Introduction

The inflammatory state of the visceral adipose tissue may therefore represent one of the biological predictors of surgery-induced weight loss. Whether and how adipose inflammation, in conjunction with systemic inflammation, in neuropsychiatric symptoms and in behavioral changes after bariatric surgery, contributes to neuropsychiatric comorbidity in this condition. The precise characterization of the inflammatory profile of obese subjects, as well as the role of adipose and systemic inflammatory profiles, is still needed so as to answer the question whether adipose and systemic inflammatory profiles predict the magnitude of bariatric surgery-induced weight loss.

The present study aimed at assessing the association of adipocytokines expression in immune cells in the visceral adipose tissue of obese patients, and their relationship with systemic inflammation.

Moreover, this study investigated the association of systemic and adipose inflammation before surgery with surgery-induced weight loss.

Methods

Visceral adipose tissue was associated with circulating levels of inflammatory markers, consistent with the contribution of the adipose tissue to obesity-related inflammation.

The inflammatory state of the visceral adipose tissue was associated with circulating levels of inflammatory markers and anti-inflammatory cytokines in obese patients, suggesting the notion that low-grade inflammation in obesity plays a role in neuropsychiatric symptoms and in behavioral changes after bariatric surgery.

The basal inflammatory state of the visceral adipose tissue may therefore represent one of the biological predictors of surgery-induced weight loss. Whether and how adipose inflammation, in conjunction with systemic inflammation, in neuropsychiatric symptoms and in behavioral changes after bariatric surgery, contributes to neuropsychiatric comorbidity in this condition. The precise characterization of the inflammatory profile of obese subjects, as well as the role of adipose and systemic inflammatory profiles, is still needed so as to answer the question whether adipose and systemic inflammatory profiles predict the magnitude of bariatric surgery-induced weight loss.

Results

Relationships between adipocytokines and immune cell subpopulations markers in the visceral adipose tissue

Adipocytokines

<table>
<thead>
<tr>
<th>Adipocytokines</th>
<th>IL-6</th>
<th>IL-1β</th>
<th>TNF-α</th>
<th>IL-10</th>
<th>IL-1β</th>
<th>MCP-1</th>
<th>Leptin</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL-6</td>
<td>0.622***</td>
<td>0.364*</td>
<td>0.439*</td>
<td>0.318**</td>
<td>0.760***</td>
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<td></td>
</tr>
<tr>
<td>MCP-1</td>
<td>0.567***</td>
<td>0.564***</td>
<td>0.760***</td>
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</tbody>
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T-Cell markers

<table>
<thead>
<tr>
<th>T cells</th>
<th>CD8 (CD49a)</th>
<th>CD4 (CD25a)</th>
<th>Th1 (IFN-γ)</th>
<th>Th2 (IL-4/IL-13)</th>
<th>Reg (CD127)</th>
<th>Th2/Th1 (IL-12/27)</th>
<th>Th2/Th1 (IL-10/27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD8 (CD49a)</td>
<td>0.368</td>
<td>0.638***</td>
<td>0.521**</td>
<td>0.506**</td>
<td>0.559**</td>
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</tr>
<tr>
<td>CD4 (CD25a)</td>
<td>0.654***</td>
<td>0.449**</td>
<td>0.451</td>
<td>0.738***</td>
<td>0.427**</td>
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</table>

Macrophage markers

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</thead>
<tbody>
<tr>
<td>CD11B (CD14L)</td>
<td>0.392***</td>
<td>0.533**</td>
<td>0.564**</td>
<td>0.776**</td>
</tr>
<tr>
<td>CD206 (CD14L)</td>
<td>0.380***</td>
<td>0.511**</td>
<td>0.382</td>
<td>0.741**</td>
</tr>
<tr>
<td>CD16/32 (CD14L)</td>
<td>0.387</td>
<td>-0.391</td>
<td>0.714**</td>
<td></td>
</tr>
</tbody>
</table>

Expression of macrophage and T-cell markers were related to adipocytokines expression in the visceral adipose tissue, supporting the role of macrophages and T cells in adipose inflammation. The absence of association of IL-6, IL-1β or MCP-1 with immune cell markers suggests that they may primarily originate from adipocytes.

Association between the visceral adipose inflammatory state before bariatric surgery and surgery-induced weight loss

The inflammatory state in the visceral adipose tissue predicted the magnitude of bariatric surgery-induced decrease in BMI. Higher pro-inflammatory profile and lower anti-inflammatory profile was related to lower reduction in BMI.

Patients and methods

Patients

Thirty-seven severely or morbidly obese patients (body mass index [BMI] > 35-40 kg/m²) awaiting for surgical treatment of obesity were included. Twenty-eight patients (76%) were successfully followed at 1-3 months after surgery (mean time: 1.3 months) and twenty-five (68%) were followed after six months after bariatric surgery (range: 6-14 months, mean time: 10.6 months).

Statistical methods

Fasting blood samples were collected before surgery for the measurement of high-sensitivity (hs) interleukin-6 (hsIL-6), hs tumor necrosis factor-α (hsTNF-α), hs C-reactive protein (hsCRP), leptin and neopterin by ELISA.

Conclusion

The present study are in line with recent data suggesting the contribution of T cells, in addition to macrophages, to the adipose inflammatory state.

In addition, our results indicate significant association between the inflammatory state of the visceral adipose tissue and circulating concentrations of inflammatory markers in obese patients, supporting the notion that lower-grade inflammation in obesity reduces, at least partially, on adipose inflammation.

Importantly, higher pro-inflammatory profile of the visceral adipose tissue was associated with reduced weight loss, while higher adipose anti-inflammatory profile was related to greater weight loss, one to three months after bariatric surgery. This association was still apparent at later stages after surgery, although to a lesser extent probably because of the additional involvement of lifestyle factors.

These results suggest that visceral adipose inflammation may modulate the efficacy of bariatric surgery on weight reduction, with increased visceral adipocyte processes associating with reduced success of the intervention. The basal inflammatory state of the visceral adipose tissue may therefore represent one of the biological predictors of surgery-induced weight loss in obese patients.

Future studies are needed in order to assess the role of adipose inflammation, in conjunction with systemic inflammation, in neuropsychiatric symptoms associated with obesity and in behavioral changes after bariatric surgery.

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