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Advances in management of periprosthetic joint infections: an historical prospective study

R. PAPALIA[1], U. VESPASIANI-GENTILUCCI[2], U.G. LONGO[1], C. ESPOSITO[1], B. ZAMPOGNA[1], R. ANTONELLI INCALZI[3], V. DENARO[1]

[1]Department of Orthopedic and Trauma Surgery University Campus Bio-Medico of Rome, Rome, Italy
[2]Department of Internal Medicine and Hepatology Unit, University Campus Bio-Medico, Rome, Italy
[3]Department of Internal Medicine and Geriatric Unit, University Campus Bio-Medico, Rome, Italy

Abstract. – OBJECTIVE: The purpose of our study is to assess the incidence of prosthetic joint infection (PJI) after total Knee arthroplasty (TKA), total Hip arthroplasty (THA) and total Shoulder arthroplasty (TSA), to identify risk factors, determine the microbial spectrum and management's outcome.

PATIENTS AND METHODS: A case-control, retrospective observational study was performed analyzing patients who developed a PJI after TKA, THA, and TSA from 2000 to 2017 at our hospital. The patient's risk profile was defined extracting from clinical records the following data: sex, age, BMI, type of implant, comorbidity, year of surgery, year of infection, previous intra-articular injection, microbial isolation, medical and surgical management outcome. We include in the "control group" for each "case" at least 3 patients who didn't have a PJI after TJA.

RESULTS: 28 patients met all inclusion and exclusion criteria. Comparing the "cases" with "controls" demographics parameters, medical comorbidities and previous intra-articular injection were not associated with an increased risk of PJI. Comparing the "early/delayed group" with "late group", BMI was associated with an increased risk of early/delayed PJI, while demographics parameters, medical comorbidities, and previous intra-articular injection did not significantly increase the risk of PJI. Logistic regression showed that for each BMI unit there was a 20-fold increased risk of early prosthetic infection (OR 1.19, IC 1.03-1.38, *p*=0.01). Staphylococci were isolated most frequently from pre-operative and intra-operative cultures. Two-stage arthroplasty exchange and surgical debridement resulted in the most performed surgical treatment with a success rate of 88 and 87%.

CONCLUSIONS: Obesity is a risk factor for "early/delayed infection" of TJA. Two-stage arthroplasty exchange, debridement, antibiotics, and implant retention in patients are treatments with a high rate of success in terms of reinfection.

Key Words
Prosthetic joint infection (PJI), total Knee arthroplasty (TKA), total Hip arthroplasty (THA), Risk factors, Arthroplasty exchange, Antibiotics therapy.

Introduction

Total joint arthroplasty is a successful treatment that improves joint function, relieves pain, and increases the overall quality of life[1]. Due to the increase in the number of patients undergoing joint replacement procedure, a concomitant increase in the number of complications is expected[2]. "Prosthetic Joint Infection" (PJI) is one of the most feared complications of arthroplasties that has been estimated to range from 2.0% to 2.4% of total hip and knee replacement[3]. Despite advancement in surgical procedures and in antibiotic prophylaxis, PJI remains the most important cause of implant failure and require for revision. Its consequences represent an impressive clinical and economic burden. It extends hospitalization by 12-20 days and doubles the re-hospitalization rate with a considerable impact on the patient quality of life. PJI often requires one or more complex surgical procedure, that increase the cost of care. Treatment's cost of a PJI is 3 to 4 times the cost of a primary implantation and 2.8 times the cost of an aseptic revision arthroplasty[3,4]. Today, a gold-standard definition of PJI does not exist. To standardize the definition of PJI, especially to avoid compromising the validity and comparability of study's results, several medical societies and working groups have proposed different definitions. In 2011, the *Musculoskeletal Infectious Society* (MSIS) proposed a group of criteria for the diagnosis of PJI[5], that was later revised by the *International Consensus Meeting on PJI*[6], providing the best available evidence regarding the prevention, diagnosis, and management of PJI (Table I). In 2018 Parvizi et al[7] published an evidence-based and validated updated version of PJI diagnosis criteria. They assigned a weighted score to all minor criteria and divided preoperative from intraoperative diagnosis. The new criteria definition obtained a better sensi-

Corresponding Author: Biagio Zampogna, MD; e-mail: b.zampogna@unicampus.it

Table I. Definition of PJI according to the International Consensus Group.

