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ORIGINAL RESEARCH

Pathogen Distribution, Drug Resistance, and Postoperative High-Quality Nursing Intervention Effectiveness in Knee Osteoarthritis Patients After Knee Arthroplasty With Postoperative Infection

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Objective: To analyze the distribution and drug resistance of pathogens in patients with postoperative infection following knee arthroplasty (TKA) for knee osteoarthritis (KOA) and to explore the effectiveness of high-quality nursing interventions postoperatively.

Methods: A retrospective analysis was conducted on clinical data from 87 KOA patients who underwent TKA and developed postoperative wound infections (infection group) at the first Affiliated Hospital of Harbin Medical University from July 2022 to September 2024. Another 87 patients without postoperative infection during the same period were selected as the control group. Deep wound exudate samples were collected from the infection group for pathogen culture, isolation, and identification. Drug susceptibility testing was performed using the K-B disk diffusion method. Additionally, venous blood samples were collected from both the infection and control groups one week after surgery, and serum levels of inflammatory markers [interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), procalcitonin (PCT)] were measured using enzyme-linked immunosorbent assay (ELISA). According to the type of nursing interventions received, the infection group was divided into the conventional care group (n=43, receiving standard orthopedic perioperative care) and the high-quality care group (n=44, receiving comprehensive high-quality care based on routine care). The pain levels [Visual Analog Scale (VAS) scores], knee joint function [Hospital for Special Surgery (HSS) knee scores], activities of daily living (modified Barthel index), and patient satisfaction [Newcastle Satisfaction with Nursing Service (NSNS) scale] were compared between the two groups.

Results: Among the 87 KOA patients with postoperative infection after TKA, 83 patients had a single pathogen infection, and 4 patients had mixed infections with two pathogens, resulting in the cultivation and isolation of 91 pathogens. Of these, 63 (69.23%) were Gram-positive bacteria, primarily Staphylococcus aureus (29.67%) and Staphylococcus epidermidis (17.58%). There were 25 (27.47%) Gram-negative bacteria, primarily Escherichia coli (9.89%) and Pseudomonas aeruginosa (6.59%). Three (3.30%) fungal strains were isolated, all identified as Candida albicans. Gram-positive bacteria showed high resistance to penicillin, benzylpenicillin, ampicillin, erythromycin, clindamycin, ciprofloxacin, and gentamicin, but low resistance to gatifloxacin, and no resistance to vancomycin or teicoplanin. Gram-negative bacteria showed high resistance to ciprofloxacin, levofloxacin, gentamicin, and tobramycin, but low resistance to cefepime, imipenem, meropenem, gatifloxacin, and amikacin. The infection group had significantly higher serum levels of IL-6, TNF-α, and PCT compared to the control group ($P<0.05$). The VAS scores at 24 hours, 3 days, and 7 days postoperatively were significantly lower in the high-quality care group compared to the conventional care group ($P<0.05$). The HSS scores and modified Barthel index scores at 3 months postoperatively were higher than preoperative values in both groups, with a greater improvement observed in the high-quality care group ($P<0.05$). The satisfaction rate in the high-quality care group (93.18%) was significantly higher than in the conventional care group (74.42%) ($P<0.05$).

Conclusion: The primary pathogens causing postoperative wound infections in KOA patients after TKA are Gram-positive bacteria, with Staphylococcus aureus and Staphylococcus epidermidis being predominant. Serum levels of inflammatory markers are

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significantly higher in infection patients compared to non-infection patients. High-quality nursing interventions can effectively alleviate postoperative pain, promote recovery of knee joint function, enhance activities of daily living, and improve patient satisfaction.

Keywords: knee osteoarthritis, knee arthroplasty, postoperative wound infection, pathogen distribution and drug resistance, high-quality nursing care

Introduction

Knee osteoarthritis (KOA) is a common chronic degenerative joint disease characterized by cartilage degradation and joint deformity, typically leading to joint pain and restricted mobility, which severely affects the quality of life of patients.[1,2] With the global aging population, the incidence of KOA has been rising, making it one of the leading causes of disability among the elderly.[3] Symptomatic treatments such as pharmacotherapy and physical therapy can only temporarily relieve symptoms and do not address the underlying pathology.[4] Therefore, knee arthroplasty (TKA) has become a widely used and effective treatment for end-stage KOA. TKA significantly improves knee joint function, reduces pain, and enhances the patient's quality of life.[5,6] However, despite the significant clinical efficacy of TKA, postoperative infection remains a common and serious complication that warrants attention. Literature[7] reports that the incidence of postoperative infection after TKA is about 1–2%, and once infection occurs, it not only increases the patient's pain but also raises the risk of secondary surgeries, affecting both the surgical outcome and the patient's prognosis. The main pathogenic factors in TKA-related infections are the invasion of microorganisms,[8] making it essential to understand the distribution of pathogens and their drug resistance characteristics to implement appropriate antimicrobial treatments to control infection effectively.

