Postoperative Wound Infection Rates after Posterior Instrumented Spinal Surgery in Diabetic Patients

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Background: Diabetes mellitus is thought to be a risk factor for surgical site infection. There have been no reports about the infection rate in diabetic patients who have undergone posterior spinal instrumented fusion. We present a retrospective analysis of infection rates after posterior spinal instrumented fusion in diabetic and non-diabetic patients.

Methods: Of 337 patients who underwent posterior spinal instrumented fusion between 1995 and 1997, 39 were diabetic. Plasma glucose concentration, body mass index, type of instrument, operation time, blood loss, hospital stay and complications were recorded. The pathogenic organism and treatments for infection were also described.

Results: The rate of wound infection in diabetic patients was 10.3% compared with 0.7% in non-diabetic patients ($p = 0.003$). Body mass index and preoperative blood sugar were also significantly different between the two groups ($p = 0.02$, $p < 0.001$).

Conclusions: Patients with a diabetic history or preoperative hyperglycemia had a higher infection rate after posterior spinal instrumented fusion when compared with non-diabetic patients.

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Key words: posterior instrumented fusion, wound infection, diabetes mellitus.

Diabetes mellitus (DM) is a systemic disease that alters the metabolism of blood sugar. Patients with DM incur risk of numerous systemic and complication-related microangiopathies and neuropathies. There is a widely held belief that infections are usually more frequent and severe in diabetic patients. Di Palo et al. demonstrated that diabetic patients had a considerably higher rate of septic complications in clean surgical procedures.[1] However, Hjortrup et al. reported on 224 controlled match DM and non-DM cases who received vascular surgery or abdominal surgery, and found no difference in wound infection rates between these two groups.[2] Wimmer et al. analyzed 850 patients who underwent spinal procedures and argued that DM was a predisposing factor for infection in spinal surgery.[3] Simpson et al. compared 62 diabetic patients who had posterior decompression surgery with 62 age and sex-matched non-diabetic patients who had had a similar procedure.[4] There were high rates of postoperative infection, prolonged hospitalization and poorer postoperative results among the diabetic patients.

With the development of spinal implants, posterior instrumentation spinal surgery is becoming increasingly common. The purpose of this study was

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to analyze the infection rates of diabetic patients who underwent posterior instrumented spinal surgery.

METHODS

Between January 1995 and December 1997, 348 patients with lumbar spondylolisthesis underwent posterior instrumentation surgery by the corresponding author in our department. Three patients died of causes unrelated to surgery. Eight patients were lost to follow-up in the year after surgery. A total of 337 patients were enrolled in the study. There were 305 patients with degenerative spondylolisthesis and 32 with spondylolytic spondylolisthesis. Prophylactic antibiotics were used for all patients: all patients received intravenous cefamezine (500 mg) 30 minutes before surgery and the antibiotics were continued for three days (intravenous cefamezine 500 mg six hourly). Duration of clinical follow-up was for a minimum of one year. The patients' gender, age, DM history, body mass index, preoperative plasma sugar, operation time, blood loss, fusion level and length of hospitalization were recorded. Wound infection characterized by wound erythematous changes, partial wound dehiscence with purulent discharge and wound culture data was obtained from the charts. The time between surgery and infection onset, culture data and management of infection were also recorded. Patients were classified as DM if they had a history of DM with medication controls or had symptoms of DM plus a preoperative plasma glucose concentration over 200 mg/dl.[5] Body mass index was measured as weight/height^2 (Kg/m^2).

Of the 337 cases, 59 cases were male and 278 were female. There were 298 patients in the non-DM group and 39 patients in the DM group. Of the 39 diabetic patients, 30 had a DM history with medical controls and the other nine patients had no DM history but preoperative blood sugar concentrations over 200 mg/dl. The average follow-up period was 32.6 months (range 12~68 months). Thirteen patients had had previous spinal surgeries.

