European Journal of Clinical Nutrition (2005) 59, 720–722

0954-3007/05 $30.00
www.nature.com/ejcn

SHORT COMMUNICATION

Analysis of nutritional parameters in idiopathic scoliosis patients after major spinal surgery

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Objective: The aim of the study is to investigate the evolution of nutritional parameters after major spinal surgery in patients with idiopathic scoliosis.
Methods: This retrospective study included 31 patients with a mean age of 18 y, diagnosed with idiopathic scoliosis. The following variables were analyzed: demographic, surgical (type, number of fused segments, duration, and blood loss), nutritional assessment (proteins, albumin, prealbumin, transferrin, lymphocytes, and body mass index), and duration of hospitalization at different time points. Statistical analyses were performed with the SPSS 6.1 software.
Results: Before surgery, nutritional status was normal in all patients. At 24–48 h after surgery, statistically significant decrease with respect to preoperative values was recorded for all the parameters studied: proteins ($P<0.001$), albumin ($P<0.001$), prealbumin ($P<0.01$), transferrin ($P<0.001$), and lymphocytes ($P<0.001$).
Conclusion: Our results showed a significant postoperative decrease in the nutritional parameters analyzed in a previously well-nourished population considered to be at low risk for nutritional depletion.
European Journal of Clinical Nutrition (2005) **59,** 720–722. doi:10.1038/sj.ejcn.1602126
Published online 2 March 2005

Keywords: major spinal surgery; idiopathic scoliosis; nutritional assessment; nutritional parameters

Introduction

The incidence of malnutrition is high in hospitalized patients, with a range of 30–50% according to the population group and time of nutritional assessment (Jensen *et al*, 1982; Mandelbaum *et al*, 1988; Celaya, 1992; Klein *et al*, 1996; Bruun *et al*, 1999; Correia *et al*, 2003). In various clinical and surgical populations, these nutritional deficiencies have been related with increased morbidity and mortality rates (Cannon *et al*, 1944; Mandelbaum *et al*, 1988).

Jensen *et al* (1982) have reported nutritional deterioration in orthopedic surgery patients and have related nutritional status with the development of postoperative complications. Stambough and Beringer (1992) as well as Mandelbaum *et al* (1988) found a clear relationship between spinal surgery postoperative infections and nutritional depletion. MacBurney and Wilmore (1981) demonstrated a direct relationship between the magnitude of the surgical procedure and increases in caloric and protein requirements.

The documented risk factors for nutritional depletion in patients undergoing major spinal surgery are patient age over 50 y (Lenke *et al*, 1995; Klein *et al*, 1996), diagnosis of cerebral palsy (Jevsevar & Karlin, 1993; Hu *et al*, 1998), circumferential spinal surgery (Lenke *et al*, 1995; Klein *et al*, 1996; Hu *et al*, 1998), and fusion levels equal to or greater than 10 (Jevsevar & Karlin, 1993).

In a previous study by our group, the risk factors that correlated significantly with longer total parenteral nutrition (TPN) duration in major spinal surgery patients were as follows: lengthy surgery time, considerable bleeding, low

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Contributors: ***Protocol design***: MPL, MJC and JB; ***Data analysis***: JB, MPL and SC; ***Manuscript preparation***: MPL and MJC; ***Subject inclusion***: JB and CG; and ***Data collection***: SC, MJC and SG.
Abstract presented as a poster during the Congress ***Euroanaesthesia*** 2003 ***(Joint Meeting of the European Society of Anaesthesiologists and European Academy of Anaesthesiology***, Glasgow, Scotland, May-June 2003 and abstract published in: ***European Journal of Anaesthesiology*** 2003; 20 (suppl 30): S144.
Received 26 May 2004; revised 22 December 2004; accepted 2 January 2005; published online 2 March 2005

weight, diagnosis of kyphoscoliosis secondary to neuromuscular disease, and surgical intervention using a circumferential technique (Lalueza *et al*, 2000).

In the studies mentioned above, the patient populations are heterogeneous and include congenital disease and neuromuscular scoliosis. Patients with idiopathic scoliosis have been less extensively studied with regard to nutritional monitoring, since they are considered at low risk for nutritional depletion (Lapp *et al*, 2001).

