Dopamine infusion following liver surgery prevents hypomagnesemia

H. Bacher[1], H.-J. Mischinger[1], A. Supancic[2], G. Leitner[2], S. Porta[2]

Zusammenfassung

In unsere Studie wurden 30 Patienten aufgenommen, die sich einer Leberoperation unterziehen mußten. Die Leberresektion bestand hauptsächlich aus anatomischen und nichtanatomischen Segmentektomien, links lateralen Segmentektomien, sowie aus rechten und linken Hemihepatektomien. Nach erfolgter Leberresektion wurden 15 Patienten für eine niedrig-Dosis Dopamin Infusion (2µ/kg/min) über 5 Tage randomisiert.

Trotz kontinuierlicher Dopamininfusion beobachteten wir ab dem ersten postoperativen Tag einen deutlichen Abfall des freien Dopaminserumspiegels. Zusätzlich wurden die Magnesium- und Calciumplasmaspiegel signifikant durch die Dopamin Infusion beeinflußt. Im Falle des Serummagnesiums verhinderte die Dopamininfusion einen Magnesiumabfall (Hypomagnesiämie). Die Calciumserumwerte wurden durch die Dopamininfusion signifikant schneller normalisiert.

Abstract

The study group comprised 30 patients requiring liver surgery, mainly anatomical and nonanatomical segmentectomies, left lateral segmentectomies, as well as right and left lobectomies. Following surgery, 15 were randomized to a low-dose dopamine infusion (2µg/kg/min) for 5 consecutive days. In spite of continuous infusion, free dopamine serum values were observed to fall dramatically, beginning already on the first postoperative day. However, serum magnesium and calcium levels were clearly affected by the dopamine infusion throughout the entire period of treatment, in that dopamine prevented serum magnesium from falling to hypomagnesemic values and also significantly accelerated the normalization of calcium levels.

Department of General Surgery[1], University of Graz
Institute of General and Experimental Pathology[2], University of Graz
Institute of Applied Stress Research[2], Bad Radkersburg, Austria

Introduction

The main effect of low-dose dopamine infusions (100-300 µg/min) is the stimulation of beta-adrenergic receptors resulting in positive inotropic cardioactive effects and increased coronary, splanchnic and renal perfusion. Furthermore, renal and splanchnic perfusion is stimulated by an additional specific dopaminergic receptor [1,2]. As a result, increased diuresis with subsequent sodium and potassium elimination is to be expected. Dopamine infusions over several days are therefore administered following liver surgery to improve renal perfusion and to prevent postoperative renal failure. Practical experience has demonstrated that these effects diminish during the third day of infusion therapy. This is generally considered a result of dopamine receptor down-regulation. However, to our knowledge, post-surgical effects of dopamine on blood magnesium and calcium levels have not yet been investigated.

Material and methods

Our prospective randomized study (9/95 - 6/97) included 30 patients with 13 primary liver tumors (4 hepatocellular carcinomas, 4 of focal nodular hyperplasia, 2 hepatic adenomas, 1 angio-leiomyoma), 5 livers cysts (3 congenital, 1 echinococcal, 1 neoplastic), 9 liver metastases (6 colon, 1 appendix carcinoid, 1 pancreas, 1 malignant melanoma) and 3 neoplasms of the gallbladder. According to a randomization list, 15 patients were scheduled for a dopamine infusion (2 micrograms/kg/min) for 5 consecutive days, beginning one hour after the end of the operation.

Dopamine plasma levels were determined by HPLC (Beckman Gold, electrochemical detector). Total magnesium was estimated by the Greiner method, total calcium by O-Cresolphthalein-Complexon (Hitachi 7–37). Data within each group was compared using the Wilcoxon Signed Rank test, and the unpaired t-test was used to compare the two groups with one another (Apple Stat View 4.0. statistics package).

Results

1. Dopamine plasma levels (Fig. 1)

Mean plasma levels of free dopamine increase to 54896 pg/ml in the 12 hours after beginning dopamine infusion. Then, while the infusion continues, dopamine levels already begin to fall significantly ($p=0.0009$) on the first day to 25807 pg/ml, until they approach the pre-infusion levels of 4239 pg/ml on day 5 (9507 pg/ml, $p=0.2588$).

2. Magnesium serum levels (Fig. 2)

Serum magnesium in patients receiving dopamine treatment never deviated significantly from pre-infusion values. In untreated persons on the other hand, serum magnesium levels are generally significantly decreased, reaching absolute hypomagnesemic levels [3] on day 2 ($p=0.0032$).

3. Calcium serum levels (Fig. 3)

In patients receiving dopamine infusions, the rise in serum calcium was significantly steeper ($p=0.001$), with higher end values than in non-treated patients (e.g. day 3, $p=0.0326$).

