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Mini Review

Complications of Spine Surgery in Diabetics

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Abstract

High stress periods such as surgery alter the metabolism of glucose. Generally these patients are at increased risk for higher morbidity and longer hospital stays. Bone and soft tissue healing are negatively affected by poorly controlled diabetes, which might be due to peripheral artery disease, and end stage renal disease. Wound healing is also impaired due to multiple reasons including microangiopathic changes and ischemia, impaired granulocyte function, and a lack of platelet-derived growth factor function in the wound.

Diabetes has been associated with infection, nonunion, and less favorable functional outcomes after lumbar spine procedures. Prolonged drainages and infection rate have been reported to be 6 to 34% following lumbar spine arthrodesis in diabetics. Increased need for postoperative transfusion in diabetics postoperatively is a subject of debate in the literature. Higher body mass index, which is mostly seen in diabetes type 2, is associated with increased rate of transfusion and discharge to assisted living facilities after thoracolumbar or lumbar spine fusion.

Previous studies have demonstrated the association between the DM and poor outcomes after cervical spine fusion. Diabetes has also been suggested to be a risk factor for the ossification of the posterior longitudinal ligament. There is a higher incidence of complications and hospital discharge variables in diabetics especially if it was uncontrolled. Diabetics also have less favorable recovery of lower extremities sensory and motor function form myelopathy.

There should be clear guideline regarding when the diabetes specialist should be involved. Multi-modal analgesia as well as anti-emetic medications should be used for early return to normal diet and the self-management of diabetes should be resumed as soon as safely possible. Patients with a short starvation period, which do not exceed more than one missed meal, should be managed by modification of their diabetes medication. Other patients should be given a variable rate intravenous insulin infusion. Capillary blood glucose levels should be monitored at least hourly postoperatively as well as during the procedure.

Keywords: Diabetes mellitus; Spine surgery; Complications; Cervical spine; Lumbar spine; Diabetics

Introduction

In 2010, an estimated 285 million adults were diagnosed to have Diabetes Mellitus (DM) worldwide and this number will rise to 439 million by the year 2030. The global cost for prevention and treat DM was 376 billion dollars in 2010 [1]. High stress periods such as surgery alter the metabolism of glucose. Generally these patients are at increased risk for higher morbidity and longer hospital stays [2]. Bone and soft tissue healing are negatively affected by poorly controlled DM which might be due to peripheral artery disease, and end stage renal disease. It has been reported that the complication rate of well controlled diabetic patients without comorbidities is not higher than patients without diabetes [3].

Diabetes mellitus is classified depending on the absolute need for insulin replacement and the onset of symptoms. Patients with type 1 require insulin therapy due to the beta cell autoimmune dysfunction. Most of patients with diabetes suffer from type 2 which is seen in older patients, elevated Body Mass Index (BMI), less active individuals, and patients with genetic predisposition [3]. Randomized studies have shown that optimal glycemic control is associated with better outcomes in diabetics. During the periods of increased stress like surgery insulin therapy is recommended even in patients without prior need for insulin therapy [4].

Diabetes results in macro vascular and micro vascular disease which causes a lot of complications including cardiovascular (2 to 4 fold increase) like coronary artery disease, and hypertension [5]. Wound healing is also impaired due to multiple reasons including microangiopathic changes and ischemia, impaired granulocyte function, and a lack of platelet-derived growth factor function in the wound [6-8]. Diabetes has been found to reduce the bone mineral and crystal formation in the tibial metaphysis of diabetic rats. This results in decreased biomechanical stiffness and toughness of the callus [3].

