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NON-INFECTIOUS COMPLICATIONS OF TOTAL HIP ARTHROPLASTY THAT ARE NOT ASSOCIATED WITH INSTABILITY OF COMPONENTS

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We analysed outcomes of 369 cases in 364 patients with complications after total hip arthroplasty. In this study we focused on cases with non-infectious complications of total hip arthroplasty that are not associated with instability of components which included prosthetic head dislocations, paraarticular heterotopic ossification, periprosthetic fractures of the femur, pain in replaced joint (not associated with the instability). The effectiveness of surgical elimination of the dislocations was significantly higher compared to the closed reposition. The only efficient method to manage heterotopic ossification was its prompt removal. Open reposition, followed with metal osteosynthesis, was the only effective remedy for 100% of periprosthetic fractures. In case of vertebrogenous pain syndrome, the best results had patients with lesions of posterior column of the lumbar spine.

Keywords: hip joint, complications of arthroplasty, dislocation, heterotopic ossification, periprosthetic fracture, revision prosthetics.

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НЕІНФЕКЦІЙНІ УСКЛАДНЕННЯ ЕНДОПРОТЕЗУВАННЯ КУЛЬШОВОГО СУГЛОБА, ЩО НЕ ПОВ'ЯЗАНІ З НЕСТАБІЛЬНІСТЮ КОМПОНЕНТІВ

Ми проаналізували результати 369 випадків у 364 пацієнтів з ускладненнями після тотального ендопротезування кульшового суглоба. У цьому дослідженні ми зосередили увагу на випадках з неінфекційними ускладненнями тотальної ендопротезування кульшового суглоба, які не пов'язані з нестабільністю компонентів, які включали вивихи голівки ендопротеза, параартикулярну гетеротопічну осифікацію, перипротезні переломи стегнової кістки, біль у оперованому суглобі (не пов'язаний з нестабільністю). Ефективність хірургічного усунення вивихів була значно вищою порівняно із закритою репозицією. Єдиним ефективним методом лікування гетеротопічної осифікації було її швидке видалення. Відкрита репозиція з подальшим остеосинтезом була єдиним ефективним засобом для 100% перипротезних переломів. У разі вертеброгенного більового синдрому найкращі результати мали пацієнти з ураженням заднього стовпа поперекового відділу хребта.

Ключові слова: кульшовий суглоб, ускладнення ендопротезування, вивих, гетеротопічна осифікація, перипротезний перелом, ревізійне ендопротезування.

The work is a fragment of the research project "To develop new and improve existing methods of diagnosis and treatment of patients with coxarthrosis with concomitant pathology of the spine", state registration No. 0119U001022.

Due to the wide implementation of total hip arthroplasty (THA) into clinical practice, the number of associated mistakes and complications is constantly growing. According to different authors, their frequency ranges from 7 % to 30 %. The most commonly encountered are: aseptic instability of components, prosthetic head dislocations, heterotopic ossification, periprosthetic femur fractures, infectious complications [1].

Femoral head dislocations in the postsurgical period remains one of the most severe complications after these surgical operations, and in 7.8 % of cases leads to a revision. This complication occurs quite frequently and worsens the results of arthroplasty, sometimes leading to a secondary infection.

Heterotopic ossification around a total prosthesis can spoil the outcome after the surgery. In such a case, the patient will need repeated operations. According to different authors, this complication occurs in 15–25 % of patients. The causes of such complication's development remain unknown. In some patients, the prostheses serve more than 15 years without the ossification, and others can encounter restrictions in their range of motions even in 3–6 months after the operation [2, 4, 10, 11, 12].

Periprosthetic femoral fractures relate to very problematic complications. As a rule, they demand urgent surgical management for reposition and stable fixation of fragments, or for revision arthroplasty, to replace a femoral component or the complete hip prosthesis [3, 6, 8, 9, 13].

Development of certain complications after the total hip arthroplasty demands revision surgeries; their number is growing every year, in Ukraine as well. To prevent the occurrence of these severe conditions in the future, the orthopaedic surgeons undoubtedly shall perform a deep analysis of their backgrounds.

The purpose of the study was to evaluate backgrounds of complications after total hip arthroplasty and outcomes after the treatment.

