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Tran Trung Dung*, Pham Trung Hieu, Nguyen Trung Tuyen, Vu Tu Nam and Nguyen Huy Phuong

Department of Orthopedic Trauma, Saint Paul Hospital, Hanoi Medical University, Vietnam

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***Corresponding author:** Tran Trung Dung, vice head Director of Saint Paul Hospital, Hanoi, Department of Orthopedic Trauma - Sports Medicine, Hanoi Medical University, Vietnam, Tel: 084 983762005; E-mail: dungbacsy@dungbacsy.com

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Research Article

Infection Associated with periprosthetic hip in Vietnamese adults

Abstract

A retrospective case-series study was carried out on 21 patients undergoing postoperative infection following a hip replacement at Vietnam – Germany University Hospital from January 2013 to September 2016. This study were also selected the case for inclusion of the main clinical and paraclinical characteristics of periprosthetic hip joint infection (PJI). The results showed that 47.6% of the cases occurred in the early stage following the Fritzgerald's classification. Restriction of hip joint movements occurred in 86% of the cases. The incidence of inflammation around the incision was 100% and fistula of hip joint was 95%. The sedimentation rate increased in 100% of the cases, with an average value of 53 ± 26.8 mm. More than a quarter of the patients had positive bacterial culture results, of which almost half were *Staphylococcus aureus*. The clinical and subclinical characteristics of PJI in this study were quite typical and similar to previous studies. The mainly indexes supporting the diagnosis such as the elevated CRP level, the elevated synovial-fluid leukocyte count, the percentage of neutrophils were consistent with infection and the culture of fluid results. It is very necessary based on the results of bacterial culture tests to be conducted regularly for postoperative follow-up and antibiotics.

Background

Periprosthetic hip joint infection (PJI) appears as one of the most serious complications that curbs the success of this measure. Currently, in the United States, PJI rate is 0.88% [1]. The revision surgery treating this complication is predicted to increase significantly in the next 25 years, which leads to an increase in burden for patients, medical staffs and society.

Globally, a range of studies have been conducted to demonstrate the characteristic of PJI, as well as PJI treatment protocols. As hip replacement was applied later in Vietnam than other developed countries, the research about PJI has gradually shown its importance in recent 10 years, when the explosion of the number of hip replacements was witnessed. Nguyen Tien Binh (2004) reported the PJI rate was 0.6% [2], and Do Huu Thang (2004) found at 3% [3]. Tran Dinh Chien and Le Ngoc Hai (2012) assessed the outcome of total hip replacement by the minimally invasive technique with the conclusion that the PJI rate was 1.6% [4]. Among 138 patients undergoing total hip replacement in 108 Military Central Hospital, it's reported that 5% of them suffered from post-op infection [5]. This figure in Vietnam – Germany University Hospital was 8.6% [6].

Signs and symptoms of infection are generally poor and late-detected. In addition, the difficulty in choosing appropriate treatment and management of PJI is significantly considerable, especially in developing countries as Viet Nam where sterile conditions in the surgical field are not fully guaranteed, caring for patients after surgery is inadequate, and the habit of using antibiotics treatment without prescription and the high rate of antibiotic resistance are favorable factors for postoperative and recurrent infection.

Materials and Methods

Subjects

A total of 21 patients diagnosed with periprosthetic hip joint infection and indicated surgical treatment at Vietnam – Germany University Hospital, Hanoi, Vietnam were enrolled into the study from January 2013 to September 2016.

Selection criteria

Selected patients were those who aged over 18, had one or two hip replacements in Vietnamese – Germany University Hospital and were diagnosed with periprosthetic hip joint infection following the criteria of Musculoskeletal Infections Society and were indicated surgical treatment [7].

Exclusion criteria

The patients who were indicated inpatient treatment but did not consent to continue the treatment and could not be contacted after treatment were excluded.

Following the criteria, most of the patients were males

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(81%) - about four times more than females (19%). The mean age of the patients was 57.4 (range 22-79). Over a half of participants were 55 years and older (66.7%). 71.43% of the patients had not received surgical treatment before admission and 23.81% had surgery for debridement with retention and 4.76% had been treated by implant removal at many different hospitals.

