Preoperative nutritional evaluation as a prognostic tool for wound healing

Luis A Marín[1], José A Salido[1] , Antonio López[2] and Agustín Silva[3]

Departments of [1]Orthopedics, Complejo Hospitalario C.Real, Spain, [2]Orthopedics, University of Alcalá. Madrid, Spain, [3]Statistics, University of Alcalá, Madrid, Spain. Correspondence: Dr. Luis Alberto Marín-Morales, C/Mata 23 2°F, ES-13004 Ciudad Real, Spain. E-mail: lammph@teleline.es
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ABSTRACT – In 170 patients given primary hip or knee joint prosthesis surgery, we determined the relation between variables connected with the preoperative nutritional state and delayed healing of the surgical wound. 46 patients had a lymphocyte count of less than 1500 cells/mm^3 (normal 1500–3300 cell/mm^3), 18 an albumin level of less than 3.5 g/dL (normal 3.5–5 gr/dL), and 35 patients had a transferrin level of less than 200 mg/dL (normal 200–400 mg/dL). We found an association between the preoperative lymphocyte count and delay in wound healing, whereas preoperative serum albumin and transferrin levels had no significant predictive value.

In addition, a preoperative lymphocyte count of less than 1500 cells/mm^3 was associated with a 3 times higher frequency of healing complications.

Malnutrition in hospitalized patients is still high. Historically, only substantial nutritional deficiencies have been recognized in time in surgical patients, yet the mildest forms have not been detected, due either to the technical difficulty of diagnosis or to lack of analytical procedures for screening (Dickhaut et al. 1984, Sullivan et al. 1999).

Malnutrition increases postoperative mortality, morbidity and rehabilitation time, the risk of infection and delays wound healing (Pedersen 1992). The inflammatory phase is prolonged, and fibroplasia impeded, which means a reduction in fibroblast proliferation, proteoglycan and collagen synthesis, neoangiogenesis, and wound remodeling (Stadelmann et al. 1998, Mora 1999, Hunt et al. 2000). In states of malnutrition, protein synthesis declines, metabolic pathways are altered, and the immune system becomes incompetent.

A preoperative nutritional evaluation by biochemical (albumin and transferrin) (Kay et al. 1987, Gibbs et al. 1999, Koval et al. 1999) and immunological (lymphocyte count) (Law et al. 1974, Greene et al. 1991) variables may help to detect patients with malnutrition.

Patients and methods

We did a cohort prospective study on 170 patients subjected to prosthetic hip or knee surgery between 1995 and 1997. They were chosen at random by their order on the waiting list for surgery. Revision surgery patients were excluded. All the operations were done in the usual operating room, with uniform prophylaxis in all cases. This study was approved by our Internal Review Board (IRB) and patients gave their informed consent.

Of the 170 patients in the study, 92 had a total hip arthroplasty (Poropalcar) and 78 a total knee arthroplasty (Duracon). Their average age was 67 (41–81) years. The etiology was arthrosis in 155 cases, rheumatoid arthritis in 9, and avascular necrosis in 6 cases.

The preoperative nutritional state was evaluated by determining the serum albumin (g/dL) and transferrin (mg/dL) levels. Their immune state was assessed by preoperative determination of the total lymphocyte count (cells/mm^3). Other demographic variables (age, gender), surgical details (diagnosis and type of operation) and concomitant diseases

(diabetes, rheumatoid arthritis, previous therapy) were also studied.

As antibiotic prophylaxis, we gave 2 g of Cefamandole a few hours before surgery, followed by 2 g intravenously every 8 hours for 3 consecutive days. If surgery lasted more than 2 hours, 100 mg of tobramycin was added postoperatively followed by 100 mg i.v. every 12 hours.

All patients were given low molecular weight heparin 12 hours before surgery and for 2 months thereafter.

For hips, we used the Watson-Jones anterolateral approach, and for knees, a medial parapatellar incision. The drainage systems were removed 48 hours after surgery and the redon tips cultured in all cases.

Delay in wound healing was defined by the following criteria (Gherini et al. 1993):

1. Persistence of wound drainage more than 3 days after surgery.
2. Separation of wound edges by more than 1 cm in width and more than 2 cm in length.

The wounds were considered infected when bacteriological cultures were positive.

Statistics

For the statistical analysis we made a descriptive study of the variables considered. We then analysed the data with logistic regression by the backward method and adjusted it according to the likelihood of the model.

Results

46 patients had a preoperative lymphocyte count of less than 1500 cells/mm^3, 18 patients an albumin level lower than 3.5 g/dL, and 35 patients a transferrin level of less than 200 mg/dL, i.e., 44% of the patients had parameters of nutritional depletion before surgery.

39 patients (23%) had delayed wound healing. 3 of them a superficial infection (2 by *Staphylococcus epidermidis* and 1 by *Staphylococcus aureus*), and 2 of these patients had low preoperative lymphocyte and albumin levels.