Materials and methods. We performed detailed analysis of clinical material to study the structure of aseptic complications THA that are not associated with instability of components. The study involved 364 patients, 369 cases of total hip arthroplasty, operated from 2005 to 2018 and having the following complications: prosthetic head dislocations – 41 cases (11.1 %), periarticular heterotopic ossification – 30 (8.0 %), periprosthetic femoral fractures – 25 cases (6.8 %), pain in the joints replaced (not associated with the instability) – 35 (9.5 %).

Dislocations of the endoprosthetic head are divided by localization (front and rear), by number (single and recurrent), by time of occurrence (early and late), by etiological factor (primary traumatic and secondary, due to wear of the polyethylene liner). Dislocation of the head of hip arthroplasty dominated in young and middle-aged people (45–59 years) – 39 %. The second place in the frequency of this complication is occupied by patients aged over 75 years – 24.4 %. The average age of patients was 61 years. Women were dominated – 63.4 %.

The type of periprosthetic fracture was determined by the Vancouver classification, according to which fractures are divided into type A, B or C, depending on its location. The overall structure of periprosthetic fractures was dominated by male patients (56 %) of working age, which accounted for 64 % of the total number of patients. According to the Vancouver classification, type B2 fractures dominate, with a violation of the stability of the femoral component, which amounted to 53.8 %.

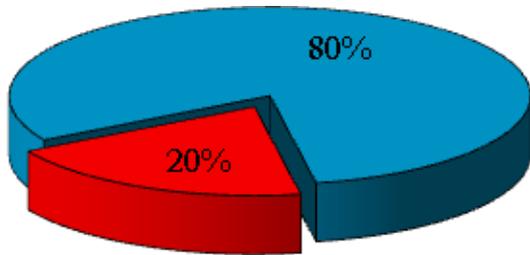
Paraarticular heterotopic ossification was determined and evaluated by radiographs according to the classification of A.F. Brooker and all (1973), according to which paraarticular heterotopic ossifications are divided into four stages according to maturity. Heterotopic paraarticular ossification of stage I was observed in 12 cases (40.0 %), stage II-III - in 10 cases (33.3 %), stage IV – in 8 cases (26.7 %).

During the follow up examination after hip arthroplasty, a group of patients was diagnosed with residual pain of mild to moderate intensity. Residual pain develops as a result of sacroiliac imbalance, pathological changes in the anterior and posterior columns of the spine, neurological disorders and may have a positional origin. The overall structure of the pain syndrome was dominated by female patients (60.0 %) and the predominance of middle-aged and elderly patients. Among the total number of patients with pain, there were 18 (51.4 %) patients with residual pain in the hip joint. All of them were diagnosed with concomitant pathology – osteochondrosis of the lumbar spine, radiculopathy L3–L4., The clinical manifestations of which were partially preserved after TEP. Among 17 patients with new pain sensations, 7 had neurological complications, 5 had positional pain, and 5 had adaptive pain.

The research involved the following methods of study: clinical, radiological, statistical, and microbiological. For the statistical analysis, we used Statistica (StatSoft) software package, version 12.6 (2015).

Results of the study and their discussion. Head dislocations of hip prostheses occurred to patients at the most active (45–59 years old – 37.5 %) and senior (> 75 years old – 25 %) age. Among them, the dislocations after the primary arthroplasty prevailed significantly ($t=6.9$, $p=0.0039$), as they took place in 33 cases (80 %). Posterior dislocations dominated in the general structure (64.4 %). Fig. A illustrates the shares of dislocations depending on the type of hip arthroplasty.

The following were reliable causes of hip prosthesis head's dislocations: I–III stages of obesity ($t=4.4$; $p=0.004$), AC frontal inclination angle $>15^\circ$ ($t=3.9$; $p<0.011$) and $<10^\circ$ ($t=2.26$; $p=0.009$), 28 mm diameter of heads ($t=22.1$; $p=0.0005$). Risk factors were: surgical treatment of dysplastic coxarthrosis ($t=2.8$; $p=0.005$), operation due to medial fractures and pseudoarthroses of femoral necks ($t=2.2$; $p=0.005$). The recurrent prosthetic head dislocations after a closed reduction occurred in 72.7 % of cases, while after surgical elimination – only in 20.6 %. The efficiency of surgical elimination of the dislocations is reliably higher compared to the closed one ($\chi^2=15$; $p=0.005$; $n=2$).