At the same time, effective nursing interventions play a crucial role in enhancing postoperative recovery and preventing infections in KOA patients. In recent years, high-quality nursing interventions, due to their individualized, systematic, and meticulous approach, have become an effective method for improving the quality of postoperative recovery in patients.[9] However, there is currently a lack of systematic studies on the effectiveness of high-quality nursing interventions in KOA patients with postoperative infection after TKA. Therefore, this study retrospectively analyzed the distribution and drug resistance of pathogens in 87 KOA patients with postoperative wound infections after TKA at our hospital. The patients were divided into groups receiving routine care and high-quality care to explore the role of high-quality nursing interventions in alleviating postoperative pain, promoting joint function recovery, and enhancing patient satisfaction, with the aim of providing clinical reference for future practices.

Materials and Methods

Study Subjects

A retrospective analysis was conducted on the clinical data of 87 KOA patients who underwent TKA and experienced postoperative incision infection (infection group) between July 2022 and September 2024 at the first Affiliated Hospital of Harbin Medical University.

Among them, 37 were male and 50 were female, aged 29–77 years, with a mean age of (55.79±16.47) years. Another 87 patients who underwent TKA without postoperative infection were selected as the control group. In this group, 34 were male and 53 were female, aged 27–76 years, with a mean age of (56.04±16.69) years. Inclusion criteria: (1) KOA was unilateral; (2) patients met the indications for TKA surgery and were undergoing TKA for the first time; (3) postoperative incision infection met the clinical diagnostic criteria;[10] (4) age ≥ 18 years, regardless of gender; (5) complete and accurate clinical data were available for analysis. Exclusion criteria: (1) open injury or history of previous knee joint trauma; (2) severe dysfunction of the heart, liver, kidneys, or other organs; (3) comorbid metabolic, autoimmune, or hematologic diseases; (4) comorbid malignant tumors; (5) comorbid other infectious diseases or pre-existing infections; (6) comorbid cognitive, communication, and/or psychiatric disorders. This study was approved by the Medical Ethics Committee of our hospital (approval number: XK-WK-24-11022).

Pathogen Identification and Drug Sensitivity Testing

For patients diagnosed with postoperative incision infection, deep incision secretion samples were collected following strict aseptic procedures. First, the incision surface was cleaned with sterile saline, and then 1–2 mL of deep secretion samples were collected using sterile suction devices or disposable sterile cotton swabs from the incision base or wall and placed in sterile tubes. The samples were sent to the laboratory for microbial culture and analysis within 2 hours. The collected samples were inoculated onto MacConkey agar and Columbia blood agar plates, incubated at suitable constant temperatures for 24–48 hours, and observed for bacterial growth. If growth was observed, further isolation and purification of the bacteria were conducted. After purification, the pathogens were identified qualitatively using an automatic microbiological analyzer (VITEK 2 Compact, bioMérieux, France). Drug sensitivity tests were performed using the K-B paper disk agar diffusion method (Kirby-Bauer method). Interpretation of drug sensitivity results followed the 2021 edition of the Clinical and Laboratory Standards Institute (CLSI) guidelines for antimicrobial susceptibility testing.[11]

Serum Inflammatory Marker Level Detection

The infection group and control group patients had venous blood (5 mL) collected in the morning, fasting, 1 week post-surgery. Blood samples were placed in vacuum tubes containing anticoagulants, and serum was separated by centrifugation at 3000 r/min (centrifugal radius 10 cm) for 10 minutes. The serum supernatant was used to measure the levels of inflammatory markers, including interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and procalcitonin (PCT), using enzyme-linked immunosorbent assay (ELISA) with a Biorad 1680 enzyme reader. The ELISA kits were provided by Shanghai Enzyme-linked Biotechnology Co., Ltd., and the procedures were strictly followed according to the manufacturer's instructions.

Nursing Methods

In this retrospective study, patients were divided into two groups based on the type of nursing intervention they received postoperatively. Specifically, the classification into the conventional care group and the high-quality care group was made after reviewing the clinical data of the patients who underwent TKA and developed postoperative infections.

The infection group consisted of 87 patients who experienced postoperative wound infections, while the control group included 87 patients who did not develop infections during the same timeframe. The division into the two nursing intervention groups was based on the treatment protocols applied during their recovery, which were recorded in their medical histories.