Study design

This is a retrospective case-series. Medical records were retrieved from the hospital's database. In particular, the patients after being diagnosed would undergo surgery to treat the infection. The culture was taken directly in the operation immediately after reopening the incision site, where the Intraoperative periprosthetic tissue was taken, including bone, joint capsule, and soft tissues around the prosthetic. The number of samples taken was at least 3 samples. All of samples were sent to the Laboratory of the Department of Microbiology of Viet Duc University Hospital on the same day for culture, isolation and identification of each bacterium according to standard procedures. These procedures used for culture of periprosthetic tissue is aerobic and anaerobic blood aga, and the duration of incubation is 7 days.

Study indices

General characteristics of the participants include age and sex. Classification of the clinical stage according to Fritzgerald (1977) is based on onset time and clinical presentation [8]. There were three stage such as early stage occurs within the first month after surgery and is clearly visible at the extremity with signs such as severe pain, fever, and fistula. It is caused by highly pathogenic bacteria; Delayed stage occurs from about 1 to 24 months after surgery. Symptoms sometimes manifest solely with pain. Symptoms of joint loosening may or may not be present; and late stageusually develops after 2 or 3 years of hip replacement and is derived from blood and lymph vessels. Postoperative clinical symptoms were evaluated such as pain, restriction of hip joint movements, inflammatory response syndrome (SIRS), and localized localization.

In addition, cases are also evaluated for laboratory tests such as blood culture, culture and identification of bacteria in joint fluid.

Results

General characteristics of the study subjects

Based on the Fritzgerald's progressive classification, 10 patients (47.6%) were identified as at the early stage. The number of patients at delayed stage of infection was 7 (33.3%). There were four patients (19%) on the last stage of infection. In the early stage, the onset time might be three days postoperatively, but in the late stage, this might last up to five years.

Clinical presentation

Clinical presentation of PJI comprised pain, limitation of hip joint movement, Systemic Inflammatory Response Syndrome and focal inflammation as shown in tables 1-3. 13 patients experienced pain after surgery, accounting for 61.9%. Comparing the level of pain between different stages of PJI, the most severe pain was encountered at the early stage and the least severe pain was witnessed in patients at the delayed stage.

Total 18 of 21 patients (86%) developed movement limitation of prosthetic hip joint after surgery. Of these, 18 of these patients (61.9%) included limitation of movement and pain.

Table 3 illustrates the SIRS occurring in our participants. SIRS, manifested in 66% of the cases, occurs 100% at the early stage, rarely occurs at delayed- and late stage. Research on the traumatic features of hip replacement indicates that fistulas, with different numbers, at different levels and positions, accounted for 95%. These figures are significant at $p<0.01$.

Paraclinical characteristics

To assess the severity of PJI, we included below criteria: ESR and CRP, the culture of joint fluid. The CRP test has only started routinely since 2015. As in our study, we included the small sample size of 21 patients, we did not use this index for the calculation. For blood sedimentation tests (Table 4), the value for the first hour increased in 100% of the cases, ranging from 19 to 140 mm, with an average value of 53 ± 26.8 mm. The highest figure was 61±34.2mm, spotted in early stage ($p<0.05$) (Figure 1).

Table 1: The proportion of clinical syndromes of hip joint pain according to Fritzgerald's segment on study group.

Manifestation	Stages according to Fritzgerald			Σ
	Early	Delayed	Late	
No pain	1 (10.0)	6 (85.7)	1 (25.0)	8 (38.1)
Pain but not significant	1 (10.0)	1 (14.3)	0 (0.0)	2 (9.5)
Pain, must use painkiller like aspirin	0 (0.0)	0 (0.0)	2 (50.0)	2 (9.5)
Pain, must use painkiller stronger than aspirin	6 (60.0)	0 (0.0)	1 (25.0)	7 (33.3)
Pain and restriction of hip joint movements	2 (20.0)	0 (0.0)	0 (0.0)	2 (9.5)
Sum	10 (100.0)	7 (100.0)	4 (100.0)	21 (100.0)

Table 2: Limitation of hip joint movement.

