CAPELLA’S GASTROPLASTY: metabolites and early phase proteins changes in midline and bilateral arciform approaches

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ABSTRACT – Background - Obesity has adverse health effects. Dietary reeducation does not seem to offer sustained weight loss. For appropriately selected patients, surgery may be beneficial. Aim – To evaluate early postoperative metabolic response to surgery in patients submitted to Capella’s gastroplasty using two different surgical approaches to the abdominal cavity. Patients/Method - Twenty patients (9 males and 11 females, aged 21 to 53 years) were randomized prior to submission to either one of the surgical access incisions (bilateral arciform or supra-umbilical midline incisions). Blood samples were collected at the beginning and end of the operation, 12 (T -12 h) and 24 hours (T-24 h) postoperatively. Diuresis and synthesis time, blood loss, planimetry of operative field, operative time, hospital stay, hemoglobin, hematocrit, lymphocytes, potassium, albumin, erythrocyte sedimentation rate, C-reactive protein, glucose, pyruvate, lactate and ketone bodies were analyzed. Results – Diuresis time was significantly decreased when median approach was used. Total operating time, hospital stay, hematocrit, hemoglobin, lymphocyte count, potassium and albumin concentrations were similar in both groups. C-reactive protein (T-12 h), glucose and pyruvate concentrations (T-24 h) increased significantly after completion of surgical procedure. Ketone bodies concentrations were significantly decreased 24 hour following completion of surgical procedure. Conclusion - Capella's gastroplasty induces metabolic and inflammatory changes in blood parameters. There is no evidence of technical superiority of arciform over midline incisions in this study.

INTRODUCTION

Obesity is defined as a condition where the body weight is above normal pattern for height and skeleton frame associated with an excessive ingestion of calories and decreased consumption leading to significant weight gain with adverse health effects and diminished longevity.

Human obesity is accompanied by an outstanding increase of the number of adipocytes. Weight loss may decrease cellular volume; however, cell number remains elevated. Patients who develop early obesity present an increased number of adipose cells when compared to those with late onset of the illness[1,2].

Adipocytes work together as a single unit in the release of many substances such as leptin, adipsin, angiotensinogen, prostaglandins and tumor necrosis factor (TNF-alpha) among others. Leptin has been acknowledged as an adipocyte-derived signal molecule, able to limit food intake and increase energy expenditure by interacting with specific leptin receptors located in the central nervous system and in peripheral tissues. Leptin concentration in humans is directly proportional to the mass of fatty tissue. There is a clear association between weight loss and decrease of leptin (10% weight loss may occur if leptin concentration drops to 50% of original values)[3].

Even mild degrees of obesity have adverse health effects and are associated with decreased longevity. There is already considerable evidence of links between increased production of some adipocyte factors and the metabolic and cardiovascular complications of obesity[4]. Patients with body mass index exceeding 40 have medically significant obesity and a substantial risk of health hazards with concomitant reduction in life expectancy. Dietary reeducation does not seem to offer sustained weight loss. For appropriately selected patients, surgery may be beneficial[5,6].

Bariatric surgery seems to be the treatment of choice for well-informed and motivated obese patients with acceptable operative risks, who strongly desire substantial weight loss or who have severe impairments because of their weight[7,8].

This study aims to evaluate early postoperative metabolic response to surgery and the usefulness of two different surgical approaches (transverse arciform and midline incisions) to the abdominal cavity in morbid obesity patients submitted to Capella’s gastroplasty.

PATIENTS AND METHODS

Patients and study design

The study population comprised of 20 patients (9 men and 11 women aged 21 to 53 years, mean 35.5 years). Written consent was obtained from all patients before the study. The study was conducted in accordance with the Declaration of Helsinki and
was approved by the Ethics on Research Committee of the Federal University of Ceará, Fortaleza, CE, Brazil (Protocol #128.02).

**Patient’s randomization**

Patients were randomized prior to submission to either one of the surgical access incisions (transverse arciform or supra-umbilical midline incisions). The first patient was selected by single card drawing and was submitted to standard midline incision. Next patient was submitted to transverse arciform incision. The remaining odd-even patients were allocated in an alternated fashion.

**Patient’s care**

Preoperative care included complete evaluation of general health by a team of clinical specialists and multiple preoperative exams (upper digestive tract endoscopy, spirometry, gasometry, electrocardiography, abdominal ultrasound sonography and radiological examination of lungs and atlantooccipital articulation). Laboratory exams included complete blood count, coagulogram, blood glucose, urea, creatinine, total proteins and fractions, transaminases, gama-glutamyltransferase, viral markers for hepatitis, anti-HIV test, total bilirrubin and fractions, alkaline phosphatase, total cholesterol and fractions, triglycerides, calcium, potassium and zinc determinations and urinalysis. All surgical procedures were performed by the same operating team (head surgeon, two auxiliary surgeons, a scrub nurse and two anesthesiologists). Post-operative care was carried out by a multidisciplinary team composed of intensive care, cardiology, nutrition, physiotherapy and psychology specialists along with a general care nurse.