Patients in the conventional care group received standard orthopedic perioperative care, which included routine monitoring and basic postoperative support. In contrast, patients assigned to the high-quality care group received a more comprehensive care plan that incorporated personalized nursing strategies aimed at enhancing recovery and minimizing complications. This included individualized pain management, psychological support, dietary guidance, and tailored rehabilitation exercises.

The decision to categorize the patients into these groups was made based on their documented care experiences and outcomes, ensuring that the groups were comparable in terms of baseline characteristics. This retrospective approach allowed for an analysis of the effectiveness of different nursing interventions on postoperative recovery outcomes.In this study, patients in the infection group were divided into two subgroups based on different postoperative nursing interventions: the conventional group (n=43) and the quality care group (n=44). There were no statistically significant differences in baseline characteristics (gender, age, etc) between the two groups (P>0.05), making them comparable. The conventional group received conventional perioperative nursing interventions, including monitoring vital signs, preventing postoperative infection (refers to the measures and practices implemented to reduce the risk of infections occurring at the surgical site after a procedure. This includes strategies such as maintaining sterile conditions during surgery, administering prophylactic antibiotics when appropriate, and ensuring proper wound care and hygiene during the recovery period to minimize microbial contamination), guiding rehabilitation exercises, and providing necessary pain medication according to the patient's condition. The quality care group received comprehensive quality care in addition to conventional nursing, including the following specific measures: (1) Postoperative Communication and Psychological Guidance: After surgery, the nursing team communicated actively with patients and their families, explaining perioperative precautions and helping patients and families understand potential postoperative issues and coping strategies. Particularly for managing patients' emotional responses, the nurses provided effective psychological counseling for postoperative anxiety, tension, and fear. Through active listening, emotional support, and timely psychological guidance, patients' emotional states were adjusted, increasing their confidence in treatment and reducing anxiety. (2) Personalized Ward Care and Environment Management: To ensure a supportive recovery environment, patients in the quality care group were placed in single rooms, which helped reduce the risk of cross-infection. Nursing staff regularly disinfected the bed and equipment in the room, strictly adhering to hospital disinfectant protocols. The room was ventilated regularly to ensure air circulation, keeping the environment clean and hygienic to prevent bacterial growth. Additionally, the team meticulously implemented sanitation and cleaning protocols to provide a comfortable and safe recovery environment for patients. (3) Scientific Diet and Nutritional Guidance: In dietary management, the quality care group followed scientifically balanced nutritional principles. Nursing staff formulated meal plans that adhered to the principles of small, frequent meals, focusing on a balanced intake. Particularly, greasy, spicy, and irritating foods were avoided to reduce gastrointestinal burden, promote digestion and absorption, and provide sufficient nutritional support to aid wound healing and bone recovery. (4) Postoperative Rehabilitation Exercises and Family Training: Nursing staff designed personalized rehabilitation exercise plans based on the patient's recovery condition. These exercises focused on restoring joint mobility and strengthening lower limb muscles to enhance functional recovery and reduce postoperative complications. Additionally, family members were trained in rehabilitation care, teaching them to perform massage and limb care techniques, assisting the patient in restoring joint function and alleviating postoperative pain. (5) Continuous Nursing Quality Monitoring and Improvement: To ensure ongoing high-quality care, the quality care group received periodic nursing quality monitoring. The nursing team assessed patient recovery and summarized nursing experiences in real-time, continuously optimizing care plans to ensure that interventions achieved the best possible outcomes. Both groups underwent a 3-month period of nursing intervention followed by evaluation.

Observation Indicators

(1) Pain Level: Pain was assessed using the Visual Analog Scale (VAS)[12] at preoperative, postoperative 24 hours, 3 days, 7 days, and 14 days. The VAS score ranges from 0 to 10, with higher scores corresponding to greater pain.
(2) Knee Joint Function: Knee function was assessed using the American Special Surgery Hospital (HSS) knee score[13] at preoperative and 3 months postoperative. The score ranges from 0 to 100, with higher scores indicating better knee function.
(3) Activities of Daily Living: The modified Barthel index[14] was used to assess patients' daily living abilities preoperatively and at 3 months postoperative. The score ranges from 0 to 100, with higher scores indicating better ADL.
(4) Satisfaction: Patient satisfaction was evaluated using the Newcastle Satisfaction with Nursing Services Scale (NSNS)[15] before discharge. This 19-item scale uses a Likert 5-point scoring system, with higher scores indicating greater satisfaction. Based on scores, satisfaction was classified as very satisfied (≥76 points), satisfied (57–75 points), fair (18–56 points), and dissatisfied (<38 points). Total satisfaction = (very satisfied cases + satisfied cases) / total cases × 100%.