Hip mobility	Pain	No pain	Σ No. (%)
Limited	13 (100.0)	5 (62.5)	18 (86.0)
Not limited	0 (0.0)	3 (37.5)	3 (14.0)
Sum	13 (100.0)	8 (100.0)	21 (100.0)

Table 3: Rate of Systemic Inflammatory Response Syndrome and Focal inflammationby each stage of Fritzgerald.

Inflammatory	Stages according to Fitzgerald			Σ (N=21)	p-value
	Early (n=10)	Delayed (n=7)	Late (n=4)		
With SIRS	0 (0.0)	5 (71.4)	2 (50.0)	7 (33.3)	< 0.01
Without SIRS	10 (100.0)	2 (28.6)	2 (50.0)	14 (66.7)	
With FI	0 (0.0)	6 (85.7)	4 (100.0)	10 (47.6)	< 0.01
Without FI	10 (100.0)	1 (14.3)	0 (0.0)	11 (52.4)	

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Table 4: ESR pre-operation.

Stages	X ± SD (mm)	p-value
All of stages	53 ± 26.8	< 0.05
Early	61 ± 34.2	
Delayed	44 ± 16.3	
Late	48 ± 16.5	

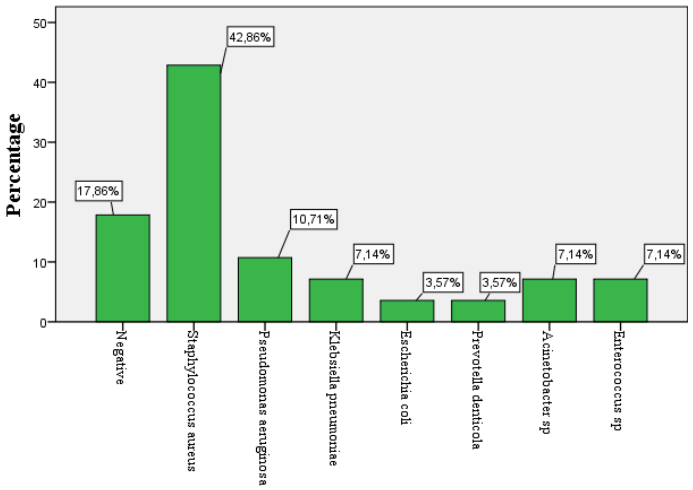

Figure 1: Results of culture of joint fluid after surgery.

The joint fluid culture showed positive results in 16/21 patients (76.2%), in which 33.3% of the samples were infected with two types of bacteria. The bacteria mostly isolated were *Staphylococcus aureus* accounting for 42.9% of all cases, and 100% of early stage cases, followed by Gram-negative bacteria (14.3%) with *Klebsiella pneumoniae, (7.14%), Escherichia coli (3.57%), and Prevotella denticola (3.57%)*; *Pseudomonas aeruginosa* (10.7%); *Acinetobacter* sp. (7.1%); Gram-positive bacteria such as *Enterococcus* sp. accounting for 7.1%.

Discussions

General characteristics

Male patients registered the number of 81%. It is significantly higher than the number of female patients (19%). This proportion is similar to the study of Tran Dinh Chien and Le Ngoc Hai (2012) in which the proportion of males and females was 88.7% and 11.3% respectively [4]. This indicates that in Vietnam, male is more likely to have a hip replacement and postoperative complication rather than female. In Vietnam, the male generally does the labor-intensive tasks in order to make a living, therefore, after surgery, they tend to work early than the expected time leading to the poor outcome of treatment and increased infection risk.

The age of patients ranged from 22 to 79 years old, with the average of 57.4 years. Over a half of participants are 55 years and older (66.7%). Other studies [4,9]. illustrated that on average, Vietnamese have hip replacement at 50-60 age old group. These findings remark the relationship between age and depressed immune response, poor healing, contributed by risk factors such as previous medical problems causing increased risk of infection after major surgery, intervention to the hip.