Statistical methods

Statistical analysis was performed using the t-test for comparison of body mass index, preoperative plasma sugar, blood loss, operation time and hospitalization day. The Fisher's exact test was utilized to assess the infection rates and diagnosis for both groups. The Chi-square test was used for analysis of gender and fusion levels.

RESULTS

The majority of patients in both groups were 60 or 70 years old. (Fig. 1) Of the male patients, 53 were in the non-DM group and six were in the DM group. A total of 245 female patients were classified as non-DM and 33 as DM. There was no statistically significant difference in gender distribution among the two groups ($p = 0.711$). Thirty-five patients in the DM group had degenerative spondylolisthesis and four patients had spondylolytic spondylolisthesis. In the non-DM group, 269 patients had degenerative spondylolisthesis and 28 had spondylolytic spondylolisthesis. There was no significant diagnosis-based difference between the two groups ($p = 0.776$). The mean body index in the non-DM group was 25.6 kg/m^2 (range 16.3~39.1). The mean body mass index for the DM group was 27.1 kg/m^2 (range 20.4~37.1). There was significant difference in the mean body mass index for these two groups ($p = 0.02$). There was also significant difference in preoperative plasma sugar levels in the two groups. The mean plasma sugar level in the non-DM group was 109.4 mg/dl (range 63~195); the DM group's mean plasma sugar level was 239.9 mg/dl (range 104~408) ($p < 0.001$). In the non-DM group, 182 patients underwent single-level fusion and instrumentation procedures, and 116 patients underwent multiple-level fusion and instrumentation procedures. In the DM group, 19 patients received single-level fusion and instrumentation procedures, and 20 patients received multiple-level

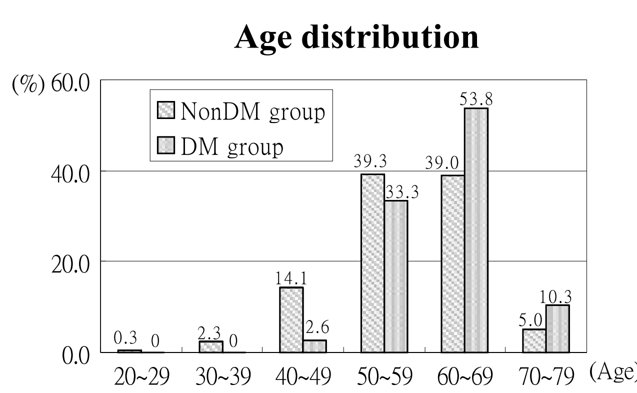

Fig. 1 Age distribution for DM and non-DM groups. The majority of patients in both groups are 60 or 70 years old.

fusion and instrumentation procedures. There was no significant difference in fusion levels between the two groups (p = 0.139). Reduction Fixator (RF) (Advanced Spinal Technology, Oakland, CA, USA) was the principal implant applied in this series (259/337).

The mean blood loss during surgery was 748 cc (range 100~3,000) for the non-DM group and 858 cc (range 200~2,700) for the DM group. The mean surgical time was 191 minutes (range 70~400) for the non-DM group and 193 minutes (range 125~310) for the DM group. The mean hospital stay was 11.4 days for the non-DM group (range 6~51) and 14.9 days (range 8~68) for the DM group. There were no significant differences between the two groups in terms of blood loss, operation time and length of hospitalization (p = 0.25, 0.72, 0.06, respectively). The DM group had a higher infection rate compared to the non-DM group (Table 1). Two patients in the non-DM group presented with infection (infection rate 0.7%, 2/298). One infected patient received oral antibiotic treatment only, while the other received debridement and intravenous antibiotic treatment. Four patients in the DM group presented with wound infection (infection rate 10.3%, 4/39) (p = 0.003). All four patients received intravenous antibiotic treatment. Three patients underwent surgical debridement. The most common pathogenic organism was staphylococcus aureus (Table 2).