PJI is present if patients meet one of the major criteria or at least three of the minor criteria proposed	
Major criteria	1. Two positive periprosthetic cultures with phenotypically identical organisms, OR 2. A sinus tract communicating with the joint, OR
Minor criteria	(a) Elevated serum C-reactive protein (CRP) AND erythrocyte sedimentation rate (ESR) (b) Elevated synovial fluid white blood cell (WBC) count OR ++ change on leukocyte esterase test strip (c) Elevated synovial fluid polymorphonuclear neutrophil percentage (PMN%) (d) Positive histological analysis of periprosthetic tissue (e) A single positive culture

tivity (97.7%) compared to the MSIS (79.3%) and International Consensus Meeting definition (86.9%), and a similar specificity of 99.5%. Given the severity of PJIs, many studies have been performed to identify the risk factors involved in the development of a PJI. The huge number of risk factors includes *patient-related factors* as well as *procedural* and *post-procedural factors*[8,9]. Clinical conditions, such as rheumatologic disease, diabetes, and obesity, have been reported as steady risk factors for PJI[10-12]. However, many variables described in the literature regarding other clinical conditions have been reported, including *non-modifiable risk factors* and *modifiable risk factors*[11,13-16]. From a microbiological point of view, PJI is considered as biofilm-related infection in which pathogens attach to the surface of the arthroplasty forming colonies within an extracellular polymeric matrix[17]. The successful management of patients with PJI is due to an early and accurate diagnosis. Several diagnostic tests that may help to determine the cause of prosthetic joint failure are now available[18-22]. Despite significant improvements in the diagnosis of PJI, today, there is no single routinely used clinical or laboratory test that reaches an excellent diagnostic accuracy. A correct diagnostic process for PJI is achieved from the evaluation of several aspects: clinical examination, microbiological data, histological evaluation of periprosthetic tissue, peripheral blood and synovial fluid laboratory tests, intraoperative inspection and imaging results[17]. A recent systematic review and meta-analysis[23] underlines the diagnostic utility of synovial fluid markers (CRP, leukocyte esterase, IL-6, IL-1β, α-defensin, and IL-17) which all possess high diagnostic utility. However, despite this progress, a concrete diagnosis of PJI remains elusive, and clinical experience should outweigh diagnostic tests when suspicion for infection is high[21]. The management of PJI requires surgical and pharmacological therapy in most cases. Different medical and surgical strategies can be used to treat PJI: antimicrobial suppression without surgery, debridement without removal of the arthroplasty, removal of the arthroplasty with re-implantation of a new arthroplasty either at the time of removal (one-stage arthroplasty revision) or delayed by weeks to months (two-stage arthroplasty revision), removal of the arthroplasty without re-implantation, arthrodesis and amputation[24-28]. The prevention of any hospital infection, surgical and non-surgical, starts from the precise knowledge of internal cases. This is the key element to understand and program specific interventions. A deep knowledge of the risk factors can help easier to identify patients at high risk; in the same way, correct screening for pre-existing medical comorbidities, and improvement of these conditions is also decisive.

Therefore, the aim of the present study is to assess the local incidence of joint infection after total Hip (THA), Knee (TKA) and Shoulder arthroplasty (TSA), to identify independent patient-related risk factors for infection, including the influence of previous intra-articular injection on infection risk and to determine the relative frequency of microorganisms and the outcome of the different medical-surgical managements used to treat PJI.