**METHODS**

All patients were submitted to general inhalatory anesthesia. Pre-anesthetic medication includedlorzepam, ranitidine, cephalozine and fraxiparine. Surgical approach was carried out according to the procedure selected during randomization. All patients were submitted to Capella’s gastroplasty (combination of vertical banded gastroplasty and Roux-en-Y gastric bypass)\(^3\). Blood samples were collected at the beginning and at the end of the surgical procedure (T-0 and T-F, respectively) and 12 and 24 hours later.

The following parameters were considered when comparing incisions: time of dieresis (from skin to parietal peritoneum incisions); time of synthesis (from parietal peritoneum to skin sutures); dry and wet sponge weights for blood loss determinations; planimetry of operative field, length of time required for jejunoo jejunosotomy and making of gastric pouch; visualization of gastrooesophageal junction.

**Biochemical determinations**

Heparinized blood samples collected for enzymatic determinations were deproteinized in vials containing HCl, (10%) and kept cold until centrifuged. Following neutralization supernatant fractions were used as samples for enzymatic analyses (blood concentrations of glucose, pyruvate, lactate, acetoacetate and 3-hydroxybutirate). Glucose concentrations were measured after SLEIN's method\(^10\). Pyruvate and acetoacetate concentrations were measured after HOHORST et al.\(^17\) and WILLIAMSON et al.\(^14\) methods. Lactate concentrations were measured after HOHORST\(^17\) method and \(\beta\)-hydroxybutirate was measured after WILLIAMSON et al.\(^14\) methods. Additional heparinized blood samples were used for complete blood count, albumin, potassium, sedimentation rate and C-reactive protein (CRP) determinations.

**Statistical analyses**

Friedman’s and Mann-Whitney statistical tests were used for statistical analyses. Results were expressed as mean ± SEM. Values of \(P<0.05\) were accepted as statistically significant.

**RESULTS**

Mean values for time spent on abdominal wall dieresis is shown in Table 1. There was a significant decrease \((P<0.05)\) in dieresis time when median approach was used. Blood loss was similar in both groups (Table 1). There was no significant statistical difference between groups when comparing surgical exposure area (planimetry), abdominal incision closure time (synthesis), length of time required for jejunoo jeunosotomy or gastric pouch making and visualization of gastrooesophageal junction. Total operating time and hospital stay were similar in both groups.

**TABLE 1 – Type of incision and time spent on abdominal wall dieresis and blood loss during surgical procedure**

<table>
<thead>
<tr>
<th>Type of incision</th>
<th>Time (min)</th>
<th>Blood loss (mm3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midline (M)</td>
<td>8.4* ± 1.53</td>
<td>52.5 ± 1.64</td>
</tr>
<tr>
<td>Arciform (A)</td>
<td>10.9 ± 1.44</td>
<td>55.4 ± 1.72</td>
</tr>
</tbody>
</table>

\(P<0.05\) compared to (A)

Hematocrit (Table 2) and hemoglobin (Table 3) were significantly decreased \((P<0.001)\) 12 hours later (T-12 h) when compared to T-0 when all cases were included in one large group \((n = 20)\) despite of absence of significant differences between groups. The same results were found when comparing lymphocyte count (Table 4).

**TABLE 2 – Types of incision and hematocrit values during and after (p.o.) surgical procedure**

<table>
<thead>
<tr>
<th>Type of incision</th>
<th>Postoperative time (p.o.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T-0</td>
</tr>
<tr>
<td>Midline (M)</td>
<td>40.18 ± 1.69</td>
</tr>
<tr>
<td>Arciform (A)</td>
<td>42.0 ± 1.27</td>
</tr>
<tr>
<td>Total (M+A)</td>
<td>41.35 ± 1.06</td>
</tr>
</tbody>
</table>

\(P<0.001\) when compared to T-0

**TABLE 3 – Types of incision and hemoglobin values during and after (p.o.) surgical procedure**

<table>
<thead>
<tr>
<th>Type of incision</th>
<th>Postoperative time (p.o.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T-0</td>
</tr>
<tr>
<td>Midline (M)</td>
<td>13.41 ± 0.44</td>
</tr>
<tr>
<td>Arciform (A)</td>
<td>14.18 ± 0.61</td>
</tr>
<tr>
<td>Total (M+A)</td>
<td>13.79 ± 0.38</td>
</tr>
</tbody>
</table>

\(P<0.001\) when compared to T-0

Potassium concentrations were alike in patients submitted to median or arciform incisions. However there was a decrease in kalemia T-24h compared to T-0 when all \((n = 20)\) patients were analyzed together (Table 5).

Blood albumin concentration (Table 6) and sedimentation rate (Table 7) were significantly decreased in T-F compared to T-0.
TABLE 4 – Types of incision and lymphocyte count during and after (p.o.) surgical procedure

<table>
<thead>
<tr>
<th>Type of incision</th>
<th>Postoperative time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T-0</td>
</tr>
<tr>
<td>Midline (M)</td>
<td>2.26 ± 0.83</td>
</tr>
<tr>
<td>Arciform (A)</td>
<td>0.81 ± 0.16</td>
</tr>
<tr>
<td>Total (M+A)</td>
<td>1.54 ± 0.45</td>
</tr>
</tbody>
</table>

*P < 0.001 when compared to T-0
† P < 0.05 compared to median access

CRP concentrations increased significantly 24 hours after completion of surgical procedure (Table 8).

