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Original Article

Spinal Implants Can Be Retained in Patients with Deep Spine Infection: A Cohort Study
深層脊椎感染的患者可以保留脊柱植入物 - 一項隊列研究

Hey Hwee W.D. [a, *], Ng Li W.N. [a], Kumar Nishant [a], Lau Tze-Chun E. [a], Thambiah Joseph [a], Kumar Naresh [a], Lau Leok-Lim [a], Liu Ka-Po G. [a], Vasudevan Anupama [b], Fisher Dale [b], Wong Hee-Kit [a], Tambyah Paul A. [b]

[a] University Orthopaedics, Hand and Reconstructive Microsurgery Cluster, National University Health System, Singapore
[b] Department of Medicine, National University Health System, Singapore

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ABSTRACT

Background/Purpose: It is unclear whether implant removal is necessary when deep spine infection of spinal instrumentation occurs. This study compares mortality, relapse, and reoperation rates between such patients with and without removal of spine implants.
Methods: A total of 20 patients were retrospectively reviewed. Baseline characteristics of the implant removal and nonremoval groups were compared. Outcome measures between groups were compared using multivariable logistic regression and predictors of each outcome identified.
Results: There were no significant differences in mortality, relapse, or reoperation rates between groups. Multiple vertebral level involvement was common (85%), and the L4 (30%) and L5 (35%) levels were most commonly involved. The majority of patients had osteomyelitis/spondylodiscitis (50%) and *Staphylococcus aureus* infections (60%). Thoracic spine infection was associated with relapse (odds ratio = 1.26) and reoperation (odds ratio = 1.101).
Conclusion: Implant removal is not always necessary in cases of deep spine infection as retention of implants is not associated with higher mortality, relapse, or reoperation rates.

中 文 摘 要

背景/目的: 目前還不清楚是否需要在已有脊柱內固定植入物發生深層脊椎感染時將脊柱植入物移除。這項研究比較了有移除或沒有移除脊柱植入物的患者之間的死亡率、復發率和再手術率。
方法: 回顧性分析20例受試者。比較植入物去除和未去除組別的基線特徵。以多變量邏輯和預測因子將兩組別每個確定的結果測量進行比較。
結果: 兩組別之間的死亡率、復發率或再手術率無　　統計學意義的差異。多站點脊椎發生是常見的(85%)。L4(30%)和L5(35%) 最常見的。大多數患者有骨髓炎/脊椎椎間盤炎 (50%) 和金黃葡萄球菌感染(60%)。胸椎感染與復發 (OR=1.26) 和再次手術 (OR=1.101)有關。

Introduction

Deep infection involving the instrumented spine is an unfortunate complication of spine surgery with an incidence ranging from 0.2% to 6.7%.[1–4] Infection could result from haematogenous seeding, adjacent spread, or contamination during the time of spinal instrumentation.[5–7] Management should aim at timely diagnosis[8] and instituting early treatment. This often involves a prolonged course of appropriate antibiotics, surgical debridement, with or without the removal of existing implants.[8]

Microorganisms form a layer of biofilm on implants, leading to difficulty in eradication, and frequent relapses.[9] The surgical dilemma is whether the spinal implants should be routinely removed to aid bacterial clearance, or should they be retained to provide spinal stability.

* Corresponding author. *E-mail:* dennis_hey@nuhs.edu.sg.

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When stabilization is critical, removal of implants may lead to neurological sequelae, problems with brace fitting or prolonged bed immobilisation that has to be balanced with the potential benefits of eradicating infection and reducing recurrence.[10]

In this study, we compared the outcomes in terms of mortality, relapse, and reoperation in patients with spinal instrumentation who either underwent implant retention or removal. We hypothesized that there would be no difference in any of the outcomes between these two groups.

Methods

This was part of a large retrospective study of all patients with pyogenic deep spine infection treated at an academic medical centre in Singapore from 1999 to 2012.[11] The hospital is a tertiary healthcare centre with seven spine specialists and eight active infectious disease specialists. Surgery for all deep spine infection was decided based on a clinical consensus made during grand rounds attended by the same panel of spine specialists in consultation with the infectious disease team.

This study defined deep spine infection as patients with clinically and radiologically apparent typical features, with or without the isolation of microorganisms because of the well-documented risk of false-negative sampling.[12,13] Patients without radiological evidence of deep spine infection were excluded. In our inclusion criteria, patients had clinical features of back pain or constitutional symptoms (fever, loss of weight and appetite) and radiological evidence on magnetic resonance imaging (MRI) scans, including increased signal intensity on T2-weighted images in the vertebral body or disc space, or decreased signal intensity in the disc and adjacent endplates on T1-weighted images, with or without the presence of epidural and paraspinal abscesses. Patients with suspected tuberculous infections, which are endemic in the region, were excluded.

