normal</td>
<td>bicycle, soccer</td>
<td>walking and jogging</td>
<td>jogging</td>
<td>walking but keep back pain</td>
</tr>
<tr>
<td><strong>Time pain down</strong></td>
<td>3 weeks</td>
<td>4 weeks</td>
<td>3 weeks</td>
<td>4 weeks</td>
<td>1 week</td>
</tr>
<tr>
<td><strong>Last complication</strong></td>
<td>no</td>
<td>no</td>
<td>Neurodystrophy</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Diffusion of CPBC</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Biopsy</strong></td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>16 G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fibrous membrane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>no continuous</td>
<td></td>
<td>synovial layer</td>
</tr>
<tr>
<td><strong>MRI after procedure</strong></td>
<td>no</td>
<td>no</td>
<td>one year after oedema</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td><strong>CT after procedure</strong></td>
<td>no</td>
<td>no</td>
<td>one year after cement around the cyst and osteopenia</td>
<td>partial new bone material packing the cyst (10 months because different pain)</td>
<td>no</td>
</tr>
<tr>
<td><strong>Follow-up findings</strong></td>
<td>no pain (phone)</td>
<td>no pain (phone)</td>
<td>no pain (physical examination and phone)</td>
<td>no pain (physical examination and phone)</td>
<td>no pain (physical examination and phone)</td>
</tr>
</tbody>
</table>
Fig. 0: Sagittal CT of the talus after procedure: the CPBC is very close to the bone cortex and full packs the cyst.

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Fig. 0: Coronal CT of the tibial pilon after procedure: the CPBC is outside the cyst on an area of osteopenia.

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Fig. 0: Coronal CT of the ankle 10 months after the procedure: there is a neo-formation of bone around the cement in the cyst.

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Conclusion

CONCLUSION

We describe the technique of percutaneous injection of intraosseous ganglia using calcium phosphate cement. We injected under the guidance of CT and fluoroscopy a group of five patients with pain caused by paraarticular intraosseous cyst from April 2007 to July 2009. All patients had relief of pain and recovered activity over varying periods of follow-up (ranging from 2 to 28 months).

Percutaneous injection of CPBC of intraosseous ganglia is a relatively novel treatment that merits further consideration. In our study of five patients it appears to be very efficient. It appears to be a minimally invasive and low-cost procedure that provides immediate and long-term pain relief.

Before becoming the norm this treatment of an unusual pathology has to be evaluated. Further study with a greater group of patients are required and a longer period of following. Of course further comparisons of this technique with other conventional techniques, such as classical surgery or minimal invasive surgery, are still needed to precisely define the role of percutaneous injection of PCBC in the treatment of symptomatic IOGC.

DISCUSSION

The diagnosis of IOGC among many others intraosseous cysts is not easy. If there are a lot of signs of degenerative disease with global degenerative destruction of the joint, the treatment should be the one of osteoarthritis (with sometimes joint replacement). When IOGC seems to be developed on a focal chondropathy or seems to be idiopathic, surgical treatment of the cyst could be done on a classical approach.

Bone autografts are considered to be the definitive standard for the reconstruction of bone defects (autogenous iliac crest bone). Surgical treatment is generally efficient. Recurrence of the cyst is uncommon (5) (1). Nevertheless, the use of surgical treatment is associated with significant disadvantages including: donorsite morbidity (3 % of infection, 40 % 6 months pain (15)), intraoperative blood less, increase operative time, unpredictable resorption of bone grafting, infection, morbidity like thrombophlebitis, length of hospitalization, immobilization. Furthermore adequate surgical exposure for proper placement of bone graft increase the risk of post operative complication related to more extensive dissection.
We decided then to use a percutaneous technique with cement injection under CT and fluoroscopic guidance like treatment of vertebral hemangiomas. Here we touch again on a technique that has been described in the literature to successfully treat bone lesions including lytic metastases (7) (8) (9); as well as vertebral compression fractures caused by osteoporosis and vertebral hemangiomas (9).