■ Primary ■ Revision

Fig. A. Shares of dislocations depending on the type of hip arthroplasty

post-surgical hematoma ($t=4.0$, $p=0.007$). The most efficient method to cure and restore a joint's function in case of paraarticular heterotopic ossification in patients with hip contractures over 20° in two planes was surgical removal of the ossificates.

The number of patients with periprosthetic fractures after an initial (0.11 %) and revision (3.56 %) THA meets standards of the leading clinics of the world. We determined hip osteoporosis according to Barnett-Nordin index ($t=2.0$, $p=0.001$) as the reliable cause of periprosthetic fractures. The only efficient treatment to periprosthetic fractures in 100 % of cases was open reposition of the fragments and osteosynthesis with metal devices. We registered no cases of recurrent femoral fractures or pseudoarthrosis.

Among the patients with pain syndrome after the hip arthroplasty, 51.4 % were the patients with a residual pain, 48.6 % – those with new pain feelings. In patients with the residual pain syndrome, vertebrogenous disorders dominated significantly ($t=1.54$, $p=0.03$). Pain syndrome after THA, not related to the surgery, had the background in degenerative-dystrophic changes in the anterior column of the lumbar spine ($t=1.37$, $p=30.025$). In case of a vertebrogenous pain syndrome, the best results were in the patients with the disorders of their lumbar spine posterior column. Conservative therapy testified its effectiveness in all patients with positional and neuropathic pains.

Statistical analysis established reliable causes of prosthetic head dislocations: a patient's excessive weight, use of a head 28 mm diameter. There is no consensus in the literature that the number of dislocations depends on age. According to several research [14] the risk of dislocation for patients older than 80 years increases by 2–5 times. At that time, according to data presented in Kaiser Permanente Total Joint Registry [15], based on arthroplasties performed in Southern California, did not find an increased risk of dislocation in elderly patients, which was 9.2 % of dislocations in patients older than 80 years, and excluding patients with femoral neck fractures – 3.7 % . According to various authors, dislocations are more common in women than in men. Also in patients with a high body mass index, there was an increase in the frequency of dislocations of prosthetic head. Previous hip surgeries are a significant risk factor for dislocations, increasing its frequency to 4–6 %, while in nonoperated patients its frequency reaches 2–3 %. The pathology of the hip joint which was a cause of arthroplasty can also increase the level of dislocations. At total arthroplasty concerning a fracture of a neck of a femur, according to various authors, the frequency of dislocations increases to 8–15 %. According to most researchers, the leading role in the occurrence of dislocations is played by errors in the orientation of the acetabular component. The most common is the implantation of a cup in the retroversion position. Some researchers mark 44 % of dislocations in patients with acetabular component retroversion, while in patients with the correct position dislocations were recorded in only 6 %. Design of the endoprosthesis components (head, neck, shell, liner) play an important role in the prevention of dislocations. Many works are devoted to the study of hip replacement results with heads of large diameter – 32, 36 mm. As the diameter of the head increases, the distance “jump distance” for dislocation increases. But with the increase in the volume of movements, the stability of the joint, the

wear of polyethylene also increases. It is also thought that the use of small diameter heads increases the frequency of dislocations.

In cases of paraarticular heterotopic ossifications in patients with hip joint contractures in two planes $>20^\circ$, the most efficient way to cure and restore joint functions was the surgical removal of the ossificates. The roots of the development of paraarticular heterotopic ossification were: hypertrophic osteoarthritis and surgical injury. Heterotopic ossification refers to disorders characterized by bone formation in tissues that do not normally have osteogenic properties. Ossifiers can be formed in almost all tissues and human organs. Bone tissue bears signs of structural and functional inferiority, sometimes acquires signs of organ organization. The formation of ossifications may be associated with musculoskeletal trauma (post-traumatic myositis), as well as subsequent surgery (osteosynthesis and arthroplasty). Heterotopic ossification is one of the most common complications of hip arthroplasty. The frequency of which is from 10 to 90 % of cases after surgery. As a result of a fracture of the acetabulum ossification occurs in 5 % of cases, but with open osteosynthesis, the risk of development increases from 18 to 90 % of cases [2, 4, 10, 11, 12].