DISCUSSION

Spinal infection after spinal surgery is a serious complication. Intravenous antibiotics and debridement are generally the first treatment. To eradicate an infection, implant removal is often required, although implant removal may result an unstable spine.[6-8]

Despite modern aseptic procedures and surgical techniques, patients are still susceptible to postoperative infection. Discectomy is associated with less than 1% of infections, spinal fusion without instrumentation is associated with a 1%-5% risk of infection and fusion with instrumentation is associated with a risk of 6% or greater.[9] In this series, all patients underwent posterior instrumentation for

Table 1. Data of Non-DM and DM Group in Our Series

	Gender	BMI	Sugar	Dx	Fusion level	OP time (Min)	Blood loss (c.c.)	Hospitalization (days)	Infection
Non-DM	M:53 F:245	25.59	109.4	D:269 L:28	S:182 M:116	191	748	11.4	2/298
DM	M:6 F:33	27.11	239.9	D:35 L:4	S:19 M:20	193	858	14.9	4/39
p value	0.711	0.02	< 0.001	0.776	0.547	0.72	0.25	0.06	0.003

Abbreviations: DM: diabetes mellitus; M: male; F: female; BMI: body mass index; Dx: diagnosis; D: degenerative spondylolisthesis; L: spondylolytic spondylolisthesis; S: single level; M: multiple level.

Table 2. Data of Patients with Post-operative Wound Infection in the Current Series

Group		Gender	Age	Infection	Time to onset	Culture	Management
Non-DM	1	M	55	Deep	2 weeks	ORSA	Debridement, Septopal beads deposition, intravenous antibiotics.
	2	F	61	Superficial	1 week	No growth	Oral antibiotics
DM	1	F	57	Superficial	10 days	ORSA, Klebsiella pneumonia, Proteus mirabilis	Debridement, vancomycin beads insertion, intravenous antibiotics
	2	F	78	Superficial	1 month	Pseudomonas aeruginosa, OSSA	Intravenous antibiotics
	3	M	72	Superficial	1 week	No growth	Debridement, intravenous antibiotics
	4	F	51	Deep	20 months	ORSA	Debridement, removal of implants, intravenous antibiotics.

Abbreviations: DM: diabetes mellitus; M: male; F: female; ORSA: oxacillin-resistant *Staphylococcus aureus;* OSSA: oxacillin-sensitive *Staphylococcus aureus*.

spondylolisthesis. The total infection rate was 1.8% (6/337). However, the DM group had a significantly higher infection rate than the non-DM group (10.3% vs. 0.7%) (p = 0.003). Numerous risk factors for surgical infection during spinal surgery have been discussed. Old age, obesity, diabetes, nicotine abuse and poor nutrition were identified as being related to increases in the rate of spinal surgical infection. Preoperative or perioperative steroid use, increased blood loss, prolonged operation time, prior surgery and posterior instrumentation are associated with spinal surgical-site infections.(10,11) Posterior spinal surgery has higher infection rates than anterior spinal surgery. This result is due to devascularization of paraspinal muscle produced by extensive muscle dissection required to expose the posterior elements and transverse processes. Long-term use of large retractors may also induce paraspinal muscle ischemia change. The large incisions required for instrument implantation also produce large dead spaces where hematomas can occur that carry risk of infection.(12)

In other orthopedic fields, higher rates of surgical-site infection have been observed in diabetic patients who received total knee arthroplasty or total hip arthroplasty. Yang et al. reported the results from 109 consecutive total knee arthroplasties in 86 diabetic patients and found an overall wound infection rate of 7.3%. This infection rate was higher than that of a similar study in the general population.(13) Menon et al. retrospectively studied 44 diabetic patients who had undergone 62 Charnley low-friction arthroplasty procedures. The superficial infection rate was 9.7% and deep wound infection rate was 5.6%. A statistically significant increase in the overall rate of infection was found in diabetic patients when compared to non-diabetic osteoarthritic patients. Also emphasized was the importance of treatment with prophylactic intravenous antibiotics.(14) McCormack proposed that nonsurgical treatment for relatively old diabetic patients with ankle fractures was preferable because of the higher wound complications from surgical treatment for these patients.(15)

