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Letter to the Editor

# Rheological red blood cell properties in morbidly obese and super obese patients

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In a recent paper by Wiewiora et al. published in this Journal [7], the authors observed that superobese patients (BMI >50 kg/m$^2$) show erythrocyte rheological differences when compared with morbidly obese patients (BMI >40 kg/m$^2$). In this sense, although they did not observe differences in erythrocyte deformability using the LORCA device, they found a higher erythrocyte aggregation index (AI10), a shorter erythrocyte aggregation time (Ta) and a higher erythrocyte disaggregation threshold (γD) in superobese patients when compared with morbidly obese ones. This greater tendency of erythrocytes to aggregate does not seem to be related with either plasmatic lipids or fibrinogen levels, and the authors have no explanation for this feature.

To further clarify this issue, we analyzed the rheological red blood cell properties in morbidly obese patients from a previous published study [6] by evaluating erythrocyte aggregation (AI10, Ta, γD) and erythrocyte deformability (EI) at 12, 30 and 60 Pa [2, 4, 5], along with biochemical, inflammatory and haematological parameters in 54 morbidly obese subjects and 27 superobese subjects, who were age- and sex-matched qualified for bariatric surgery.

Table 1 shows the differences in the several parameters analysed. Superobese subjects showed higher glucose levels, and AI10 ($P = 0.030$; $P = 0.012$, respectively), lower Ta and γD ($P = 0.026$; $P = 0.007$, respectively).

Pearson's bivariate correlation (Table 2) showed the correlations between erythrocyte aggregation and the other parameters analysed. In the morbidly obese, γD correlated directly with fibrinogen ($P < 0.01$), but with haematimetric indices MCV and MCH ($P < 0.05$) in the superobese.

The results of the present study indicate that superobese patients showed a higher AI10 and, correspondingly, a lower Ta, which is in agreement with Wiewiora et al. However, γD was lower than in the morbidly obese subjects, indicating that the cohesion force of the rouleaux formed was lower than in the morbidly obese subjects, which is in disagreement with Wiewiora et al. [7]. This surprising fact may

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Table 1
Anthropometric, lipidic, haematological and rheological parameters in morbidly obese and superobese subjects

| | Morbidly obese ($n=54$) | Superobese ($n=27$) | $P$ |
|---|---|---|---|
| Age (years) | $41 \pm 11$ | $41 \pm 12$ | 0.978 |
| Gender (male/female) | 16/38 | 8/19 | 1.000 |
| Weight (kg) | $118.8 \pm 15.3$ | $144.8 \pm 20.9$ | <0.001 |
| BMI (kg/m$^2$) | $44.0 \pm 3.6$ | $55.1 \pm 4.6$ | <0.001 |
| Waist (cm) | $127.3 \pm 11.7$ | $140.1 \pm 13.0$ | <0.001 |
| Glucose (mg/dL) | $97 \pm 27$ | $125 \pm 60$ | 0.030 |
| Total-cholesterol (mg/dL) | $202 \pm 45$ | $197 \pm 35$ | 0.561 |
| HDL-cholesterol (mg/dL) | $49 \pm 14$ | $50 \pm 12$ | 0.760 |
| LDL-cholesterol (mg/dL) | $127 \pm 36$ | $119 \pm 28$ | 0.304 |
| Triglycerides (mg/dL) | $143 \pm 61$ | $160 \pm 118$ | 0.386 |
| HbA1c (%) | $5.91 \pm 0.97$ | $6.66 \pm 1.89$ | 0.084 |
| Leptin (ng/mL) | $44.2 \pm 24.6$ | $42.6 \pm 28.4$ | 0.830 |
| Insulin (μUI/mL) | $23.8 \pm 15.5$ | $24.4 \pm 13.8$ | 0.863 |
| CRP (mg/L) | $8.48 \pm 6.73$ | $11.40 \pm 7.75$ | 0.097 |
| Fibrinogen (mg/dL) | $384 \pm 70$ | $391 \pm 70$ | 0.068 |
| EI 12 Pa (%) | $46.77 \pm 2.89$ | $45.72 \pm 2.27$ | 0.129 |
| EI 30 Pa (%) | $51.24 \pm 2.71$ | $50.42 \pm 2.20$ | 0.176 |
| EI 60 Pa (%) | $53.12 \pm 2.83$ | $52.64 \pm 2.26$ | 0.445 |
| Ta (s) | $1.51 \pm 0.40$ | $1.28 \pm 0.33$ | 0.026 |
| AI10 | $56.15 \pm 8.64$ | $64.64 \pm 18.12$ | 0.012 |
| γD (s$^{-1}$) | $121.6 \pm 104.8$ | $72.22 \pm 25.81$ | 0.007 |
| Haematocrit (%) | $41.6 \pm 3.1$ | $42.0 \pm 3.6$ | 0.559 |
| MCV (fL) | $87.6 \pm 5.4$ | $87.0 \pm 4.7$ | 0.627 |
| MCH (pg) | $29.1 \pm 2.1$ | $28.4 \pm 1.9$ | 0.198 |
| MCHC (g/dL) | $33.2 \pm 1.01$ | $32.7 \pm 1.32$ | 0.057 |

Table 2
Pearson's bivariate correlation in the morbidly obese and superobese between erythrocyte aggregation and the other parameters analysed

| | Morbidly obese | | | Superobese | | |
|---|---|---|---|---|---|---|
| | AI10 | Ta | γD | AI10 | Ta | γD |
| BMI | | −0.462** | | | | |
| Glucose | 0.338* | | | | | |
| HbA1c | 0.361* | | | | | |
| HDL-cholesterol | | | | 0.515* | 0.489* | |
| CRP | | −0.307* | | 0.676** | | |
| Fibrinogen | | −0.582** | 0.494** | | | |
| Haematocrit | −0.361* | | | −0.481* | | |
| MCV | | | | | | 0.453* |
| MCH | −0.335* | 0.336* | | | | 0.450* |

*$P<0.05$; **$P<0.01$.

be explained by the results obtained in Pearson's bivariate correlation in which γD related to plasmatic factors (fibrinogen) in the morbidly obese patients, whereas haematimetric indices (MCV, MCH) were related to γD in the superobese patients. In other words, in the superobese patients, γD seems to be associated with intrinsic red blood cell properties, but not with inflammatory parameters. In this sense, it is well-known that both plasma proteins [3] and erythrocyte characteristics may influence erythrocyte aggregation [1].

In conclusion, when compared with the morbidly obese, superobese patients showed higher AI10 and, correspondingly, a lower Ta, but the cohesion of the rouleaux formed was lower and related to red blood cell itself, and not to plasmatic factors. Further research should be performed to shed light on this topic.

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