In case of a vertebrogenous pain syndrome, the therapy was most efficient in patients with an impaired posterior column of the lumbar spine. Conservative treatment confirmed its efficiency for all patients with positioning and neuropathic pain. Pain syndrome, unconnected to the instability of components, originates from spine pathology – degenerative–dystrophic changes in the anterior column of the lumbar spine. Recurrent dislocations of a hip prosthetic head after a closed reposition occurred in 72.7 %, while after surgical elimination there of – only in 20.6 %. The surgical correction of the dislocations was significantly more efficient compared to closed reposition ($\chi^2=15$; $p=0.005$; $n=2$). According to a number of researchers, the causes of pain can be divided into two major groups: unrelated complications and those related to hip arthroplasty. The first group includes concomitant pathology that causes pain in the hip joint, and the value of which was not taken into account at the stage of preoperative planning. In this case, the pain syndrome in the literature is called residual. Vertebrogenic pathology (osteochondrosis, congenital malformations, spinal injuries, etc.) is the most common concomitant pathology that can cause pain in the lower back and operated limb, both before and after surgery. In recent decades, osteoarthritis of the hip joint has been studied not only as a purely joint problem, but as part of a number of biomechanical changes in the system of the hip–pelvis–lumbar spine. These disorders, which have a wide range of clinical manifestations, are collectively called hip–lumbar syndrome or hip–spine syndrome. The second group of complications, which leads to the appearance of new pain after arthroplasty, is actually associated with the operation itself – is the incorrect spatial location of the components of the prosthesis or changes in anatomical parameters in the hip joint (positional and adaptive pain) and nerve damage neuropathy).

The only efficient method of treatment to periprosthetic fractures, in 100 % of cases, was open repositioning the fragments and osteosynthesis with metal devices. We registered no cases of recurrent femoral fractures or pseudoarthrosis. According to some authors, the incidence of fractures during total arthroplasty is higher in patients with rheumatoid arthritis than in patients with osteoarthritis. Perhaps the cause is osteopenia of steroid etiology. Patients with concomitant osteomalacia, Paget's disease, marble disease, and imperfect osteogenesis are also at greater risk of fracture during the procedure. The use of press fit implants increases the number of periprosthetic femoral fractures. This situation can occur when using an implant without a guide, which can not enter the thigh exactly along the axis, or a prosthetic leg with a large proximal filling. Revision surgery is also associated with an increased risk of intraoperative fracture than primary. Thus, among the main risk factors should be noted: osteoporosis primary or secondary, osteopenia, local osteolysis, neuromuscular disorders, previous hip surgery, revision arthroplasty, instability of the endoprosthesis, narrow bone marrow canal in dysplastic osteoarthritis.

Conclusions

1. The complications had the following structure: aseptic instability of components – 158 cases (42.9 %), prosthetic head dislocations – 41 (11.1 %), paraarticular heterotopic ossification – 30 (8.0 %), periprosthetic femoral fractures – 25 (6.8 %), pain in a joint operated (not related to instability) – 35 (9.5 %), and infectious complications – 80 cases (21.7 %).

2. Reliable causes of heterotopic ossification development were: the presence of osteophytes ($t=2.39$, $p=0.006$), duration of surgery over 2 hours ($t=3.7$, $p=0.005$), blood loss over 500 ml ($t=3.4$, $p=0.006$). In the therapy of paraarticular heterotopic ossification, the most efficient method to cure and

restore the functions of a joint was surgical removal of ossification, though recurrent ossifications occurred in 70 % of cases.

3. Osteoporosis (the values of Barnett-Nordin indices ($t=2.0$, $p=0.001$) was a reliable cause of periprosthetic fractures.

Roots of prosthetic head dislocations were: obesity ($t=4.4$, $p=0.004$), vertical position of the artificial acetabulum ($t=2.28$, $p=0.009$), head diameter 28 mm ($t=22.1$, $p=0.005$). Surgical management of dislocations is reliably more efficient compared to closed reposition ($\chi^2=15$; $p=0,005$; $n=2$).

4. In patients with the residual pain syndrome, vertebrogenous disorders dominated significantly ($t=1.54$, $p=0.03$). Pain syndrome after THA, not related to the surgery, had the background in degenerative–dystrophic changes in the anterior column of the lumbar spine ($t=1.37$, $p=30.025$).

5. In case of a vertebrogenous pain syndrome, the best results were in the patients with the disorders of their lumbar spine posterior column. Conservative therapy testified its effectiveness in all patients with positional and neuropathic pain.

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