



Infectious Complications of Hip Arthroplasty: Causes and Results of Treatment



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Abstract

The objective of the research is to study the causes and outcomes of infectious complications after total hip arthroplasty. The background of the research is the analysis of outcomes of 364 patients with complications after total hip arthroplasty; 369 cases, from 2005 to 2018. The infectious complications accounted for 21.7% (80 cases). The work involves clinical, radiological, microbiological, and statistical research methods. As a result of research causes of suppurative complications after total hip arthroplasty were: chronic infectious diseases of internal organs ($t=3.37$, $p=0.001$), instability of prosthetic components ($t=3.14$, $p=0.002$), over two previous surgical interventions involving the affected joint ($t=2.43$, $p=0.005$). In the treatment of periprosthetic infections, sanitizing interventions without the prosthetic components' removal appeared efficient within only up to 3 weeks. If the sanitizing interventions were inconclusive, the double-stage revision prosthetics appeared adequate in a reliable number of cases ($t = 11.2$, $p = 0.0028$), namely 24, which amounted to 92.3%. In conclusion, it was concluded that the causes of periprosthetic infections were: diseases of the internal organs, instability of the components, over two surgical operations involving the same joint. The development of various complications after total hip replacements demands surgical revision procedures.

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1 Introduction

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% (Vasiuk et al., 2019; Haiko et al., 2018; Shubnyakov et al., 2019; Bori et al., 2019; Izakovicova et al., 2019). The most commonly – encountered are: aseptic instability of components, prosthetic head dislocations, heterotopic ossification, periprosthetic femur fractures, infectious complications (Tihilov et al., 2019; Poluliakh et al., 2019; Afzal et al., 2019; Lindgren et al., 2014; Mäkelä et al., 2019). Periprosthetic infection, according to different authors (Shubnyakov et al., 2019; Izakovicova et al., 2019; Korzh et al., 2018; Tihilov et al., 2019; Delanois et al., 2018; Postler et al., 2017; Renard et al., 2019), requires necessary surgical treatment in 69.0% of cases. Many scholars report the development of such complications in 0.3-1.3% after the primary total hip arthroplasties, and in 5-10% – after the revision ones (Shubnyakov et al., 2019; Korzh et al., 2018; Tihilov et al., 2019). Periprosthetic infections lead often to septic conditions, multi-organ failure, and death. In surgical practice, the following methods of treatment of infections complications of total hip arthroplasty are common: debridement, antibiotic therapy, irrigation, and implant retention (Al-Jabir et al., 2020). This method is very attractive for its simplicity and low cost and shows efficiency in the early stages of the infections process. Other methods require the removal of the endoprosthesis. This is a one-stage revision, when the implant is removed at the same time, debridement is performed, after which the implantation of a new endoprosthesis is performed. According to various authors, its effectiveness ranges from 70 to 96% (Bori et al., 2018; Kunutsor et al., 2018; Zahar et al., 2019). The next method, which shows high efficiency, is considered a two-stage revision (Kunutsor et al., 2018; Petis et al., 2019; Sigmund et al., 2019). The first stage is debridement, removal of the endoprosthesis, and in most cases, a cement spacer saturated with an antibiotic is installed (Rava et al., 2019; Silakarma et al., 2021). Then, after a certain period, the spacer is removed and a permanent endoprosthesis is installed.

Development of certain complications after the total hip arthroplasty demands revision surgeries; their number is growing year by year, in Ukraine as well. To understand how to prevent such severe complications, the authors shall investigate their backgrounds, establish groups of risk, assess the efficiency of infectious complications management, and improve differentiated treatment tactics (Shubnyakov et al., 2019; Korzh et al., 2018; Delanois et al., 2018; Postler et al., 2017). The task of the research is to study the backgrounds of infectious complications after total hip arthroplasty and outcomes after the treatment.

2 Materials and Methods

This study used methods such as detailed analysis of clinical material to study the structure of complications after THA. The research involved 364 patients, 369 cases of total hip arthroplasty, operated from 2005 to 2018 and has the following complications: aseptic instability of the components–158 cases (42.9%), 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%), and infectious complications – 80 cases (21.7%). In this study, the authors focused on infectious complications of hip arthroplasty. The research involved the following methods of study: clinical,

radiological, statistical, and microbiological. For the statistical analysis, the authors used Statistica (StatSoft) software package, version 12.6 (2015).