Before being admitted to Vietnam-Germany University Hospital, 71.43% patients had not received surgical treatment. There were only 23.81% of the cases having surgery for inflammation debridement with retention and 4.76% of the cases being treated by implant removal. This shows that the ability to diagnose and treat the disease in different levels of medical centers is not equivalent. While patients had inflammation debridement, the outcome was unsuccessful. In terms of the duration of the first hip replacement surgery to the onset of the first symptom, we subdivided the participants into three groups corresponding to Fritzgerald's three-stage classification. The early stage occurred within 1 month after surgery, accounting for 47.6%, followed by delayed stage, 1 to 24 months after surgery with the proportion of 33.3% and late stage (19%). At the early stage, the onset may be just 3 days after surgery, and in the late stages this can last up to 5 years. In the study by K. Liu (2014), the proportion of patients in the delayed and late stages accounted for almost 100% of the cases [10]. This can be explained by the fact that, in Vietnam, preoperative, postoperative and postoperative factors are significantly higher than those in developed countries [10].

Clinical presentation

Of the functional symptoms, pain is considered as one of the most annoying symptoms after surgery that causes patients to have a re-examination. It is reported that pain is also the most common symptom patients experienced after surgery with the proportion of 79% to 100% [11]. In PJI, pain occurs mostly in early stage due to post-op related mechanism, lasting in a certain period. Whereas, pain in patients undergoing antibiotic-loaded cement spacers is more likely from muscle strain, anatomical and physiological incompatibility of temporary joint, presenting by severe pain, continuously and gradually increases [11]. In our study, patients experienced preoperative pain in different levels. Comparing pain levels between stages, the most severe pain was recorded at the early stage and the least severe pain was recorded at delayed stage. As stated by Fritzgerald, pain in the early stage is the most severe. This can be explained by the fact that, in early stage, among the first month postoperatively, local injuries are healing, inflammation reaction is triggered and vigorous in structures surrounding the joint. Naturally, even if patients did not have an infection, they might have pain in different levels when rehabilitation [8].

Another common symptom is restricted range of movement of the hip joint registering 86%. There are two key situations for this. Firstly, it happens immediately after surgery because of bacterial infections, patients cannot or do not dare to continue rehabilitation training. Therefore, ROM as well as the load-bearing capacity after surgery is not ameliorated or even deteriorated comparing with that before surgery. Secondly, after a successful hip replacement, patients do a good rehabilitation, but after a period, due to bacterial infections, the function of the prosthetic joint movement is decreased. Both the situations require patients to have re-examination and additional treatment. According to Rihard Trebce (2012),

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the infection causes the artificial joint to be gradually loose and painful, even if the loose joint does not appear in all patients [8]. In the delayed stage, the most common manifestation is persistent postoperative pain, and more obvious when the joint works excessively. In some cases, the infection develops later than others, manifested by pain, gradually increasing, with limited range of motion. And at the same time, aside from pain, focal inflammation and loose joint appear. In conclusion, manifestation of the delayed stage of bacterial infections may occasionally be painful symptoms only and the loose joint may present or not [8]. Other report by DT. Tsukajama (1996), in 106 patients with prosthetic infections, the number of loose joint was 59% [12].

Of the physical symptoms of post-hip replacement infection, infection syndrome, clinically presented by fever, dry lips, dirty tongue, is systemic syndrome manifested in most of the cases at the rate of 66.7%. Infection syndrome is recorded mainly in the early stage with 100% of the cases, which is consistent with the pathophysiology of postoperative infections. According to Rihard Trebce (2012) and A.J. Tande (2014), at the early stage, the trigger cause of the disease is high virulent bacteria such as Staphylococcus aureus, which causes massive systemic symptoms. In the delayed stage, low virulent bacteria with a slower rate of accumulation of toxicity, presentations are more likely to be localized in the area around the joint rather than in the whole body. At the late stage, mainly due to decreased immune response and the appearance of spread infection through the blood stream and lymphatic system, systemic manifestations may manifest as the early stage in some cases [8, 11].