Patients and methods

This is a monocentric, case-control, retrospective observational study approved by the local hospital ethics committee and scientific board. Informed consent was waived due to the retrospective design of this study. Medical records of Orthopedics and Trauma Surgery department from our institution, encoded with codes 996.66 (“infection and inflammatory reaction from internal joint prostheses”) and 996.67 (“infection and inflammatory reaction from other prostheses,

implants and internal orthopedic implants") between January 2000 and July 2017 were analyzed. We included in the "cases' group" all patients who developed a PJI after a total hip/knee/shoulder arthroplasty, which diagnosis was confirmed by the positive cultures exam and/or clinical exam's positivity (i.e. a sinus tract communicating with the joint) according to the major criteria proposed by PJI Consensus Group. The following exclusion criteria were applied: prosthetic joint infections in other joints, non-prosthetic joint infections, prosthetic joint infection which doesn't meet one of the major criteria or at least three of the minor criteria proposed by the *International Consensus Meeting on PJI* for PJI diagnosing, subcutaneous and soft tissues' infection without involvement of prosthetic components, lack of demographic and anthropometric data, mobilization of arthroplasty caused by metastatic localization or different from the infectious one. From the application of above-mentioned criteria, 35 patients were excluded from the 63 patients initially enrolled. To limit the bias related to the possible variations of operative/perioperative techniques and nosocomial infectious agents' epidemiology during the seventeen years, we decided to include in the "control group" for each "case" at least 3 patients who did not have an infection after total joint arthroplasty, randomly drawn from homogeneous type of implant and year of surgery. To define the patient's risk profile and the variables related to the onset of infection, we reviewed clinical records extracting the following data: sex, age, BMI, type of implant, comorbidity, year of surgery, year of admission, microbial isolation, medical and surgical management, and relative outcomes. Previous ipsilateral intra-articular injection therapy, type of injection, and the timing of the last injection before the surgery were also recorded. Variables to be evaluated were selected according to data availability of our retrospective cohort and to literature current evidence for association to PJI[8,9]. Patient follow-up was analyzed until the most recent outpatient examination or new hospitalization.

Statistical Analysis

Statistical data analysis was performed with SPPS statistical software (version 21, Chicago, USA). The two groups were compared with *Mann-Whitney U-test* for continuous variables, and the X^2 *test* for categorical variables. Binary logistic regression was used to analyze the association between BMI (the only variable significantly different between the group "early" and "late-onset" or "controls") and risk of PJI. Only p-values < 0.05 were considered to represent statistical significance.

Results

According to our inclusion and exclusion criteria, 28 patients who developed a PJI infection in the investigation time-lapse (from 2000 to 2017) were enrolled in the study. Of these, 10 patients (35.72%) underwent to a total hip arthroplasty, 16 patients (57.14%) underwent a total knee arthroplasty, 2 patients (7.14%) underwent a total shoulder arthroplasty. The "*cases' group*" consist of 28 patients, 12 women and 16 men, with an age of 73.32 ± 8.29 years, and a BMI of 28.97 ± 4.39 kg/m^2. The "*controls' group*" consist of 84 patients, 47 women and 37 men, with an age of 75.43 ± 9.10 years and a BMI of 28.29 ± 3.59. Therefore, the "control group" was composed of 84 patients, homogeneous for site and year of surgery. The prevalence of diabetes, dyslipidemia, and hypertension were, respectively, 14.3%, 21.4%, and 75% in the "cases' group" and 8.3%, 20.2%, and 58.3% in the "controls' group" (Table II). In the cases' group, 9 patients received an intra-articular injection before arthroplasty: in 8 patients hyaluronic acid was used while for 1 patient PRP was used.

Table II. Patients' features: groups "cases" vs. "controls".

Parameter	Cases	Controls	p
Age	73.32 ± 8.29	75.43 ± 9.10	0.086
Gender (M/F)	16/12	37/47	0.277
BMI	28.97 ± 4.39	28.29 ± 3.59	0.256
Diabetes	4/28 (14.3%)	7/84 (8.3%)	0.463
Dyslipidemia	6/28 (21.4%)	17/84 (20.2%)	1
Hypertension	21/28 (75%)	49/84 (58.3%)	0.176
Intra-articular injection	9/28 (32.1%)	43/84 (51.2%)	0.080

Table III. Timing of infection.

