X-ray diagnostics and endoprothesis replacement of knee joints when hemophilic arthropathy of the people of Kazakhstan

Poster No.: C-0808
Congress: ECR 2015
Type: Educational Exhibit
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Keywords: Trauma, Image verification, Demineralisation-Bone, Treatment effects, Surgery, Diagnostic procedure, MR, CT, Absorptiometry / Bone densitometry, MR physics, Haematologic, Bones
DOI: 10.1594/ecr2015/C-0808

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Learning objectives

Learn to evaluate the role of integrated use of standard X-ray methods and computed tomography in evaluation of severity of joint destruction in patients with hemophilia.
Background

One of the head symptoms of hemophilia are bleeding in large joints. They account for about 60-70% [1]. They frequently occur after injury, with transition chronic phase, followed by progression of arthropathy, result of which - rough deforming changes and early disability among patients with hemophilia [2].

Timely diagnosis and treatment of joints changes with hemophilia in early stages of their formation can significantly affect prognosis of disease [3, 4]. Due to development of new technologies, we have new opportunities to detect changes osteoarticular system and soft tissues patients with hemophilia with using x-ray, computed tomography, magnetic resonance imaging, ultrasound, scintigraphy [5, 6]. Magnetic resonance imaging allows us to identify early joints changes and periarticular tissues of hemophilic arthropathy [6, 7]. In recent years computed tomography (CT) widely used for detecting even small changes of bone structure with hemorrhages into joints. But we don't have information about using CT for verifying stage of progression of hemarthrosis, no clear description of computer tomograms at various stages hemophilic arthritis [6, 8].

According to our colleagues [4, 9] and our opinion, complexity of "replacement" large joints such patients can be regarded as at 1/10 "total hip arthroplasty" and 1/20 at "knee replacement". There is one operation conducted patients with hemophilia, complexity is equivalent to 10 or 20 operations, routine patients.

Implementation in practice of health densitometric devices allows you to control level BMD of periprosthetic region and in postoperative period to prevent instability of implant and improve knee replacement surgery [9, 10, 11].
Findings and procedure details

The work is based on an analysis of results of examination and treatment of 65 patients with hemophilic arthropathy of large joints. They treated in specialized department of replacement orthosurgery and polytrauma JSC JSC "National Scientific Center of emergency medical care", Astana. All patients with hemophilia A, except for hematological studies to determine the volume of orthopedic care at admission and after surgery, joint replacement beam used methods: X-ray, CT and MRI, rentgendensitometry, ultrasound osteometry.

We used the clinicoradiological classification EZ Novikova (1967) when using standard X-ray to assess severity of joint destruction in patients with hemophilia. It found according to X-ray of the 104 examined knee in 26% revealed no pathology (although the patients complained of pain in the joints), I stage set to 5.8%, II stage - in 6.7%, 37.5%, IV stage 24.4%, during the examination of the hip joints - III-IV stage.

X-ray computed tomography widely used for pathology of joints. We evaluated progression hemophilic osteoarthritis with using standard radiography and computed tomography in order to accurately determine bone changes at different stages of osteoarthritis.

Stage 1: the x-ray: height of joint space is not reduced or decline slightly (to 10%), marginal osteophytes and subchondral cysts are absent (Fig. 1); on computer tomograms: subchondral cysts with sporadic sclerotic rim, minor subchondral sclerosis, thickening of joint capsule, glomerular bone structure in edge of articular ends as a sign of osteoporosis unexpressed.

Stage 2: the x-ray: small (from 10 to 25-50%) reduction height of joint space, isolated small osteophytes; on computer tomograms: 2-3 small subchondral cysts with sclerotic rim, sometimes with breaking line, local subchondral sclerosis in tibiofemoral or patella-femoral joint region, regional erosion in subchondral epiphysis, joint contours rough, intercondylar eminence is edgy with small defects on lateral surfaces of articular ends, bone structure is glomerulal, cellular (Fig. 2).