In the study on features in the hip replacement area, the most commonly encountered symptom in most of the patients is focal inflammation, in different numbers, levels and locations, accounting for 95%. Trisha N. Peel *et al.* (2012) found that the proportion was 76% [13]. Such high incidence of focal inflammation can be explained by the diagnostic criteria of the disease that there must be an infection. The local infection lasts long time, along with inflammation reaction, leading to a fissure, which is passed outside to skin.

In contrast to figure for fistula, the inflammation around the hip replacement is not the same between the subjects studied. The incidence of local inflammation was 52.4% with swelling, heating, redness, and pain at various degrees. The onset of inflammation occurred mostly in the early stage with 100% of the cases, only one case had inflammation at the time of delayed stage. This significant difference with $p < 0.01$ demonstrated that inflammation around the incision was one of the main symptoms for early diagnosis. In our opinion, in the early stage, the incision process is accompanied by the development of infection with swelling, heating, redness, and pain around the incision. At the same time, the fistula was epithelialization and gradually became chronic. The function and range of motion of joints are also significantly reduced, affecting the patient's activity. After the fistula is formed, systemic symptoms also decline. In rare cases, septicemia occurs. Patients who have had fistulas usually only tolerate within 1 year except for some cases which the wound heals spontaneously [13].

Paraclinical characteristics

In our database, blood sedimentation tests showed an increase in the first hour in 100% of the cases with an average value of 53 ± 26.8 mm. The highest value was 61±34.2mm, spotted in the early stage ($p<0.05$). This figure in the study by Alijanipour (2013) was 54.5mm in the early stage and 48.5 in the late stage. The difference between ESR among stages is understood as the pathophysiology of PJI [14]. All the above results illustrate the fact that, along with CRP, ESR is the index of high sensitivity and high specificity that is easy to approach and economical, advantageous to disease prognosis and follow-up.

Hip joint fluid cultures from all 21 joints were examined by microbial culture, bacterial identification, and antibiogram. Of these, 16 patients were true positive (76.2%), in which 33.3% of the cases were identified as infected with two types of bacteria. This proportion is similar to that in Ekpo study (79%).

According to A. J. Tande and R. Ratel (2014), the false negative results range from 5 – 35% among studies. The author also figured out that there are two main rationales for this situation. Firstly, bad joint aspiration leads to omit some infection or penetrate bacteria from other sources to sample. Especially in the late stage of infection, the infection site is generally located in deep under the skin, along with tissue surrounding the joint and on the artificial joint surface. Secondly, it results from the inaccurate usage of antibiotic protocols. Ideally, antibiotic therapy should be stopped at least 6 weeks preoperatively therefore antibiotic remains inhibiting effect on bacteria causing false negative results [11]. The bacteria that were mostly isolated included Staphylococcus aureus accounting for 42.9%, and 100% of early stage cases, followed by Gram-negative bacteria such as *Escherichia coli*, *Klebsiella pneumoniae*, *Prevotella denticola* at 14.3%, *Pseudomonas aeruginosa* at 10.7%, *Acinetobacter* sp at 7.1%, and Gram-positive bacteria such as *Enterococcus* sp. at 7.1%. According to many studies in Vietnam, *Staphylococcus aureus* is one of the most dangerous bacteria due to their high antibiotic resistance.

Conclusion and Recommendation

Clinical and paraclinical characteristics of prosthetic hip joint infection in Viet Nam in our study are generally similar to previous studies. For instance, fistulas and joint mobility limitation are the two most common symptoms of this type of infection, which accounted for 95% and 86% respectively. In terms of paraclinical characteristics, ESR increased in 100% of the cases and the highest figure was recorded in the early stage of the PJI. Bacterial cultures were positive in 76.2% of the cases.

It is further evidence of the need for surgeons to ensure strict sterilization procedures during surgery. In particular, training should be strengthened in the area of joint surgery in strict compliance with these procedures. In addition, antibiotic

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prophylaxis should be used prior to hip and postoperative surgery, and close monitoring of bacterial infection, especially bacterial culture.

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