Timing of infection	Number	Percentage
Early	10	35.71%
Delayed	6	21.42%
Late	12	42.85%

All 9 patients received and completed the joint infiltration cycle between one year and three months before surgery, according to the recommendations of the PJI Consensus Group. In the control's group 43 patients received an intra-articular injection before arthroplasty: in 38 patients hyaluronic acid was used, in 4 patients was used PRP while 1 received a corticosteroid injection. Similarly, to cases' group, all 43 patients received and completed the joint infiltration cycle not later than three months before surgery. As can be seen, despite the multitude of factor risk for PJI recognized in literature, there were no patient demographics (gender p=0.277, age p=0.086, BMI p=0.256) and medical comorbidities (diabetes p=0.463, dyslipidemia p=1, hypertension p=0.176) that were associated with an increased risk of PJI after TJA, comparing the "cases' group" with "controls' group". The risk of infection was not significantly increased for patients who received an intra-articular injection before the day of operation (p=0.080). Patients who developed a PJI were divided, in patients with "early infection" (within 3 months from the day of surgery), "delayed infection" (within 12 months) and "late infection" (more than 12 months) (Table III). Patients with an "early/delayed" infection were compared to patients with "late infection" for all the variables of interest. The "early/delayed infection" group consists of 16 patients, 5 women and 11 men, with an age of 73.25 ± 6.79 years and a BMI of 30.82 ± 3.94; the "late infection" group consists of 12 patients, 7 women and 5 men, with an age of 73.41 ± 10.27 years and a BMI of 26.5 ± 3.79. The prevalence of diabetes, dyslipidemia and hypertension were, respectively, 18.7%, 18.7%, and 75% in the "early/delayed group" and 8.3%, 25%, and 75% in the "late group" (Table IV). In the early/delayed infection group 6 patients received an intra-articular injection before arthroplasty: in 5 patients was used hyaluronic acid while for 1 patient was used PRP. In the late infection group 3 patients received an intra-articular injection of hyaluronic acid. The patient demographics (gender p=0.250, age p=0.802) and medical comorbidities (diabetes p=0.613, dyslipidemia p=1, hypertension p=1) did not significantly increase the risk of post-operative infection. About intra-articular injection, the risk of infection was not increased (p=0.483). Comparing the "early/delayed group" with "late group", BMI was the only factor significantly associated with an increased risk of early/delayed PJI (p=0.003). BMI index resulted statistically significant higher in the "early/delayed group" also comparing with "controls' group" (p=0.008). Logistic regression showed that for each BMI unit there was a 20-fold increased risk of early prosthetic infection (OR 1.19, IC 1.03-1.38, p=0.01). The other factors, that did not significantly increase the risk of postoperative infection are shown in Table V. Regarding to microbial spectrum (Table VI), several microorganisms were isolated from pre-operative and intra-operative cultures: S. aureus was isolated in 7 patients, *S. epidermidis* was isolated in 6 patients, polymicrobial infections were isolated in 8 patients and other coagulase-negative were isolated in 3 patients. *Klebsiella pneumoniae* or *Propionibacterium acnes* were isolated only in one case. In 2 cases the intraoperative culture failed to show growth; however, the diagnosis was confirmed by the presence of draining sinus tract, elevated CRP, and intraoperative positive histology, matching the PJI Consensus Group major and minor criteria. Several strategies were used

Table IV. Patients' features: groups "early/delayed" *vs.* "late" infection.

Parameter	Early/delayed infection	Late infection	p
Age	73.25 ± 6.79	73.41 ± 10.27	0.802
Gender (M/F)	11/5	5/7	0.250
BMI	**30.82 ± 3.94**	**26.5 ± 3.79**	**0.003**
Diabetes	3/16 (18.7%)	1/12 (8.3%)	0.613
Dyslipidemia	3/16 (18.7%)	3/12 (25%)	1
Hypertension	12/16 (75%)	9/12 (75%)	1
Intra-articular injection	6/16 (37.5%)	3/12 (25%)	0.483

Table V. Patients' features: groups "early/delayed" infection *vs.* "controls".