Sample Size

The sample size for this study was determined using the formula for comparing two proportions, considering a significance level (α) of 0.05 and a power (1 - β) of 0.80. Based on previous studies, it was estimated that the incidence of postoperative infection in knee arthroplasty patients is approximately 10% in the conventional care group. To detect a significant difference in the infection rates between the conventional care group and the high-quality care group, a minimum of 87 patients per group was required to achieve adequate statistical power. This calculation accounted for a dropout rate of 10%, resulting in a final sample size of 87 patients in each group, totaling 174 patients.

Statistical Analysis

In this study, statistical analysis was conducted using SPSS version 22.0 and GraphPad Prism version 8. Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range), while categorical variables were presented as frequencies and percentages. The independent samples *t*-test was used for comparisons between two groups for continuous data that followed a normal distribution; if the data were not normally distributed, the Mann–Whitney *U*-test was employed. Categorical data were analyzed using the Chi-squared (χ^2) test or Fisher's exact test, as appropriate. Within-group comparisons were performed using paired *t*-tests for preoperative and postoperative scores. A p-value of less than 0.05 was considered statistically significant for all analyses. Normality of continuous data was assessed using the Shapiro–Wilk test, and homogeneity of variances was checked with Levene's test. Missing data were handled using appropriate imputation methods or by excluding cases from specific analyses based on the nature and extent of missingness.

Results

Patients Characteristics

There were no statistically significant differences in baseline characteristics, such as gender and age, between the two groups ($P>0.05$), making them comparable.

Pathogen Distribution in KOA Patients With Post-TKA Incision Infections

Among the 87 KOA patients who underwent total knee arthroplasty (TKA) and developed postoperative incision infections, 83 patients had single pathogen infections, and 4 patients had mixed infections with two pathogens. A total of 91 pathogens were isolated and cultured, including 63 Gram-positive bacteria (69.23%), primarily Staphylococcus aureus (27 strains, 29.67%) and Staphylococcus epidermidis (16 strains, 17.58%). Gram-negative bacteria accounted for 25 strains (27.47%), with Escherichia coli (9 strains, 9.89%) and Pseudomonas aeruginosa (6 strains, 6.59%) being the predominant pathogens. Fungi accounted for 3 strains (3.30%), all identified as Candida albicans (3.30%). The details are shown in Table 1.

Table 1 Pathogen Distribution in KOA Patients With Post-TKA Incision Infections

Pathogen	Number of Strains (n=91)	Percentage (%)
Gram-positive bacteria	63	69.23
Staphylococcus aureus	27	29.67
Staphylococcus epidermidis	16	17.58
Coagulase-negative staphylococcus	10	10.99
Enterococcus faecalis	6	6.59
Hemolytic streptococcus	2	2.20
Enterococcus faecium	2	2.20
Gram-negative bacteria	25	27.47
Escherichia coli	9	9.89
Pseudomonas aeruginosa	6	6.59
Acinetobacter baumannii	5	5.49
Klebsiella pneumoniae	3	3.30
Enterobacter aerogenes	2	2.20
Fungi	3	3.30
Candida albicans	3	3.30

Antimicrobial Resistance in Gram-Positive Bacteria

Gram-positive bacteria showed high resistance rates to penicillin, benzylpenicillin, ampicillin, erythromycin, clindamycin, ciprofloxacin, and gentamicin, while resistance to gatifloxacin was lower. No strains resistant to vancomycin or teicoplanin were found. The resistance details are presented in Table 2.

Antimicrobial Resistance in Gram-Negative Bacteria

Gram-negative bacteria exhibited high resistance rates to ciprofloxacin, levofloxacin, gentamicin, and tobramycin, while the resistance rates to cefepime, imipenem, meropenem, gatifloxacin, and amikacin were relatively low. The resistance data are shown in Table 3.

Comparison of Serum Inflammatory Markers Between Infection Group and Control Group

The serum levels of IL-6, TNF-α, and PCT in the infection group were (23.16±2.94, 3.25±0.76, 5.38±1.12), while the control group had serum levels of IL-6, TNF-α, and PCT of (17.89±2.37, 1.96±0.53, 2.85±0.37). The levels of IL-6, TNF-α, and PCT in the infection group were significantly higher than those in the control group ($P<0.05$), as shown in Figure 1.

