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# EFFECTS OF MAJOR ABDOMINAL SURGERY ON RED BLOOD CELL DEFORMABILITY

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## 1. INTRODUCTION

Erythrocyte deformability is defined as the ability of red blood cells (RBC) to change their shape while travelling through the capillary bed of the general circulation[1]. Such deformability, influencing the blood viscosity, is the important factor in the microcirculation, and in the delivery of oxygen to the tissues[2].

Erythrocyte deformability depends mainly on three interrelated factors: the surface/ volume ratio, the viscoelastic properties of the membrane, and the viscosity of the intracellular hemoglobin solution[3]. In fact, a decrease in deformability increases the erythrocyte transit time and might reduce peripheral perfusion[4].

A reduction in erythrocyte deformability has been detected in several pathological conditions such as sepsis, chronic liver diseases and drugs therapy[5, 6, 7].

Aim of this study is to assess the modification of erythrocyte deformability, measured by LORCA essays, in patients that underwent radical surgery for major abdominal neoplasms.

## 2. MATERIALS AND METHODS

### 2.1 Patients

The study included 14 patients: 7 men and 7 women, with a mean age of 57 years. Six had gastric cancer, 5 rectal cancer and 3 colon cancer.

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### 2.2 Surgery

All patients underwent a radical surgery. Ten patients were transfused less than 500ml of concentrated red blood cells, 4 patients were not transfused at all. All had a regular recovery without any surgical complication.

### 2.3. Preparation of Blood Samples

Venous blood samples were obtained by venepuncture from an antecubital vein and anticoagulated with EDTA. The sampling times were the pre-operative day (T0) and the first (T1), the 5$^{th}$ (T5) and the 12$^{th}$ post-operative days. 200 µl of each blood sample was diluted in 5 ml of a polyvinylpyrovidone solution. The experiments were done at 37°C.

### 2.4. Determination of Erythrocyte Deformability

RBC deformability was quantified using a laser-assisted optical rotation red cell analyser (LORCA RR Mechatronics, Hoorn, The Netherlands)[8-9]. This instrument consists of a laser light, a rotating thermostatted cup and a video camera connected to a dedicated ellipse-fit computer program. It measures the diffraction pattern of the RBC under various shear stresses in the range of 0.3 to 30 Pa.

The Elongation Index (EI) was the parameter used to express RBC deformability at several shear stresses. An increased EI indicates greater cell deformability.

### 2.5. Statistical Analysis

Results are expressed as mean ± standard error (S.E.). Statistical comparison between groups was done by Student's paired *t* test. P values <0.05 were taken as statistically significant.

## 3. RESULTS

The mean preoperative EI was 0.387± 0.006 at a shear stress of 3 Pa, 0.473± 0.005 at a shear stress of 5.33 Pa, 0.568± 0.008 at a shear rate of 16 Pa and 0.595± 0.01 at a shear rate of 30 Pa. No statistically significant change of erythrocyte deformability was found on the 1$^{st}$ and 5$^{th}$ post-operative days. On the 12$^{th}$ post-operative day there was a small increase in the EI but only at higher shear stress: 0.586± 0.002 ($P<0.05$) at a shear stress of 16 Pa, and 0.6178± 0.002 ($P<0.05$) at a shear stress of 30 Pa.

## 4. DISCUSSION

In the last 10 years interest in the deformability of RBCs in different pathological diseases has increased dramatically, mainly due to the development of more appropriate and sensitive diagnostic techniques[10].

Photodynamic treatment is at the moment the best method that may be applicable in this field[11].