TABLE 5 – Types of incision and potassium concentrations during and after (p.o.) surgical procedure

<table>
<thead>
<tr>
<th>Type of incision</th>
<th>Postoperative time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T-0</td>
</tr>
<tr>
<td>Midline (M)</td>
<td>3.77 ± 0.09</td>
</tr>
<tr>
<td>Arciform (A)</td>
<td>4.11 ± 0.12</td>
</tr>
<tr>
<td>Total (M+A)</td>
<td>3.94 ± 0.08</td>
</tr>
</tbody>
</table>

*P < 0.001 when compared to T-0
† P < 0.05 compared to median access

Glucose (98.40 ± 9.05 versus 163.55 ± 19.50) and pyruvate (0.16 ± 0.22 versus 0.27 ± 0.03) concentrations were significantly increased 12 hours following completion of surgical procedure in comparison to T-0. Pyruvate concentrations were significantly increased in patients submitted to arciform incisions 12 hours postoperatively compared to midline incision patients (Figures 1, 2).

Blood lactate and acetoacetate concentrations were similar in all groups. On the other hand, 3-hydroxybutirate (0.21 ± 0.04 versus 0.14 ± 0.04 – Figure 3) and ketone bodies concentrations (0.26 ± 0.04 versus 0.14 ± 0.04 – Figure 4) were significantly decreased 24 hour later in comparison to T-0.
midline incision for tactical approach of the abdominal cavity for this
bariatric procedure. Captopra’s gastroplasty induces metabolic and inflammatory changes
in blood parameters, with significant fall of hematocrit, hemoglobin, potassium, albumin, 3-hydroxybutirate and ketone bodies along with significant elevation of erythrocyte sedimentation rate (ESR), C-reactive protein and albumin concentrations at the end of the operation.

Ketone bodies (acetoacetate and 3-hydroxybutyrate) are important alternative sources of energy to glucose. They are formed by a specific hepatic biochemical pathway (ketogenesis). Acetyl CoA is the main substrate for their synthesis. Fasting alone leads to increased concentrations of ketone bodies (hyperketonemia) in the first 24-48 hours. However when fasting is accompanied by trauma the hyperketonemic response to fast fails to occur. The catabolic phase of trauma promotes, via interleukin-1, elevation of insulin which in turn leads to a fall in hepatic ketogenesis. The significant increase in ketone bodies concentrations measured at the end of 24 hours following the surgical procedure may be explained by failure of the hyperketonemic response to this fasting period related bariatric trauma.

CONCLUSIONS

Capella’s gastroplasty induces metabolic and inflammatory changes in blood parameters, with significant fall of hematocrit, hemoglobin, potassium, albumin, 3-hydroxybutyrate and ketone bodies along with significant elevation of erythrocyte sedimentation rate, C-reactive protein, glucose and pyruvate concentrations.

There is no evidence of technical superiority of arciform over midline incision for tactical approach of the abdominal cavity for this bariatric procedure.

RESUMO - Racional - A obesidade tem efeitos de saúde adversos e a reeducação dietética não proporciona perda de peso duradoura. Em pacientes adequadamente selecionados o tratamento cirúrgico pode ser benefício. Objetivo - Avaliar a resposta metabólica pós-operatória precoce em pacientes submetidos a gastroplastia de Capella usando duas diferentes técnicas cirúrgicas de acesso à cavidade abdominal. Pacientes/ Método - Vinte pacientes (9 homens e 11 mulheres, idades variando de 21 a 53 anos) foram aleatoriamente distribuídos antes da realização de uma das duas incisões de acesso cirúrgico (transversa arciforme ou mediana supra-umbilical). Amostras de sangue foram obtidas no princípio e no fim da operação, e no período pós-operatório, às 12 (T -12 h) e 24 horas (T -24 h). Foram avaliados os tempos de diérese e síntese, perda sanguínea, planimetria do campo operatório, duração da cirurgia, permanência hospitalar, hemoglobina, hematocrito, contagem de linfócitos, potássio, albumina, taxa de hemossedimentação, proteína C-reativa, glicose, piruvato, lactato e corpos cetônicos. Resultados - O tempo de diérese diminuiu significativamente no acesso mediano. Duração da cirurgia, permanência hospitalar, hematocrito, hemoglobina, contagem de linfócitos, concentrações de potássio e albumina foram semelhantes em ambos os grupos. Houve aumento significativo das concentrações de proteína C-reativa (T -12 h) e glicose e piruvato (T -24 h) depois da conclusão do procedimento cirúrgico. As concentrações de corpos cetônicos diminuíram significativamente 24 horas após o término da intervenção cirúrgica. Conclusão - A gastroplastia de Capella induz mudanças metabólicas e inflamatórias nos parâmetros hematológicos. Não há evidência da superioridade técnica do acesso cirúrgico arciforme comparado ao acesso mediano, neste estudo.


REFERENCES

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