Parameter	Early/delayed infection	Controls	*p*
Age	73.25 ± 6.79	75.43 ± 9.10	0.112
Gender (M/F)	11/5	37/47	0.101
BMI	**30.82 ± 3.94**	**28.29 ± 3.59**	**0.008**
Diabetes	3/16 (18.7%)	7/84 (8.3%)	0.198
Dyslipidemia	3/16 (18.7%)	17/84 (20.2%)	1
Hypertension	12/16 (75%)	49/84 (58.3%)	0.270
Intra-articular injection	6/16 (37.5%)	43/84 (51.2%)	0.315

for surgical management of PJI (Table VII). Eight patients underwent to "debridement and surgical toilette", and among these patients only one patient developed a reinfection. One patient underwent to "One-Stage Arthroplasty Exchange" who later developed a reinfection. Seventeen patients underwent to "Two-Stage Arthroplasty Exchange", and among these patients only 2 developed a reinfection. Two patients underwent to "Arthroplasty Resection without Reimplantation" (i.e., Girdlestone procedure). The number of joint arthroplasties performed in our hospital has risen significantly during the study period: we moved from 14 TKA performed in 2000 to 467 in 2017, from 25 THA performed in 2000 to 331 in 2017, from 1 TSA performed in 2008 to 76 in 2017. In September of 2014 our University Hospital was accredited by the Joint Commission International (JCI) that is an independent international organization that evaluates excellence within healthcare facilities. The standards established by the Joint Commission International are objectives required to improve patient safety and the quality of patient care. Comparing the incidence of PJI before and after JCI accreditation, we recorded a reduction in the rate of PJI from 1.16% to 0.21% for hip arthroplasty and from 1.7% to 0.63% for knee arthroplasty. About shoulder, we did not record any infection in the last 3 years.

Table VI. Microorganism isolated from patients with PJI.

Microorganism	Number	Percentage
Staphylococcus aureus	7	25%
Staphylococcus epidermidis	6	21,4%
Polymicrobial infection	8	28.6%
Staphylococcus coagulase negative	3	10.7%
Culture-negative	2	7.1%
Klebsiella Pneumoniae	1	3.6%
Propionibacterium Acnes	1	3.6%

Discussion

Though several prospective and retrospective cohort studies have been published is still extremely difficult to predict the risk of post-operative PJI. Our monocentric, case-control, retrospective observational study tried to determine which factors put a patient a higher risk of PJI. We found a significant statistic correlation between BMI and early PJI: for each BMI unit increase there was a 20-fold increased risk of early prosthetic infection (OR 1.19, IC 1.03-1.38, p=0.01). Wu et al[29] found that patients with a BMI greater than 28 kg/m^2 had a 2.77 -fold higher risk of PJI compared with patients with a BMI between 18.5 and 28 kg/m^2. Several other studies support our results regarding the effect of BMI on PJI risk[11,13,16,30-35] but not all authors agree on that issue[36,37]. On the contrary, Berbari et al[38] indicated that a low BMI (<25) was associated with an increased risk of PJI. They explained that patients with low BMI might have less nutrition-

Table VII. Surgical treatment used for patients with PJI

Surgical treatment	Number	Percentage	Reinfection of infection
Debridement and toilette	8	28.57%	1
One-Stage Arthroplasty Exchange	1	3.57%	1
Two-Stage Arthroplasty Exchange	17	60.71%	2
Arthroplasty Resection without Reimplantation	2	7.15%	/