The aim of the present study is to investigate the evolution of several nutritional parameters after major spinal surgery in patients with idiopathic scoliosis, considered to be at low nutritional risk.

Materials and methods

A retrospective analysis was performed in adolescent or adult idiopathic scoliosis patients undergoing major spinal surgery from January 1999 to July 2001. The following variables were recorded for each patient: demographic data (age and sex), surgical data (type and duration of surgery, operative and total blood loss, and number of fused segments), nutritional monitoring data (total proteins, albumin, prealbumin, transferrin, total lymphocytes, body mass index (BMI), and number of days hospitalized.

The study included 31 patients, 24 women and 7 men with a mean age of 18 y (s.d. 6.99; range 11–38), with adolescent or adult idiopathic scoliosis.

The surgical techniques included instrumented anterior spinal fusion in three patients, instrumented posterior spinal fusion in 25, and anterior and posterior circumferential spinal fusion (in one stage) in three patients. Mean duration of surgery was 6.2 h (s.d. 1.8; range 3.75–11.25), mean operative blood loss was 823.4 ml (s.d. 469.4; range 300–2280), and total blood loss was 1759.6 ml (s.d. 814; range 650–3900). Mean number of fused segments was 11.15 (range 4–16 segments) and in 65.6% of patients the number of fused segments was more than or equal to 10.

Fluid balance replacement was performed through the administration of cristaloid and colloid solutions. Usually, the needs are calculated by patient's body weight and the insensitive losses. If possible, fluid balance should be negative or equilibrated. All patients received autologous blood transfusion and usually, the parameters were taken after the blood was given.

All patients received TPN according to the protocol established in our unit (0.25 g of nitrogen/kg/day equal to 1.5 proteins/kg/day; 1 g of lipids/kg/day; 30 kcal not proteic/kg/day). Total parenteral nutrition was started at 24 h after surgery when the patient was hemodynamically stable, and was terminated when the patient was able to cover the nutritional requirements with oral intake. Duration of TPN was 3.6 days (s.d. 1.1; range 2–5) and mean duration of hospital stay was 10.1 days (s.d. 2.2; range 7–17). The metabolic complications of TPN were anticipated through the determinations of triglycerides, glucose, electrolytes, and hepatic and renal function at several times.

The nutritional parameters were collected at several time points, before surgery, 24–48 h after surgery, at the end of TPN administration, and at hospital discharge. Statistical analyses were performed with the SPSS 6.1 statistical package and consisted of a descriptive univariate analysis and a bivariate analysis comparing means with the Student's *t*-test for repeated measures.

Results

The patients' mean anthropometric measurements before surgery were as follows: weight 51.71 kg (s.d. 8.67; range 38–75); height 161 cm (s.d. 7.36; range 148–177), and body mass index (BMI) 19.91 (s.d. 2.94; range 15.6–28.9).

Table 1 shows mean values and s.d. at each time point for each of the biochemical and immunological parameters determined.

Mean values were normal before surgery. At 24–48 h after surgery, there was a significant decrease in all the nutritional indicators as compared to preoperative values: total proteins ($t=-8.3$; $P=0.0001$), albumin ($t=-10$; $P=0.0001$), transferrin ($t=-9.6$; $P=0.0001$), lymphocytes ($t=-9.2$; $P=0.0001$), and prealbumin ($t=-3.2$; $P=0.008$). Since postoperative values were lower than preoperative, depletion is presented in negative. Depletion of nutritional parameters at 24–48 h after surgery was as follows: proteins, −1.57 g/dl (22%); albumin, −1.12 g/dL (26%); prealbumin, −10.48 mg/dl (38%); transferrin, −95.09 mg/dl (34%), and lymphocytes, -1.3×10^9 (62%). Also, at the end of TPN, all values were significantly lower as compared to preoperative levels: total proteins ($t=-6.6$; $P=0.0001$), albumin ($t=-10.7$; $P=0.0001$), transferrin ($t=-6.7$; $P=0.0001$), lymphocytes ($t=-5.6$; $P=0.0001$), and prealbumin ($t=-2.8$; $P=0.019$).