Table 2 Antimicrobial Resistance in Gram-Positive Bacteria (n=63)

Antimicrobial Agent	Number of Resistant Strains (n)	Resistance Rate (%)
Penicillin	62	98.41
Benzylpenicillin	58	92.06
Ampicillin	56	88.89
Erythromycin	52	82.54
Clindamycin	40	63.49
Ciprofloxacin	37	58.73
Levofloxacin	27	42.86
Gatifloxacin	18	28.57
Vancomycin	0	0.00
Teicoplanin	0	0.00
Gentamicin	35	55.56

Table 3 Antimicrobial Resistance in Gram-Negative Bacteria (n=25)

Antimicrobial Agent	Number of Resistant Strains (n)	Resistance Rate (%)
Ceftazidime	8	32.00
Cefepime	6	24.00
Imipenem	3	12.00
Meropenem	4	16.00
Ciprofloxacin	13	52.00
Levofloxacin	16	64.00
Gatifloxacin	7	28.00
Amikacin	1	4.00
Gentamicin	17	68.00
Tobramycin	14	56.00

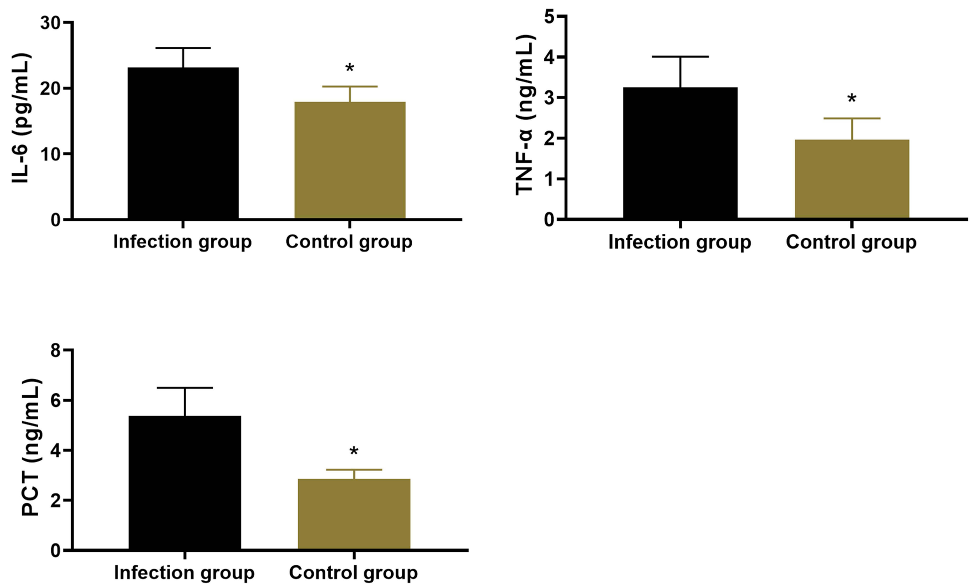

Figure 1 Comparison of Serum Inflammatory Markers Between Infection Group and Control Group.
Note: Comparison between groups, *P<0.05.

Comparison of Pain Levels Between Routine Group and Quality Group

The VAS scores for pain in the routine group were (7.02±0.93, 7.21±1.25, 6.64±0.87, 5.73±0.85, 4.21±0.68) at preoperative, postoperative 24 hours, postoperative 3 days, postoperative 7 days, and postoperative 14 days, respectively. In the quality group, the VAS scores were (6.74±1.04, 4.49±0.92, 5.13±0.80, 4.59±0.78, 4.07±0.72) at the same time points. The VAS scores at postoperative 24 hours, postoperative 3 days, and postoperative 7 days were significantly lower in the quality group than in the routine group (P<0.05), as shown in Figure 2.

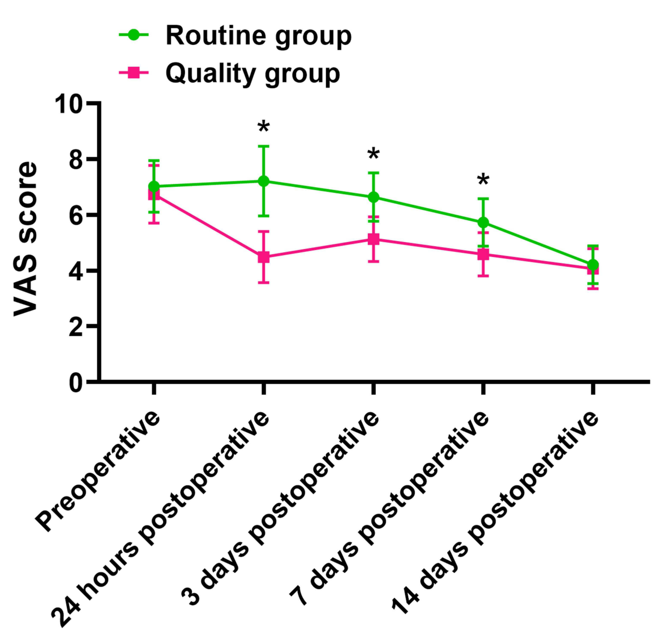

Figure 2 Comparison of Pain Levels Between Routine Group and Quality Group ($\bar{x} \pm s$, score).
Note: Comparison between groups at the same time points, *P<0.05.