al reserve and multiple comorbidities, such as immunosuppression, rheumatoid arthritis, and nicotine dependency. The American Association of Hip and Knee Surgeons (AAHKS) recommends that arthroplasty is delayed in cases of morbid obesity (BMI > 40), especially in patients with multiple comorbidities[39]. Total joint arthroplasty is one of the most common elective surgeries performed in older adults. Older patient age often coincides with poorer nutritional status and immunity depression, thus resulting in a higher risk of infection. However, in our study, we didn't find a significant correlation between age and risk of PJI. Probably, it is due to the small size and homogeneity of the "cases' group". Wu et al[29] found that patients aged 65-75 years had 3.36-fold higher risk of PJI compared with patients aged 45-65 years. Similar results were reported by Ridgeway et al[40]. In an opposite way, in a single-center analysis of 8494 TJA, Malinzak et al[32] found that younger age was associated with increased risk of infection. They supposed that younger patients are more active than elderly ones and that their implants undergo a greater number of use cycles, leading potential revision surgery, and possibility of infection. About *gender*, several studies[10,33,37,41-45] suggest that males have a higher risk of PJI. Male and female skin colonization is different, and this may result in differences in skin pH, sebum production, or skin thickness[46]. Our data showed no significant correlation between gender and PJI. In our study, the only comorbidities affecting patients who developed a PJI were diabetes, dyslipidemia and hypertension. None of these comorbidities was statistically significant correlated with a high risk of PJI. However, several studies[8,9,15,47,48] in the literature found that diabetes mellitus, smoking, alcoholism, anemia, rheumatoid arthritis, immunosuppressive medications, systemic infection, cardiology and gastroenterology disorders, liver and kidney disease, HIV infection are all related to an increased risk of infection. There are no clear conclusions regarding the relationship between preoperative intraarticular injections and postoperative PJI after TJA, since existing studies have provided conflicting results. About hip, Werner et al[49] reviewed a total of 34597 THA and found that incidence of PJI was significantly higher in the patients who underwent hip injection within 3 months before THA while this association was not noted when THA occurred more than 3 months after the injection. Other three studies have demonstrated higher rates of PJI in patients who had an intraarticular steroid injection in the hip before THA[50-53] while 4 prior studies have not demonstrated any association between preoperative intraarticular steroid injection and PJI after THA[54-57]. About knee, Cancienne et al[50] found a significant higher risk of PJI in patients who underwent ipsilateral knee injections within three months prior to TKA, but not in patients who received the injection more than three months before TKA. Several studies have reported that previous steroid injections were not associated with an increased risk of PJI following TKA[58-62]. Kokubun et al[63] found no relationship between timing and number of intra-articular injections with complication rate, infection, or poor short-term functional outcomes. In our study, we found no relationship between timing and type of injections and increased risk of PJI. Most of the patients, both in the cases' and controls' group, received an intra-articular injection with hyaluronic acid; no patient who develops a PJI received a corticosteroid injection. Moreover, all patients received the last injection cycle within one year and not later than three months before surgery, according to the recommendations of the PJI Consensus Group. Regarding the microbial spectrum, Tande et al[17] reported the microbiological results of 14 large studies including 2400 patients with hip or knee arthroplasty infection. Gram-positive cocci are involved in the majority of hip and knee PJIs in all the studies examined; infections by *S. aureus* and coagulase-negative staphylococci contribute to 50-60% of PJIs, while streptococci and enterococci together account for only 10% of cases. Aerobic Gram-negative bacilli are involved in 10% of cases of knee and hip PJI. The percentage of culture-negative infections varied from 5 to 34%. In our study, we found similar data. The most frequently isolated pathogens, *S. aureus* and/or *S. epidermidis*, and coagulase-negative staphylococci, were ensemble responsible of PJI in 53% of cases. Similarly, the polymicrobial forms were isolated in 28.6% of patients while culture-negative infection resulted in 7.1% of cases. Surgical treatment success has been variably described in the literature; there are no randomized trials comparing the different approaches, and variability between hospitals that perform mainly one-stage compared to two-stage arthroplasty exchanges limits comparison across the studies. A systematic review of hip PJI analyzing 375 patients undergoing one stage exchange reported an 87% success rate, compared with 90% for the 929 patients undergoing two-