Table 1 Results for biochemical and immunological determinations

	Before surgery	*48–72 h after surgery*	*Post-TPN*	*Discharge*	*Normal values*
Proteins (g/dl)	7.1 (s.d. 0.4)	5.6 (s.d. 0.7)	6.2 (s.d. 0.7)	7.7 (DE 0.5)	6.7–8.1
Albumin (g/dl)	4.3 (s.d. 0.3)	3.1 (s.d. 0.4)	3.3 (s.d. 0.4)	4 (s.d. 0.4)	3.4–4.8
Prealbumin (mg/dl)	27.6 (s.d. 6.9)	17.1 (s.d. 7.7)	20.2 (s.d. 8.4)	32.2 (s.d.10)	17–41
Transferrin (mg/dl)	278.3 (s.d. 67)	183.2 (s.d. 27.2)	196.6 (s.d. 36.5)	273.9 (s.d. 37)	200–260
Lymphocytes ($\times10^9$/l)	2.1 (s.d. 0.5)	0.75 (s.d. 0.2)	1.1 (s.d. 0.5)	1.7 (s.d. 0.1)	1.2–3

At hospital discharge, mean values of the parameters studied were within normal levels and individual values showed no statistical differences with respect to preoperative levels except for total proteins and prealbumin that were increased (total proteins ($t = 3.6$; $P = 0.003$), albumin ($t = -1.5$; NS), transferrin ($t = -0.5$; NS), lymphocytes ($t = -2.3$; NS), and prealbumin ($t = 3.2$; $P = 0.018$).

There is no statistical correlation between BMI and the other variables analyzed.

No infectious or metabolic complications were associated with TPN administration.

Discussion

Surgery to correct spinal deformity is highly complex and produces a severe hypercatabolic state in the patient (Boachie-Adjei *et al*, 1991) that coincides with an increase in nutritional requirements and a decrease in enteral intake. This combination of factors can produce considerable nutritional depletion in the postoperative period, which can be corrected by adequate nutritional interventions aimed toward the prevention of postoperative complications (Mandelbaum *et al*, 1988; Boachie-Adjei *et al*, 1991; Dick *et al*, 1992; Lenke *et al*, 1995).

Several factors, as patient age over 50 years (Lenke *et al*, 1995; Klein *et al*, 1996), diagnosis of cerebral palsy (Jevsevar & Karlin, 1993; Hu *et al*, 1998), circumferential spinal surgery (Lenke *et al*, 1995; Klein *et al*, 1996; Hu *et al*, 1998), and fusion levels equal to or greater than ten (Lenke *et al*, 1995) are associated with a higher risk of nutritional depletion. None of the studies included idiopathic scoliosis patients. These patients have always been considered at low risk for nutritional depletion and have been explicitly excluded from these studies.

In contrast to this line of thinking, our results showed a significant postoperative decrease in the nutrition parameters analyzed in a previously well-nourished population considered to be at low risk for nutritional depletion and receiving postoperative TPN. These data illustrate the considerable effect of the aggression involved in this type of surgery (lengthy operative time, high blood loss, complex surgical techniques) on nutritional status.

In our center, parenteral nutritional support is routinely used in the postoperative management of surgery for spinal deformity, including patients with idiopathic scoliosis (Lalueza *et al*, 2000). The justification for this policy is based on two randomized placebo-controlled trials performed by Hu *et al* (1998) and later, Lapp *et al* (2001) demonstrating the beneficial effects of nutritional support on the evolution of nutritional parameters in patients undergoing major spinal surgery.

A recent study (McMulkin & Ferguson, 2004) assessed changes in caloric requirements and substrate utilization following spinal surgery in adolescents by means of indirect calorimetry, showed a shift in substrate utilization to fat oxidation. None of the patients were being treated with parenteral hyperalimentation.

More studies are necessary to establish the parenteral support importance in adolescents, at low nutritional risk, undergoing major spinal surgery.

Acknowledgements
We thank Celine L Cavallo for translating the text.

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