There are two primary complications for diabetic patients: macrovascular and microvascular disease. Plaque easily forms in the circulatory systems of patients with macrovascular disease producing a high carriage rate of organisms. In patients with microangiopathy, subsequent decreased nutrition and oxygen delivery to peripheral tissue can reduce the body's ability to resist infection.(16) Poor blood sugar control will impair the leukocyte's ability for chemotaxis,(17,18) adherence,(19) phagocytosis and intracellular elimination of microorganisms.(20) In diabetic patients, delayed wound healing is a result of defective fibroblast proliferation and impaired synthesis of collagen.(21) Neuropathy with autonomic damage in diabetes produces dry, cracked skin. This mechanism destroys the integrity of skin and reduces its ability to resist infection.(22)

Can glucose control lower the risk of wound infection for diabetic patients? Zerr et al. reported on 1,585 DM patients who underwent open heart operations.(23) They identified 33 patients who developed postoperative wound infections. In the first two postoperative days, the mean blood glucose level was 208 mg/dl in the infected group but 190 mg/dl in the non-infected group. The incidence of deep wound infections was reduced after maintaining mean blood glucose at a level less than 200 mg/dl in the immediate postoperative period. Latham et al. and Estrada et al. identified that postoperative hyperglycemia (> 200 mg/dl) increased surgical-site infections among cardiothoracic surgery patients.(24,25)

For diabetic patients with spinal problems, we suggest conservative treatment first. If conservative treatment fails and surgery is indicated, ideally preoperative blood sugar should be controlled. Aggressive nutrition support and quitting smoking will be of benefit to this kind of patient. During surgery, careful surgical techniques, such as meticulous dissection, intermittent releases of retractors and debridement of devitalized tissue, can further reduce wound infection rates. After surgery, maintaining ideal blood glucose levels, monitoring wound condition closely and adequate prophylactic antibiotics are critical for diabetic patients.

We acknowledge limitations in this study. First, no uniform agreement exists as to the best definition of DM. The criterion that we have used was proposed in the textbook of DM.(5) Secondly, longer instrumented fusion requires a longer operation time and increases the opportunity for infection. It is ideal to control patients with the same level of instrumented fusion.

In conclusion, the current study confirmed that diabetic patients were associated with an increased risk of postoperative wound infection after undergoing posterior spinal instrumentation. Diabetic patients generally showed poor plasma sugar control before surgery. For diabetic patients, maintaining glucose levels below 200 mg/dl immediately after surgery reduces the incidence of wound infections. This finding may need further investigation in spinal surgery patients.

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糖尿病病人在接受脊椎後位內固定手術的術後傷口感染率

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背 景：糖尿病被認爲是造成手術部位感染的危險因子。有關於糖尿病病人在接受定脊椎後位内固定及融合手術的傷口感染機率隻前並沒有報告。因此我們回溯性分析糖尿病病人及非糖尿病病人在接受脊椎後位内固定及融合手術的傷口感染率。

方 法：從 1995 年至 1997 年，337 位病人接受脊椎後位及融合手術，其中 39 位病人是糖尿病患者。病人術前血糖濃度，重高指數，内固定器，手術時間，手術出血量，住院天數，併發症與以紀錄分析。同時敘述造成傷口感染的病菌及治療方法。

結 果：糖尿病病人在接受脊椎後位内固定及融合手術的傷口感染率爲 10.3%。而非糖尿病病人的傷口感染率爲 0.7%。這兩組病人在術前的血糖濃度及重高指數也有統計學上差異 (p 値 = 0.003)。

結 論：比起非糖尿病病人，糖尿病病人在接受脊椎後位内固定及融合手術有較高的術後傷口感染率。

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關鍵字：後位内固定手術，傷口感染，糖尿病。

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