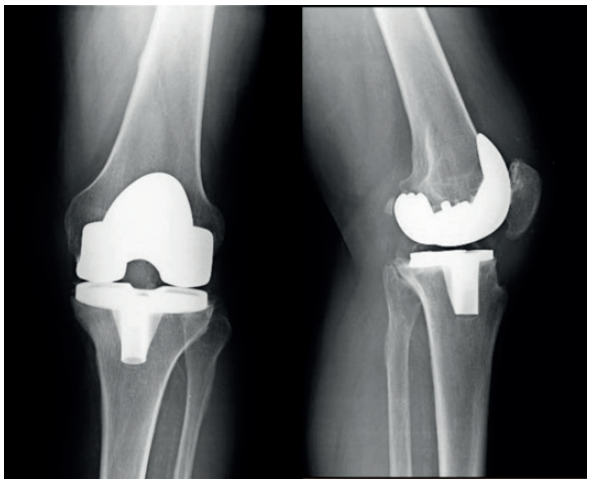

Figure 1. Primary TKA.

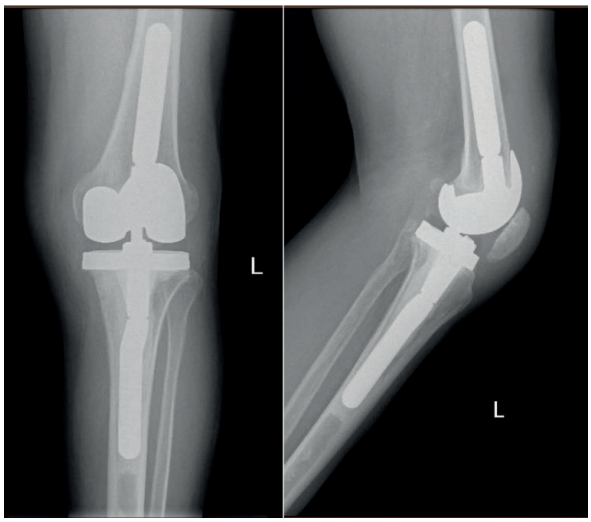

Figure 3. Revised TKA.

stage exchange[24]. Other studies comparing the one *vs*. two-stage arthroplasty exchange in infected THR showed, instead, improved infection control rates in one-stage revisions ranging from 82-100% compared to 75-95% in two-stage revisions[25,26]. A recent meta-analysis, published by Kunutsor et al[27] compared the outcomes following one and two-stage revisions of infected TKRs, with a rate of re-infection was reported as 7.6% in one-stage studies and of 8.8% for the two-stage procedure with similar postoperative clinical outcomes for both strategies. Significantly less robust data suggest similar short-term outcomes for shoulder arthroplasty infection treated with a one stage/two-stage arthroplasty exchange. In our study, we found two-stage arthroplasty exchange procedure the most performed and effective strategy in terms of infection eradication and preservation of joint function, with a success rate of 88.2% (Figures 1-6), while debridement and surgical toilette reported a success rate of 87.5%. Our results are like those found in the literature. We cannot define the efficacy of one-stage arthroplasty exchange procedure because it was performed only one time and was followed by a reinfection. The Campus Bio-Medico University Hospital is accredited by the Joint Commission International (JCI) since September of 2014. The standards established by the JCI are objectives required to improve patient safety and the quality of patient care. These are divided into two sections: those regarding the patient and those regarding the management of the healthcare facility. The implementation of every standard is verified by 'measurable indicators', there are over 1300 in all. Thanks to the fulfillment of these

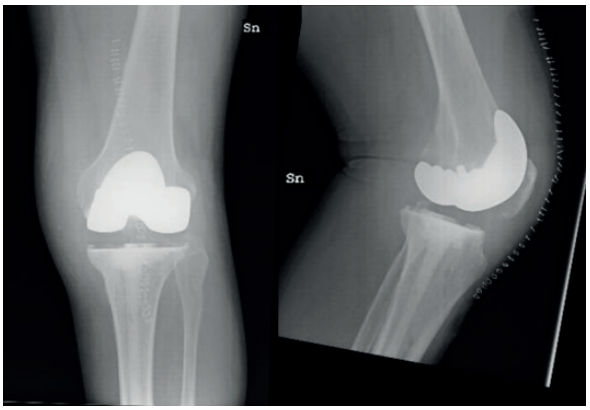

Figure 2. Knee Spacer.