14 patients had been treated with corticoids or cytotoxic drugs before surgery; 5 of these had healing problems. 23 had one or more concomitant medical diseases (diabetes mellitus 9, pulmonary disease 7, heart disease 5, renal insufficiency 4, cancer 2, vascular disease 2 and hepatic disease 1) and 11 of these patients had delayed wound healing.

Table 1. Demographic analysis

	Wound healing				
	Normal		Delayed		
Variable	Mean	*SD*	Mean	*SD*	P-value
Lymphocyte (cells/mm^3)	2222	*779*	1841	*645*	0.004
Albumin (g/dL)	4.10	*0.51*	4.09	*0.56*	0.9
Transferrin (mg/dL)	237	*39*	231	*54*	0.5
Age (years)	67	*6.1*	67	*9.2*	0.9
	Normal (n)		Delayed (n)		P-value
Age: < 70 years	94		22		
> 70 years	37		17		0.08
Sex: Women	97		26		
Men	34		13		0.4
Diabetes (n)	7		2		0.9
Rheumatoid arth. (n)	9		5		0.2

SD = Standard deviation

In the logistic regression analysis, delay in wound healing was considered to be a dependent variable. To start, we did a univariate analysis with each one of the independent variables: preoperative albumin, preoperative transferrin, preoperative total lymphocyte count, age, gender, corticosteroid therapy, rheumatoid arthritis and diabetes. In this analysis, only the correlation between the total lymphocyte count and delay in wound healing was statistically significant. ($p = 0.004$). Age, divided between over and under 70 years, was associated with a delay in wound healing ($p = 0.08$). The over 70-year-old patients had an incidence of wound problems higher than 30%, while the younger patients had this lower than 20%. We found no statistically significant differences in the other variables: preoperative albumin ($p = 0.9$), preoperative transferrin ($p = 0.51$), gender ($p = 0.4$), corticosteroid therapy ($p = 0.2$) and diabetes ($p = 0.9$) (Table 1).

In the multivariate analysis, we included three preoperative nutritional variables (albumin, transferrin and lymphocyte count), age and gender. Only the total lymphocyte count showed a statistically

Table 2. Diagnosis-based nutritional parameter, mean values

Variable	Group	n	Mean	*SD*	P-value
Lymphocyte count	A	155	2132	*771*	0.8
	R	9	2188	*690*	
Albumin level	A	155	4.12	*0.51*	0.01
	R	9	3.68	*0.89*	
Transferrin level	A	155	237	*54*	0.1
	R	9	215	*68*	

A arthrosis, R rheumatoid arthritis

significant correlation (p = 0.007) with delay in wound healing, with an odds ratio of 2.2 (CI 95% 1.2–3.9). This means that for every fall in the lymphocyte count of 1000 cells/mm^3, the risk of delay in wound healing increases 2.2 times.

According to the diagnostic groups, in patients with rheumatoid arthritis we found lower mean albumin levels before the operation (p = 0.01), but similar transferrin and lymphocyte count levels compared to patients having osteoarthrosis (Table 2). Of the 155 patients with arthrosis, 121 had normal healing and 34 wound healing complications, of the 9 patients with rheumatoid arthritis, 2 had delayed healing.

Discussion

Major orthopedic surgery induces a state of malnutrition and a consequent loss of immunocompetence (Gherini et al. 1993). In addition, fractures and associated surgical procedures cause a state of hypermetabolism, which requires nutritional supplements (Pratt et al. 1981, Jensen et al. 1982). In joint prosthesis surgery, malnutrition delays wound healing, a later start of rehabilitation and a longer hospitalization (Smith 1987, Gherini et al. 1993, Del Savio et al. 1996).

Among the variables used to identify patients with nutritional deficits are anthropometric (Gherini et al. 1993) (weight, diameter of the tricipital fold, etc.), biochemical (Kay et al. 1987, Gibbs et al. 1999, Koval et al. 1999) (serum albumin, transferrin, zinc, etc.) and immunological (Law et al. 1974, Greene et al. 1991) (lymphocyte and platelet counts, etc.) indicators.

We found a statistically significant difference between preoperative albumin or transferrin values and delayed healing. In each of their studies on lower member amputations, Kay et al. (1987) and Dickhaut et al. (1984) showed a close relation between the albumin values and healing complications. Gibbs et al. (1999) found that the albumin level was a good predictor particularly of sepsis and major infections, but Gherini (1993) did not find it of value in total hip arthroplasties; only preoperative transferrin levels had a predictive value for delayed healing.

We noted a close correlation between the preoperative lymphocyte count and healing (p = 0.007), but not between albumin or transferrin levels and healing. This was also reported by Greene et al. (1991).

Corticosteroids and/or cytotoxic drugs delay wound healing (Atkinson et al. 1992). In our study, we found that 35% of the patients who took this medication had delayed healing, although it did not differ significantly from the patients who did not needthis medication (p = 0.2). However, only a few patients were in the first group (14).

We found no difference between the etiology (rheumatoid arthritis vs osteoarthritis) and delayed wound healing, although the former had lower albumin, lymphocyte count and transferrin levels than tose with a degenerative pathology, albeit with differences that were only statistically significant for the preoperative albumin levels.

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