Stage 3: the x-ray and computer tomograms deformation of articular ends, reducing height of joint space of more than 50%, subchondral layer is destroyed due to single large or 3 small marginal osteophytes or more, 2-3 large or 3-5 small subchondral cysts and more; on computer tomograms as in aseptic necrosis - signs of depressed fracture (Fig. 3), moderate subchondral sclerosis, intercondylar eminence smoothed and destroyed, bone structure of metaphysis glomerular.

Stage 4: the x-ray and computer tomograms articular surface is deformed, flattened, joint space narrowed or complete obliteration of the interosseous space, with fibrous and most bony ankylosis, large marginal osteophytes, 4-5 large subchondral cysts in subchondral layer, significantly pronounced common subchondral osteosclerosis (fig. 4);
on computer tomograms increase CT density areas of depressed fracture, displacement of patella and its various deformation, osteoporosis as a major cellular structure. It marked erosion or bone defects, from compression of chronic hematomas, areas osteosclerosis on radiograms and increase density in CT densitometry surrounding soft tissues due to calcified hematomas (fig. 5).

CT, unlike X-rays, has high sensitivity characteristics in diagnosis of hemophilic arthropathy (91.8% and 72.7%, respectively), whereas specificity of radiography superior CT specificity (86.4% and 71.3%). The combination of X-rays + CT increases sensitivity to 96.7%, at the same time ratio of TM and DS is optimal (3: 2).

We revealed osteopenia and osteoporosis in all patients with hemophilia using ultrasound osteometry and X-ray densitometry. It was basis for prescribing calcium early in postoperative period to prevent instability of implant components. On basis of diagnosis and determine degree of joints dysfunction we have developed algorithm of complex treatment of patients with hemophilic arthropathy, which included knee replacement.

Evaluation of bone mineral density was performed at 3, 6 and 12 months after hip replacement and compared with baseline during treatment of osteoporosis. For comparison, we take a group of operated patients who were not taking calcium supplements.

We revealed influence of anti-osteoporetic drugs to prevent bone loss in areas of implant. In group of patients without treatment it showed progressive decrease BMD after 6 months almost 2 times. By the end of the year people taking drug are marked signs of recovery BMD (p # 0.05), and patients without treatment of osteoporosis are showed - slowing down recovery process, which increase risk of instability of knee joint prosthesis.
Fig. 1: Radiographs of the right knee in the frontal and lateral projections patient 15 years with hemophilia A, a severe course, range of motion is not broken

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Fig. 2: A series of CT images in the axial projection and MPR image reconstruction of the same patient

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**Fig. 3:** A series of CT scans of the left knee joint in the axial projection and MPR- and 3D-reconstruction patients 33 years with hemophilia A, a severe course, with Haemophilus arthrosis grade 3

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**Fig. 4:** Knee radiographs patient line projection of the patient 40, with Haemophilus arthrosis right and left knee grade 4

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Fig. 5: A 3D-reconstruction of the image of the same patient

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Conclusion

Our experience of highly specialized medical care to patients with hemophilia in Kazakhstan with active implementation of early surgical rehabilitation of affected joint contributed to increase number of positive results was due to recovery of life's quality of patients in this category. Using wide arsenal of methods of diagnostics like X-ray, ultrasound and magnetic resonance imaging has allowed to assess joints' changes in hemophilic arthropathy.

Our method of semiquantitative evaluation of hemophilic osteoarthritis's progression by standard X-ray, computed tomography data supplemented with detailed X-ray tomographic semiotics various stages of hemophilic arthropathy, with diagnostic sensitivity of 96.7% can serve as practical guidelines for physician radiologists, hematologists, orthopedic traumatologist. Timely establishment of changes in joints with hemophilia promotes appointment of adequate therapy, which can affect prognosis of disease evolution and reveals indications for total joint replacement.

They play an important role in evaluation of disease's dynamics, in planning of operations and timely prevention of severe complications of hemophilic arthropathy. Conducting of osteodensitometry allows to control bone mineral density's level of periprosthetic region and to prevent instability of endoprosthesis in postoperative period.
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