Bone cements are attracting alloplastics materials because of their unlimited supply, and ease of use. Calcium-based alloplastic materials are bioactive and biodegradable grafting material (16). CPBC have received widespread attention for their possible role as bone-grafting material and bone fillers in skeletal defects (17). A radiological and mechanical study of 28 sheep fractures indicates this material is a potential alternative for autologous bone grafting (18). They are accepted as highly biocompatible materials. They become injectable paste after mixing, self-hardening and recrystallizing to hydroxylapatite after injection into a living body (18) (17) (16). Minimal invasive surgery like endoscopic curettage with percutaneous injection of CPBC (14) has been proposed as an alternative to open surgery.

Two patients were under morphine therapy before procedure. That emphasize how painful IOGC could be. We demonstrate that, with the use of this technique, the time to healing is very short and patients return to full activities without restrictions once there is no functional pain. This pain relief is probably attributable to destruction of sensitive nerve endings in surrounding tissue by vascular, chemical thermal and mechanical effect. Time pain down is from 1 to 4 weeks. NSAI should be used during this period.

In three patients we observed a complete packing of the cyst. In one patient (number 4) there was a diffusion of the cement probably because of osteopenia and neurodystrophia around the cyst. We do not know if the neurodystrophia was present before procedure (there was edema on MRI) or if it was a consequence of the procedure. In another patient we could not full packing the cyst because we stopped injecting CPBC when the cement threatened reaching the joint.

A biopsy was performed on the case number 5. The pathologist found fibrous membrane and no continuous synovial layer. It is compatible with a wall of an unicameral bone cyst or an IOGC. The cellular nature of an intraosseous ganglion cyst remains somewhat controversial because histological evaluation is not frequently undertaken, and the diagnostic is usually made on the basis of the radiographic findings.
In one patient at CT follow up visit we observed bony integration with partial bone packing of the cyst and illustrated progressive restoration of the physiological proportion of bone and process of degradation of CPBC.

A fever and transitory worsening in pain may occur secondary to inflammation reaction in the hours following injection (7) (9) (10). All our five patients did not have pain or fever. Using CPBC may be minimizing these sides effects. A good pain control during the procedure is necessary. Non steroidal anti-inflammatory drugs may be administrated after the procedure.

Our five patients had no complications.

Interestingly, there have been no late recurrences of cyst and pain.

Leakage of bone cement into the joint space represents the principal risk (7). We described a rapid chondrolysis after an intra-articular leak of acrylic bone cement during injection of an acetabular subchondral cyst resulting in hip replacement (19). It is essential to systematically search for the presence of an intra-articular passage by a cystogram before injecting bone cement into a peri-articular cyst. This test must be done of high articular pressure (19). Generally, the lack of intra-articular penetration of the contrast agent is most likely due to the different pressures necessary to inject the two products, as the pasty consistency of the cement requires a pressure of at least 7 bars. This high pressure probably provokes the clearance of a narrow channel between the cyst and the intra-articular space. This risk increases when there is a destruction of the articular wall and cement with a liquid consistency is injected. CPBC seems to be more safety comparing to acrylic cement. The two needles technique with efflux of saline and contrast agent then of cement during injection is certainly a good way to avoid leakage by decrease of pressure during injection as the use of fluoroscopic -CT control. We think that using a spacer is a good way to make a clear cavity and minimize pressure and leakage (kypho balloon, spacer).

Cement leak could appear toward soft tissue and veins but are not often symptomatic. This should not automatically dictate the cessation of the procedure. The risk of leaking in soft tissue depends on the location of the cyst and the access route. For example compression of the sciatic nerve by cement during acetabuloplasty has been described. One case of soft tissue necrosis following using calcium phosphate cement in calcaneal bone cyst is described (20).

One case of asymptomatic heterotopic ossification at the needle site is described and one case of myositis treated with oral anti-inflammatory medication (10).
Other potential complications include vascular injury, nervous injury and infection.

Some study report microfragmentation of the cement and infection(17).

It's highlight the need for vigorous evaluation of the benefits and risks of percutaneous injection of calcium phosphate cement in the treatment of benign lesions, especially close to an articulation (19).

The decision to use percutaneous injection of CPBC should be made by a multidisciplinary team because the choice between this option and surgery depends on several factors. This factor include the location of the lesion, the pain and functional disability experienced by the patient, the access route, the size of the lesion.

It is difficult to round up a lot of patients who suffer from symptomatic IOGC. Our study is very small but, to our knowledge, it is the first which includes five patients treated by percutaneous injection of CPBC. We need a longer period of following. Our study is retrospective and not comparative.
References

BIBLIOGRAPHY