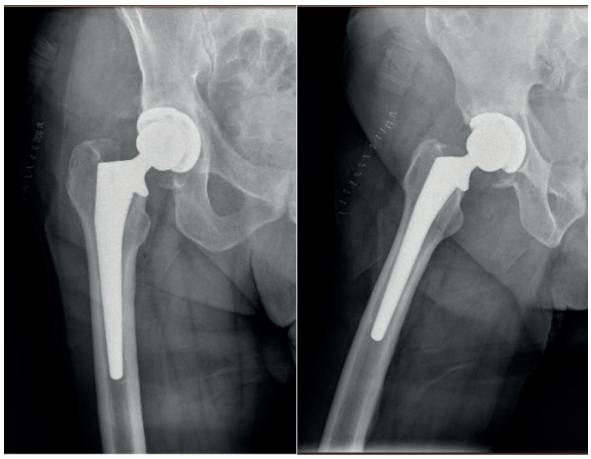

Figure 4. Primary THA.

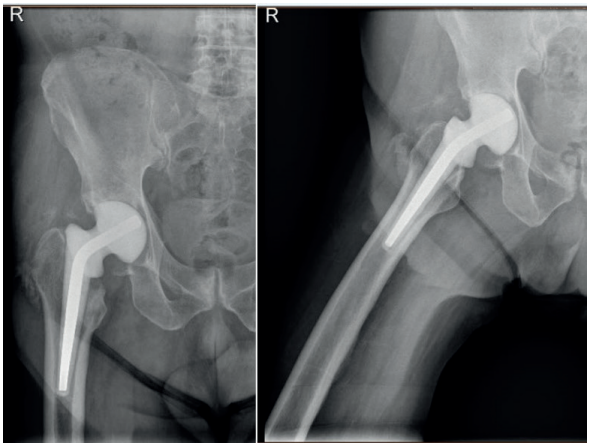

Figure 5. Hip Spacer.

standards, we recorded in the last 3 years a reduction of one percentage point in the incidence of PJI after hip, knee and shoulder arthroplasty, despite the increased number of arthroplasties.

Main weaknesses of the study are represented by a small patients' cohort and a retrospective and monocentric investigation design. The accuracy of the data is dependent on the doctor and coders who are responsible for entering it. The possibility of miscoding certainly exists and some patients with PJI may not be considered. The infection rate was very low during the studied period, but we could not evaluate the possible association between others PJI and other relevant risk factors widely recognized in literature because not available in our retrospective cohort.

Conclusions

It is essential that orthopedic surgeons understand and identify risk factors before TJA so that they can optimize patients' status and minimize their risk of developing a postoperative infection. Clarification of the most common risk factors is critical for taking further steps. Our study highlighted obesity as a risk factor especially for "early/delayed PJI" compared to "controls' and "late infection" groups in the studied period. Two-stage arthroplasty exchange, debridement, antibiotics and implant retention are treatments with a high rate of success in terms of reinfection. Waiting for further analysis, considering the growing epidemiology of obesity and associated dysmetabolic pathologies, it is essential to get weight loss before proceeding to implant a joint arthroplasty.

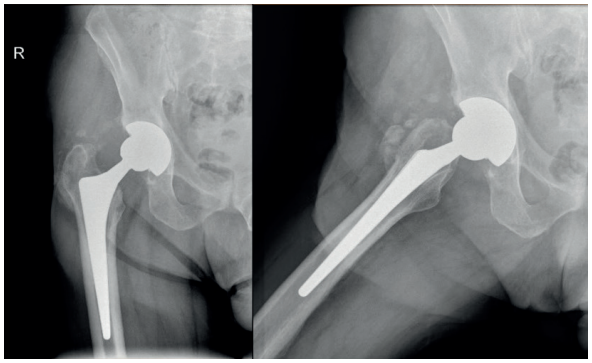

Figure 6. Revised THA

Conflict of Interests

The Authors declare that they have no conflict of interests.

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