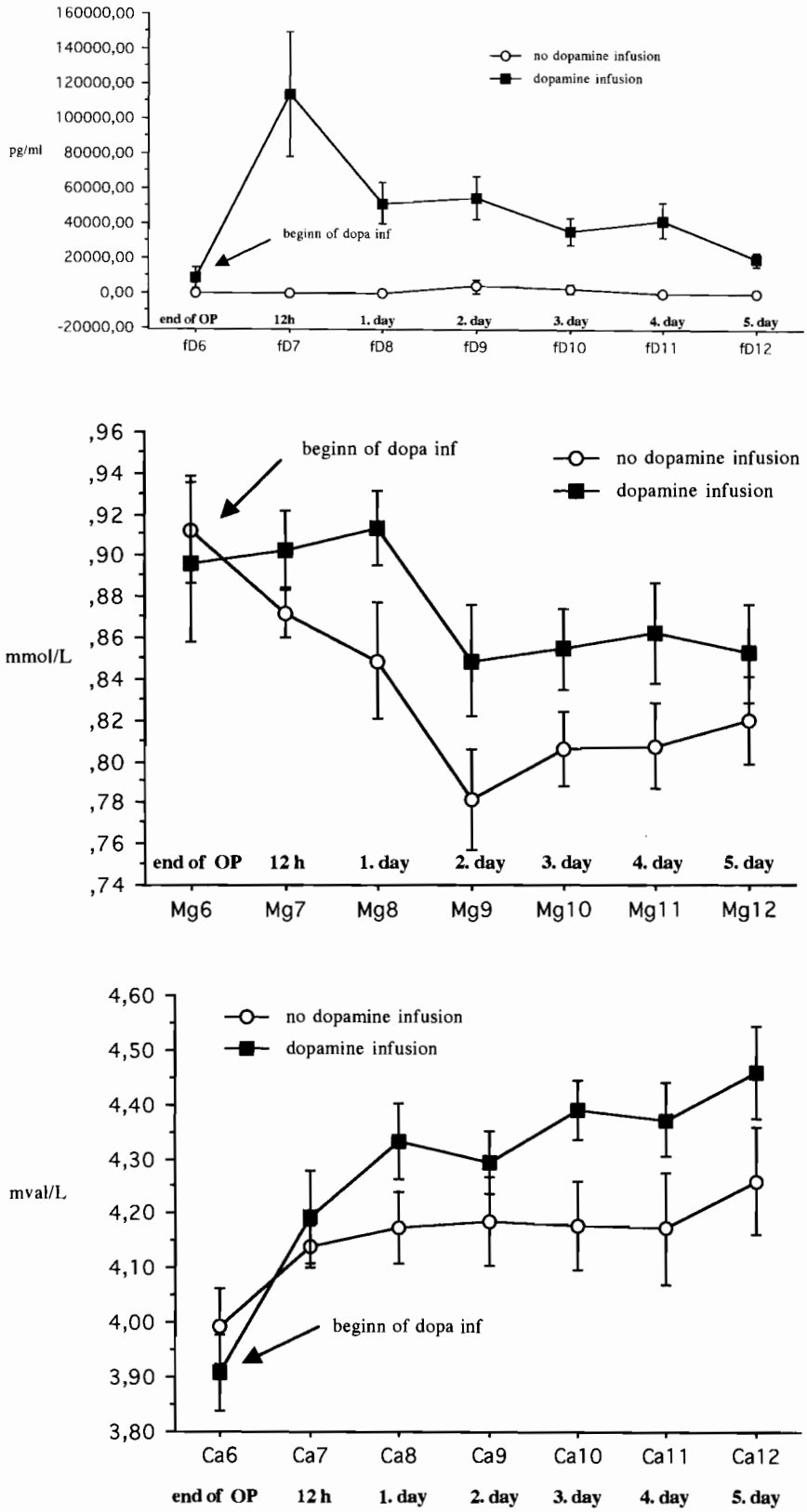

Fig. 1: Postoperative dopamine infusion (arrow: beginn at end of operation)
fD = free dopamine, Mg = magnesium, Ca = calcium
Abscissa: days of infusion; Upper ordinate: pg/ml; Middle ordinate: mmol/l;
Lower ordinate: mval/l

Discussion

The dramatic fall in serum dopamine levels in spite of continuous dopamine infusion catches the eye. The behavior of the dopamine receptors notwithstanding, the observed drop in dopamine in itself would appear sufficient explantion for the empirically observed loss of effect on renal perfusion and function. However, the blood electrolytes calcium and magnesium are obviously still affected by the infusion. The 20% drop in serum magnesium after surgery in untreated patients cannot be attributed to an intracellular magnesium shift, since no immunsuppressive agents were administered. Furthermore, it would appear that the tendency to hypomagnesemia in patients not receiving dopamine is not the result of increased renal magnesium clearance. This view is supported by the observation that magnesium levels are considerably more stable and the increase of serum calcium levels back to normal significantly steeper in infused patients, who would be expected to have a higher renal perfusion resulting from the dopamine treatment.

Consequently, a different, hitherto unknown, but rather effective anti-hypomagnesemic principle of dopaminergic action must exist in this situation.

References

[1] *Mitchell, I. M.; Pollock, J. C.; Jamieson, M. P.:* Ann. Thorac. Surg. **60**,6 (1995), 1741 - 1744.

[2] *Grey, P. A.; Bodenham, A. R.; Park, G. R.:* Anesthesia **46**,8 (1991), 638 - 641.

[3] Ergebnisse der 1. Österreichischen Konsensus Konferenz Magnesium, Zeitschrift für Mineralstoffwechsel. Sonderheft 2, 1996, 3.

Correspondence to:
Univ. Prof. *Sepp Porta,* Institute of General and Experimental Pathology, University of Graz, A-8010 Graz, Austria