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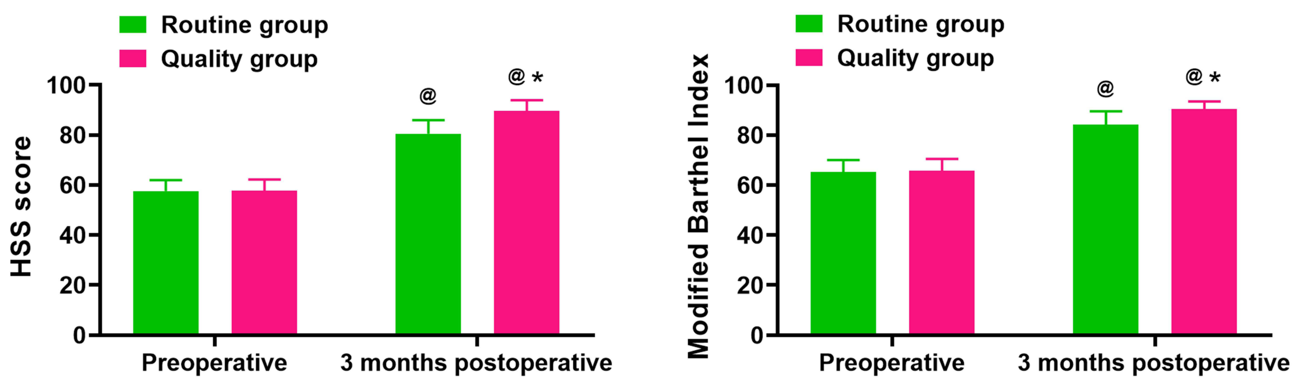

Figure 3 Comparison of Knee Function and Activities of Daily Living Between Routine Group and Quality Group ($\bar{x} \pm s$, score).
Note: Comparison with preoperative scores within the same group, @P<0.05; comparison between groups, *P<0.05.

Comparison of Knee Function and Activities of Daily Living Between Routine Group and Quality Group

The HSS scores and Modified Barthel Index at 3 months postoperatively were significantly higher than preoperatively in both groups, with the quality group showing a more significant improvement (P<0.05), as shown in Figure 3.

Comparison of Satisfaction Between Routine Group and Quality Group

The satisfaction rate in the quality group (93.18%) was higher than that in the routine group (74.42%) (P<0.05), as shown in Table 4.

Discussion

This study provides significant insights into the distribution of pathogens and their drug resistance patterns in KOA patients who developed postoperative infections following TKA. Our findings indicate that the predominant pathogens were Gram-positive bacteria, particularly *Staphylococcus aureus* and *Staphylococcus epidermidis*, which accounted for 69.23% of the isolated strains. This aligns with previous research by Weiner-Lastinger et al,[16] who reported that Gram-positive bacteria constitute a significant proportion of pathogens in surgical site infections, particularly in orthopedic procedures. The high prevalence of these bacteria can be attributed to their ability to form biofilms, which enhances their survival on skin surfaces and surgical instruments, facilitating infection during procedures.[17]

In our study, Gram-negative bacteria accounted for 27.47% of the isolates, predominantly *Escherichia coli* and *Pseudomonas aeruginosa*. This finding is consistent with reports from other studies that highlight the role of these pathogens in postoperative infections, especially in patients with pre-existing conditions like diabetes, which is common among the elderly population undergoing TKA.[18] The presence of these pathogens underscores the need for effective infection control measures during and after surgery.

The antimicrobial resistance profiles observed in this study are particularly concerning. Gram-positive bacteria showed high resistance to commonly used antibiotics such as penicillin, ampicillin, and erythromycin, while maintaining sensitivity to vancomycin and teicoplanin. This resistance pattern is congruent with findings from Liu et al, who noted

Table 4 Comparison of Satisfaction Between Routine Group and Quality Group [n(%)]

Satisfaction Level	Routine Group (n=43)	Quality Group (n=44)	x^2	*P*
Very Satisfied	13 (30.23)	18 (40.91)	–	–
Satisfied	19 (44.19)	23 (52.27)	–	–
Neutral	7 (16.28)	2 (4.55)	–	–
Unsatisfied	4 (9.30)	1 (2.27)	–	–
Satisfaction Rate	32 (74.42)	41 (93.18)	5.670	0.017

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a rising trend in antibiotic resistance among *Staphylococcus* species, driven by inappropriate antibiotic use and inadequate infection control practices. The resistance mechanisms in these bacteria often involve the production of beta-lactamases and modifications of antibiotic targets, complicating treatment options.