The authors carried microbiological data of germs collected from the majority of patients. There was mostly staphylococcus, 40% – methicillin-resistant. Those taken microscopically (82.1% of patients – during the operation) had signs of a biofilm. Germs collected from 43.6% of patients in a culture, both within the initial (22.5%) and revision (66.7%) THAs, correlated with serological studies and testified the prevalence of an endogenous way of the infection, focusing the future tactics for antibiotic therapy and prophylactics (Kurtieva et al., 2021; Widana et al., 2021). To select diagnostic criteria of infectious complications, like new PPI markers, and assess their importance in foreseeing complications, the authors tried a test to determine leucocyte esterase (LEST) in synovial liquid (Northrup et al., 2013; Braak & Braak, 1997). The positive results in 38.4% out of 47 patients examined correlated with microscopic studies of synovial fluid and S-RB concentration in blood, thus testified the expediency of further implementation of the test in complex diagnostics of a joint infection.

3 Results and Discussions

The first type of infectious complications according to Coventry (Vasiuk, Vasylychshyn & Protsiuk, 2019) is specific to patients under 60 years old with a cementless type of components' fixation and forms a reliable majority ($t=3.8$, $p=0.0025$), namely – 45 cases (56.3 %). The second type of infectious complication by Coventry is identified as a septic instability of the components and makes 22 cases (27.5%). The third type of infection by Coventry, hematogenous, is more typical of young patients with stable cementless fixation of the prosthetic components, it makes 11 cases (13.8%). A positive intraoperative culture manifested itself in 2 cases (2.5%). Figure 1 represents the structure of infectious complications, according to the Coventry classification.

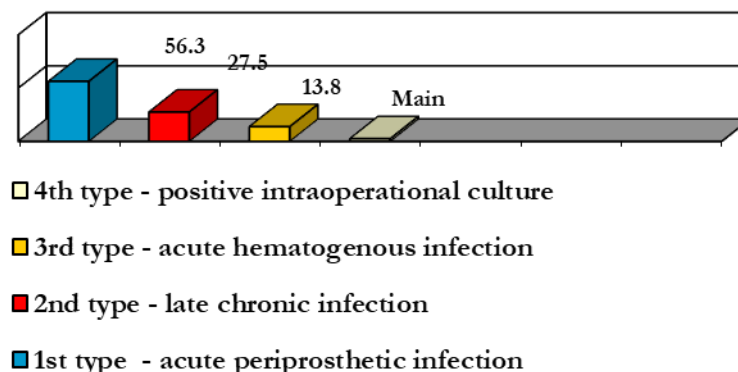


Figure 1. Distribution of infectious complications according to Coventry

Causes of suppurative complications after THA were: chronic infectious diseases of internal organs ($t=3.37$, $p=0.001$), instability of prosthetic components ($t=3.14$, $p=0.002$), over two previous surgical interventions involving the affected joint ($t=2.43$, $p=0.005$). Figure 2 shows shares of periprosthetic infections depending on concomitant pathologies.

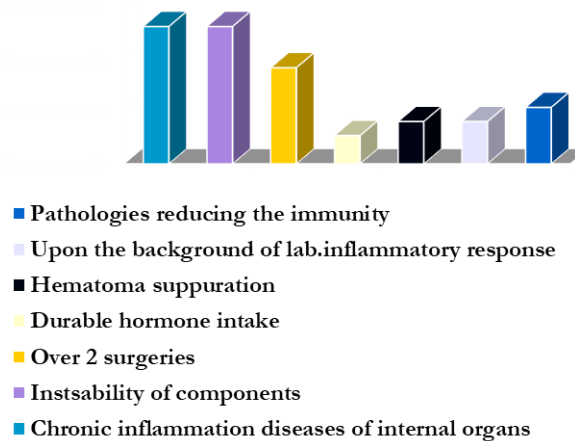


Figure 2. Shares of periprosthetic infection depending on concomitant pathologies