Lumbar Spine Surgery

Diabetes has been associated with infection, nonunion, and less favorable functional outcomes after lumbar spine procedures [6,9-12]. Prolonged drainages and infection rate have been reported

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to be 6 to 34% following lumbar spine arthrodesis in diabetics [12,13]. Increased need for postoperative transfusion in diabetics postoperatively is a subject of debate in the literature [10,14]. Browne et al.'s study demonstrated prolonged hospitalization and increased hospital charges after lumbar spine surgery in patients with diabetes [6]. Malony et al. did a study on 30-day outcomes on 126 patients age matched with 126 non-diabetic controls after single-level open lumbar microdiscectomy. The average length of stay, morbidity, urinary retention and hospital costs were higher in diabetics. They did not find any increased rate of readmission, emergency department visits, pain status at discharge and at 30 days, or postoperative radiculitis in diabetics [15].

Browne et al. performed a study on 197, 461 patients who underwent lumbar fusion from the Nationwide Inpatient Sample administrative. Around 11,000 patients (5.6%) had diabetes. They demonstrated that diabetes was associated with increased postoperative infection rate, need for transfusion, pneumonia, in-hospital mortality, increased hospital charges, length of stay, and non-routine discharge [6]. Cinotti et al. reviewed 25 diabetic and 25 non-diabetic patients who underwent decompression for lumbar spinal stenos is at an average of 3.4 years after operation. The preoperative symptoms were identical between the two groups except diabetics had increase rate of abrupt onset of symptoms, night pain and absence of posture-related pain relief. Peripheral vascular deficiency was diagnosed in 20% of diabetic versus 4% of non-diabetics. The outcome of surgery was similar in both groups [16].

Glassman et al. did a retrospective case-control study on 94 diabetic and 43 control patients treated by posterior lumbar instrumentation and fusion. The Non Insulin Dependent DM (NIDDM), Insulin Dependent DM (IDDM) and control groups were similar in age, gender, nicotine use, fusion levels, operative time and estimated blood loss. The complication rate increased with multilevel fusion in all groups. The nonunion rate was higher in the NIDDM (22%) and IDDM (26%) groups compared to controls (5%) [10]. Veeravagu et al. studied 24,774 patients who underwent spinal decompression and fusion using the Veterans Affairs' National Surgical Quality Improvement Program database. Postoperative infection was associated with longer hospital stay, higher 30-day mortality, and complication rates. Insulin dependent diabetes, current smoking, and ASA class of 3 to 5, were identified as predictors of postoperative infection [17].

Golinavaux et al. did a retrospective cohort study on postoperative complications of 15,480 patients after lumbar fusion using the American College of Surgeons National Surgical Quality Improvement Program database. They found that NIDDM was associated with an increased risk of wound dehiscence and longer hospital stay while IDDM was associated with higher mortality, sepsis, septic shock, re-intubation, the need to be on the ventilator for more than 2 days postoperatively, extended length of stay, 30 day readmission rate, and wound, urinary tract, and lung infections [18]. Shamji et al. demonstrated that higher body mass index was associated with increased rate of transfusion and discharge to assisted living facilities after thoracolumbar or lumbar spine fusion [19].

Guzman et al. study showed that uncontrolled diabetic patients had significantly increased rate of cardiac complications, deep venous thrombosis, length of hospital stay, greater cost and rate of mortality. Controlled diabetic patients and patients with suboptimal glycemic control had increased risk of acute complications. They recommended improving the glycemic control of the patients with uncontrolled DM, or poor glucose control [20]. In another study on 3174 patients who underwent spinal surgery at a single institution the estimated blood loss over 1 liter, previous Surgical Site Infection (SSI), and diabetes were found to be risk factors for SSI. Obesity increased the risk of superficial SSI while diabetes, obesity, previous SSI, and longer surgeries (more than 2 hours) were significant risk factors for deep SSI [21].