For Gram-negative bacteria, the high resistance rates to fluoroquinolones like ciprofloxacin and levofloxacin were noted, while lower resistance was observed for carbapenems. This finding reflects the broader trend of increasing resistance among Gram-negative pathogens in healthcare settings, as highlighted by the Centers for Disease Control and Prevention (CDC, 2019). The mechanisms of resistance in Gram-negative bacteria often involve the efflux pumps and alterations in porin channels, which limit antibiotic penetration and efficacy.

The study also assessed inflammatory markers, revealing significantly elevated levels of IL-6, TNF-α, and PCT in the infection group compared to the control group. These findings support the hypothesis that postoperative infections lead to a systemic inflammatory response, corroborating previous studies that established IL-6 and TNF-α as key mediators in the inflammatory cascade following infection.[19,20] Elevated PCT levels are particularly indicative of bacterial infections, as it is released in response to bacterial toxins and can serve as a reliable marker for diagnosing postoperative infections.[21–24]

Moreover, our investigation into the effectiveness of high-quality nursing interventions revealed significant improvements in pain management, joint function recovery, and patient satisfaction compared to conventional care. The pain levels in the quality care group were notably lower at multiple postoperative time points, demonstrating the importance of individualized pain management strategies. Previous research supports this, indicating that comprehensive nursing care can enhance recovery outcomes and patient satisfaction through tailored interventions and psychological support.[25,26]

The enhanced knee function and activities of daily living observed in the quality care group further emphasize the critical role of nursing in postoperative rehabilitation. This aligns with studies that highlight the importance of proactive rehabilitation and patient education in improving functional outcomes after TKA.[27] The combination of physical rehabilitation, psychological support, and nutritional guidance implemented in the quality care group likely contributed to the observed improvements, showcasing the multifaceted approach required for optimal postoperative recovery.

It is noteworthy that pain scores in both groups reached the same level by 14 weeks. This finding is interesting because it suggests that, despite the different interventions applied, the long-term management of pain may converge over time. This raises important questions about the effectiveness of each intervention and whether the differences observed in the short-term pain relief are meaningful in the long run. For instance, the natural healing process following surgery may play a significant role, as patients might experience a gradual reduction in pain regardless of the specific intervention used. Additionally, patients may adapt to their pain over time, altering their perception and reporting of pain levels. Furthermore, other variables such as medication adherence, participation in physical therapy, and overall patient engagement in their recovery could influence pain outcomes.

After TKA, recovery of knee joint function is a key factor in evaluating the success of the surgery, while daily living ability is an important indicator of postoperative quality of life. The HSS scores and modified Barthel Index at 3 months post-surgery in the quality care group were significantly higher than those in the conventional care group, indicating that quality nursing can significantly promote the recovery of knee joint function and daily living abilities. This could be attributed to the personalized rehabilitation guidance implemented early in the postoperative period in the quality care group, which helped patients appropriately balance activity and rest, engage in joint function exercises, and adjust rehabilitation plans through regular assessments. Patient satisfaction is one of the key measures of nursing quality. The quality care group not only performed excellently in pain management, joint function recovery, and improved daily living ability but also enhanced the patients' sense of safety and trust through detailed and personalized services such as psychological support, postoperative rehabilitation counseling, and nursing guidance. Patients highly evaluated this comprehensive, personalized, and caring nursing intervention model, providing strong evidence for the future promotion of quality nursing in clinical practice. Additionally, postoperative incision infections not only extend the hospital stay but can also lead to severe complications, potentially affecting the patient's quality of life and postoperative rehabilitation.[28] Although this study did not directly compare the impact of quality nursing on incision infection rates, effective nursing interventions can reduce pain, promote functional recovery, and improve satisfaction, which may indirectly lessen the negative effects of incision infections on patient recovery. Therefore, quality nursing has significant potential in reducing the occurrence of incision infections and accelerating postoperative healing.

Findings by Yeh et al[29] indicate that individuals with OA often experience indecision regarding TKA due to a variety of concerns. These concerns encompass treatment-related factors, physical condition-related issues, surgery-related apprehensions, and apprehensions about postsurgical care. Such insights highlight the complexity of decision-making in patients considering TKA and suggest that a multifaceted approach is essential for understanding the factors influencing their acceptance or rejection of this surgical intervention. Therefore, future research should explore these dimensions thoroughly to provide a more comprehensive understanding of the barriers and facilitators affecting patients' decisions regarding TKA.