In the group of type 1 infectious complications, the cases of the late manifestation of acute post-surgical infection dominated significantly ($t=4.9$, $p=0.0044$), i.e. expression of the disease pattern in 33 cases (60%) appeared three weeks after the operation. According to this information, the sanitization of a proinflammatory area with preservation of the prosthesis upon the background of early and later acute infectious complications may ($t=2.7$, $p=0.017$) be the most efficient only during the first three weeks after the first manifestations of the inflammation. If the sanitization with the preservation of the prosthetic components due to early suppurative complications has been carried out later than one month after the inflammation started, it could be efficient only in 7 out of 33 cases, i.e. 20% ($t=5.6$, $p=0.0052$). In 26 cases of poor results of the method described above, the authors removed all components and cement radically and implanted an articulating spacer within double-stage revision arthroplasty (Lenguerrand et al., 2018). The double-stage prosthetic treatment was efficient in the reliable number of cases ($t=11.2$, $p=0.0028$), namely in 24, 92.3%. Relapses occurred only in 2 cases (7.7%). Based on the above, the long-term existence of an active purulonecrotic process in the hip area demands all components of the prosthesis and cement be radically removed, followed by single- or double-stage revision arthroplasty (Austin et al., 2008).

In the group of patients with the type 2 infectious complications according to Coventry, a single component was unstable in the majority of cases ($t=11.2$, $p=0.0028$), namely 16 (72.3%); the total instability of parts appeared in 6 incidents, 27.7%. In all cases, the authors removed the prosthesis with sanitization of the inflammation area: in 11 cases (68.8%), there was a double-stage arthroplasty involving a spacer; in 4 cases (25%) components of a prosthesis were removed; in 1 patient (6.2%) the authors carried out a single-stage revision arthroplasty. The double-stage arthroplasty took a significant majority ($t=2.67$, $p=0.014$). It was 100% efficient, without any relapses during the next five years. Upon a late hematogenous infection (type 3 by Coventry), the sanitization of the inflammation areas in 5 cases (45.5%) was profitable without removal of the components, while six of them (54.5%) included the removal (Ghanem et al., 2009). Among them, in 5 cases, there was a double-stage arthroplasty with an articulating spacer. No relapses occurred. For the type 4 complications by Coventry, components' removal and the revision implantation were efficient in both cases.

Suppurative complications after total hip arthroplasty ensue from chronic infectious diseases on internal organs, instability of components, over two surgical interventions (Bremner et al., 2003). Microscopic, cultural, and serological methods discovered that patients with suppurative complications were infected with gram-positive germs, testifying mostly the endogenous way of infection. For managing early suppurative periprosthetic complications, sanitization with preserving the prosthetic components, carried out more than in 1 month after the first manifestations of the inflammation appeared efficient only in 7 out of 33 cases, 20% ($t=5.6$, $p=0.0052$). In 26 cases, where the sanitization was inefficient, the authors carried out radical removal of all components of the prosthesis and cement, implanted an articulating spacer, and fulfilled a double-stage revision arthroplasty. The double-stage arthroplasty showed its efficiency in a reliable number of cases ($t=11.2$, $p=0.0028$), i.e., 24, it makes 92.3%.

4 Conclusion

- a) Reasons for suppurative complications after THA were: chronic infectious diseases of internal organs ($t=3.37$, $p=0.001$), instability of prosthetic components ($t=3.14$, $p=0.002$), over 2 previous surgeries on the affected joint ($t=2.43$, $p=0.005$).
- b) We carried out a microbiological analysis of germs collected from the majority of patients. There was mostly staphylococcus, 40% – methicillin-resistant. Those taken microscopically (82.1% of patients – during the operation) had signs of a biofilm. Germs collected from 43.6% of patients in a culture, both within the primary (22.5%) and revision (66.7%) THAs, testified the prevalence of an endogenous way of the ingress of infection.
- c) In early suppurative complications, sanitization without removal of prosthetic components, carried out later than one month after the first manifestation of inflammation showed its efficiency just in 7 out of 33 cases, i.e., in 20% ($t=5.6$, $p=0.0052$).
- d) In 26 cases, when the sanitization was inefficient, the authors carried out radical removal of all components of the prosthesis and cement, followed by the installation of an articulating spacer and double-stage revision arthroplasty. The double-stage revision arthroplasty appeared efficient in a reliable number of cases ($t=11.2$, $p=0.0028$), namely 24, i.e., 92.3%.

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