Deformity spine surgery

A retrospective cohort study using National Inpatient Sample (NIS) administrative data on the results of spinal fusion for idiopathic scoliosis was conducted by Patil et al. They identified 51,911 patients with a total in-hospital complication rate of 14.9% for pediatric and 25.1% for adult patients. Lower morbidity was detected among pediatric and female patients. Patients with a preoperative comorbidities (including DM with or without complications) were more prone to develop a complication. The presence of a single complication increased the mean length of hospital stay, mortality rate, and adverse outcome [22]. In a study on 5119 patients older than 40 years with deformities, 23 patients with NIDDM and 23 control (group C) patients with a minimum 2-year follow-up were selected. The number of minor and major complications as well as additional surgeries was similar between the NIDDM and control groups. The control group showed improved scores in all Scoliosis Research Society (SRS) domains and Oswestry Disability Index (ODI) preoperatively and at final follow up [23].

Cervical spine surgery

Previous studies have demonstrated the association between the DM and poor outcomes after cervical spine fusion. Diabetes has also been suggested to be a risk factor for the ossification of the posterior longitudinal ligament [24,25]. Cook et al. performed a study on 37,732 patients with myelopathy who underwent cervical fusion using the Nationwide Inpatient Sample administrative data from 1988 through 2004. They found a higher incidence of complications and hospital discharge variables in diabetics especially if it was uncontrolled [26]. Another retrospective review by Dokai et al. reviewed 78 patients with Cervical Spine Myelopathy (CSM). Thirteen diabetic and 65 non diabetic patients were included. The results showed no significant difference in the Japanese Orthopaedic Association (JOA) score before or after surgery between the two groups however the diabetics had less favorable recovery of lower extremities sensory and motor function [27]. Their study probably suffered from low sample size.

Another study used the National Inpatient Sample to identify 58,115 patients with CSM undergoing spinal fusion. The average mortality and complication rates were 0.6%and 13.4%, respectively with the pulmonary and postoperative hemorrhages being the most common complications. Patients older than 65 years showed an increase in mortality compared to younger patients. Patients with three or more comorbidities were at increased risk of complications and in-hospital mortality. The most common comorbidities in their patient population were hypertension (34.2%), lung disease (12.8%), and diabetes (10.5%) [28].

Wang et al. retrospectively reviewed 350 patients who underwent percutaneous endoscopic lumbar discectomy for single-level disc herniation. They concluded that patients with age equal or more than 60 years and diabetics were at increased risk of surgical failure [29]. Koerner et al. reviewed the subgroup analyses of the Spine Patient Outcomes Research Trial (SPORT) disc herniation studies. The results showed that, the effect of treatment were greater in patients with disc herniation at upper-levels, and non-diabetic patients at 2-year follow up [30]. Smoking, disc protrusion, and diabetes have been proven to be predictors for recurrent lumbar disc herniation in a meta-analysis done on 17 studies [31]. A single institution retrospective study with a minimum of 6 months follow up was conducted by Silverstein et al. This study demonstrated that the quality of life based on EuroQol 5-Dimensions (EQ-5D), Pain Disability Questionnaire (PDQ), and Patient Health Questionnaire 9 (PHQ-9) at the last follow-up showed no changes in diabetics while non diabetics had significant improvements in EQ-5D, PDQ, and PHQ-9 [32].

Perioperative management recommendation

A significant elevation in blood glucose levels happens following epidural steroid injections commonly used for treatment of patients with lumbar radiculopathy. The serum glucose level usually normalizes in the first 48 hours after the procedure [33]. Both the surgery and the period of starvation prior to the operation induce a catabolic state. The Joint British Diabetes Societies guidelines, commissioned by NHS Diabetes, proposed multiple recommendations for peri-operative management of diabetes. They suggested that there should be clear guideline regarding when the diabetes specialist should be involved. Multi-modal analgesia as well as anti-emetic medications should be used for early return to normal diet and the self-management of diabetes should be resumed as soon as safely possible [2]. Patients with a short starvation period which do not exceed more than one missed meal should be managed by modification of their diabetes medication. Other patients should be given a variable rate intravenous insulin infusion. Capillary blood glucose levels should be monitored at least hourly postoperatively as well as during the procedure [2].

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