However, the possibility of this extensive intervention being replicated and applied in clinical practice is a critical consideration. The multipronged nature of the intervention raises questions about its feasibility and practicality in diverse healthcare settings, particularly those with limited time and resources. From a resource standpoint, the implementation of such an intervention may require significant staffing and material investments. This raises concerns about whether healthcare facilities, especially those in underserved areas, can allocate the necessary resources to replicate the intervention effectively. It is essential to identify which components of the intervention provide the most significant benefits, as this knowledge could allow for a more focused approach that prioritizes essential elements while possibly reducing resource demands. Moreover, the time commitment involved in delivering the intervention must be considered. Healthcare professionals often face competing demands, and integrating a complex, multipronged intervention into their workflow could be challenging. Therefore, exploring the potential for simplifying the intervention or providing training that allows for efficient implementation will be vital. Additionally, understanding the specific outcomes improved by each aspect of the intervention will be helpful for clinicians. This knowledge can guide the adoption of the most beneficial components in practice while making necessary adjustments to fit the operational realities of different clinical environments.

Although this study has made progress in exploring the distribution of pathogens and antibiotic resistance in KOA patients with TKA postoperative incision infections, as well as the effect of quality nursing interventions, there are still some limitations and shortcomings, which include the following aspects: (1) Small sample size, limited representativeness of the data: This study included only 87 KOA patients with TKA postoperative incision infections. While this sample size provides some statistical significance, the relatively small sample may affect the generalizability of the study results, especially in different regions and populations. Moreover, the study was limited to a single hospital, which may introduce regional bias and affect the applicability of the results. (2) Lack of long-term follow-up data: The observation period for this study was 3 months post-surgery. Although quality nursing significantly improved patients' pain levels, functional recovery, and satisfaction in the short term, long-term follow-up data is lacking. Evaluating long-term effects is essential for further confirming the impact of quality nursing on maintaining knee joint function, preventing incision infection recurrence, and improving patients' long-term quality of life. (3) Uncontrolled potential confounding factors: Although this study analyzed the changes in inflammatory markers such as IL-6, TNF-α, and PCT, the occurrence of postoperative incision infections is influenced by various factors, such as preoperative antibiotic use, the patient's preoperative health status, and the precision of the surgical procedure. In addition, the intervention implemented in this study was multipronged, making it challenging to determine which specific components contributed most significantly to the observed benefits or which outcomes were improved. This complexity highlights the need for further exploration to analyze the individual elements of the intervention. Due to the lack of independent evaluation of each component's effectiveness, we cannot clearly understand the relative contributions of each element to patient outcomes. For instance, if the intervention included aspects such as medication management, physical therapy, and psychological support, future research should focus on assessing the effectiveness of each component separately. This could involve quantitative measures, such as pain scores and recovery times, as well as qualitative feedback from patients regarding their experiences with each aspect of the intervention. Therefore, additional research aimed at evaluating the individual components of this multipronged intervention is necessary to elucidate the mechanisms driving positive results and guide the effective replication of the intervention in clinical practice. These potential confounding factors were not adequately controlled, and thus, the study results may have been affected by these unconsidered factors, reducing the accuracy and reliability of the conclusions.

Conclusion

In summary, this study provides valuable insights into the distribution of pathogens and their antibiotic resistance in patients with postoperative infections following TKA for KOA. The primary pathogens identified were Gram-positive bacteria, particularly Staphylococcus aureus and Staphylococcus epidermidis, which displayed high resistance to several commonly used antibiotics. Additionally, patients with postoperative infections exhibited significantly elevated serum levels of inflammatory markers compared to non-infected counterparts, underscoring the impact of infections on inflammatory responses.

The findings also highlight the effectiveness of high-quality nursing interventions in enhancing postoperative recovery. Patients receiving comprehensive nursing care experienced reduced pain levels, improved knee function, enhanced activities of daily living, and higher satisfaction rates. These outcomes suggest that high-quality nursing plays a crucial role in mitigating the negative effects of postoperative infections and promoting overall recovery in KOA patients after TKA.

Ultimately, this study emphasizes the need for targeted antimicrobial strategies and the implementation of high-quality nursing practices to improve patient outcomes in the postoperative setting. Further research with larger, multi-center studies and long-term follow-ups is warranted to validate these findings and enhance the generalizability of the results.

Data Sharing Statement

All data generated or analysed during this study are included in this published article. This study was approved by the ethics committee of the Second Affiliated Hospital of Harbin Medical University. Informed consent was obtained from all study participants. All the methods were carried out in accordance with the Declaration of Helsinki.

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Disclosure

The authors declare that they have no competing interests in this work.

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