All study patients were identified from electronic databases maintained by both the orthopaedic and infectious disease departments. Further verification was performed by two independent auditors not directly involved in the study, to ensure that all patients met the inclusion criteria before enrolment.

Following Domain Specific Institutional Review Board and National Ethics Domain Specific Review Board approval (reference number: 2011/02010), all electronic documentations and hardcopy medical case records were reviewed. The main outcome data collected included patient mortality, relapse of deep infection requiring only further antibiotics, and reoperation for deep spine infection. Patient characteristics and other possible predictors of poor outcome were also collected. They include demographics, comorbidity, clinical presentation, details of spine infection (radiological, laboratory, and microbiological findings), antibiotics treatment, and surgical details (debridement and surgery).

All data were collected by a single doctor and audited by an independent orthopaedic specialist for accuracy. Any doubt in the clinical documentation was clarified with the primary team managing the patient. All radiological images inclusive of X rays, computed tomography, and gadolinium-enhanced MRI were reviewed by two additional orthopaedic surgeons not directly involved in the study. If there was any discrepancy in the interpretation of these images, another musculoskeletal radiologist was consulted and a consensus was reached.

All patients were followed up for the three outcome parameters up to a minimum of 2 years duration or if a positive outcome occurred, whichever was shorter. All patients whose medical records showed a loss to follow-up were also contacted to ensure that they did not visit another hospital for relapse of infection requiring treatment.

Statistical analysis

All information collected was entered into Microsoft Excel Spreadsheet 2011 (version 14.0.4760.1000, 32-bit; Microsoft Corporation, Redmond, WA, USA) and analysed using SPSS version 16 (SPSS Inc., Chicago, IL, USA). Statistical significance was set as $p < 0.05$ for all computations. Univariate analysis was performed for baseline patient characteristics between those with implant removal and those without using χ^2 and t tests. Multivariable logistic regression modelling was subsequently used to determine the differences in both groups in terms of outcome measures, while adjusting for confounders. Odds ratios (ORs) are represented and significant predictors of each outcome were also identified.

Results

This study included 20 patients who satisfied the inclusion criteria. There were 12 men (60%) and eight women (40%). Their mean age was 52.6 (standard deviation, 18.4) years. Out of the 20 patients, seven had diabetes mellitus (35%) and two had chronic renal failure (10%). At presentation, 13 patients (65%) had significant back pain, seven patients (35%) had persistent fever, and five patients (25%) had new-onset neurological deficits. Table 1 shows the baseline characteristics of the patients who were similar for both groups.

The most commonly involved level of the spine was the lumbar region, specifically at L4 and L5, which was involved in 30% and 35% of the patients, respectively. Multiple vertebral level involvements occurred in 85% of the patients. The prevalence of osteomyelitis/spondylodiscitis (50%), epidural abscess (45%), and paravertebral/psoas abscess (40%) was similar. There was no significant difference in the mean total white blood cell count, erythrocyte sedimentation rate, and C-reactive protein values for both groups. No patients presented with pathological fractures in our cohort.

Microorganisms were identified in 19 patients (95%). *Staphylococcus aureus* was the most common causative organism isolated (60%),[14,15] followed by *Klebsiella pneumoniae* (15%). In our institution, cefazolin is the empirical antibiotic of choice when a deep spine infection is suspected. It is started promptly after cultures have been taken from the patient and changed accordingly based on definitive culture results. All empirical antibiotics started were ultimately effective against the microorganism with the exception of two patients (1 patient from each group). In these patients, the antibiotic was adjusted accordingly soon after culture results were available. Intravenous antibiotics were converted to oral antibiotics for all patients upon reduction of all inflammatory markers (total white blood cell count, erythrocyte sedimentation rate, C-reactive protein) below 50% of the peak values. They were only stopped after 6 weeks to 3 months of treatment if the patient also had resolution of clinical features, and supporting evidence from an interval gadolinium-enhanced MRI if available.

In our series, 17 patients (85%) had one operation and 16 patients (94%) were successfully treated with follow-up antibiotics for a total duration of 3 months. Three patients (15%) required two operations and all were successfully treated with follow-up antibiotics for a total duration of 3 months. No patients required more than two operations. All cases had a low suction drain connected to the surgical site that was only removed when not needed.

When comparing patients between the two groups for outcome variables, there was no difference in mortality, relapse, and reoperation rates. Under multivariate analysis, thoracic spine infection was the single parameter found to be associated with higher relapse (OR = 1.26, 95% confidence interval = 1.097–1.447) and reoperation rates (OR = 1.101, 95% confidence interval = 1.037–1.168). Table 2 shows the results for the three different outcomes in this study