

EVALUATION OF THE INFLAMMATORY PROCESS THROUGH CRYOLIPOLYSIS TECHNIQUE WITH ARMORED TIP

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Abstract

The Cryolipolysis is a non-invasive procedure for the reduction of localized fat. The principle behind this technique exploits the assumption that adipocytes are more susceptible to heat loss than other skin cells. The precise application of cold temperatures and properly measured pleats triggers apoptosis of the adipocytes, which invokes an inflammatory response and leads to digestion by surrounding macrophages. The Macrophage is a very active cell, originated from blood monocytes, with amoeboid movement and great phagocytic ability. They are important in the defense and maintenance of the body once they act as antigen-presenting cells. The onset of decrease in infiltration of immune cells is expected after 14 days of treatment. The method used in this study to evaluate the inflammatory process was the hemogram test, focusing on the percentage of circulating monocytes. Patients were selected through interviews, evaluating the physical profile and submitted to the test (time zero) before the cryolipolysis treatment. The same occurred 7 and 14 days after treatment, when the patients were submitted to the hemogram test once again. The treatment sites were the abdomen and flanks. The results showed a significant increase in the percentage of circulating monocytes in all patients undergoing the treatment. All patients also had a decrease in localized adiposity after 14 days. Thus, one may conclude that Cryolipolysis with armored tip is an extremely safe procedure, which results in inflammation and reducing fat without damaging the skin.

Key words: cryolipolysis; fat removal; body contouring; process inflammatory

Evolução do processo inflamatório através da técnica de Criolipólise com ponteira blindada.

Resumo

A criolipólise é uma técnica não cirúrgica para redução da gordura localizada. O princípio por trás desta técnica explora a premissa de que os adipócitos são mais susceptíveis a perda de calor do que outras células da pele. A aplicação precisa de temperaturas frias e pregas adequadamente mensuradas, desencadeia a apoptose de adipócitos, que invoca uma resposta inflamatória e leva a digestão por macrófagos circundantes. O macrófago é uma célula muito ativa, de movimentação amebóide, e com grande capacidade de fagocitose. São importantes na defesa e manutenção do organismo, pois atuam como células apresentadoras de antígenos. Eles se originam dos monócitos do sangue. Este tratamento trás alguns efeitos colaterais esperados como eritema temporário, hematomas (dependendo do local) e dormência transitória que geralmente desaparecem rapidamente quando utilizado adequadamente o modo pulsado/contínuo e após 14 dias do tratamento, é esperado o início da diminuição dos infiltrados das células de defesa. O método utilizado neste trabalho para avaliar o processo inflamatório foi o hemograma, focando o percentual de monócitos circulantes. Para isso, os pacientes foram selecionados através de entrevista, avaliando o perfil físico e submetidos aos exames (tempo zero), antes do tratamento de Criolipólise. O mesmo se sucedeu após 7 e 14 dias após o tratamento, onde os pacientes passaram novamente pela avaliação do hemograma. Os locais de tratamento foram a região do abdome e flancos. Os resultados obtidos mostram um aumento considerável no percentual de monócitos circulantes em todos os pacientes submetidos ao tratamento. Todos os pacientes tiveram também diminuição das adiposidades localizadas após os 14 dias. Em suma, a Criolipólise com ponteira blindada é um procedimento extremamente seguro, que resulta no processo inflamatório e redução da gordura sem causar danos à pele.

Palavras chaves: Criolipólise, remoção de gordura, contorno corporal, processo inflamatório.

Introduction

Cryolipolysis is a contemporary method used for a natural fat reduction through a local cooling application and the selected extract heat from adipocytes. Comparing with liposuction procedures, this selective noninvasive technology has been considered an advance preventing skin lesions, scar formation and severe tissue damage (Nelson et al., 2009). The principles of fast freezing, concurrent ischemia, slow thawing, reperfusion-injury, and, in certain circumstances, repetition of the freeze-thaw cycle were established in the 1960s, a period marked by the advent of cryobiology and cryosurgery (Sasaki et al., 2014).

The exact process by which cold removes the adipose tissue is still not clear. However, exploratory studies using Yucatan pigs demonstrate that cold exposure results in an inflammatory process, apparently stimulated initially by adipocyte apoptosis, followed by phagocytosis of the adipocytes (Manstein et al., 2008; Preciadoa & Allison, 2008).

Right after Cryolipolysis treatment, subcutaneous fat has no immediate visible changes. Two days after application initiates an inflammatory process with neutrophil and mononuclear cells migration. The inflammation peak occurs approximately 14 days post treatment, when the adipocytes are surrounded by histiocytes, neutrophils, lymphocytes, and other mononuclear cells. Over 14-30 days, macrophages begin the digestion of apoptotic adipocytes and, for the next 90 days, elimination of the adipocytes occurs slowly. In patients under clinical treatment, this last period corresponds to a decrease in the thickness of the subcutaneous fat layer (Manstein et al., 2008; Preciadoa & Allison, 2008).

Different cell types are involved in the inflammatory response, including neutrophils, macrophages, mastocyte, lymphocytes, platelets, dendritic cells, endothelial cells and fibroblasts. During an infection, chemotaxis is an important event for the recruitment of cells to the site of inflammation. The first cells to reach the injured parenchyma are neutrophils, followed by tissue macrophages, whose precursors are monocytes derived from hematopoietic stem cells. (Abbas & Janewa, 2000; Qureshi et al., 1986).

In order to induce the inflammatory process previously described, Cryolipolysis machine performs a controlled cooling and localized adipose tissue for a period of 60 minutes, with temperatures ranging from -5°C to -10°C (Urzedo et al., 2013). However, the metal exposure in direct contact with antifreeze membrane may bring undesired skin circumstances such as burns.

The idea of establishing a device with armored tip was a breakthrough in the Cryolipolysis, enabling a reduction in temperature to -15°C , providing a focal heat radiation and avoiding extreme freezing, known as "popsicle effect".

Considering the immune response against tissue injury, this study aims to investigate the inflammatory effect after Cryolipolysis treatment with temperature -15°C in the first 14 days, and the results on flanks and abdominal fat accumulation.

METHODS

The Cryolipolysis system used in this study (Adoxy Medical, ANVISA 80047309126) is composed by a touch system in the control console with 4 shielded applicators (without direct metal exposure), in

medium and large sizes, connected to the console at the posterior side. The equipment has controlled cooling ranging from + 5 ° C to - 15 ° C, even as continuous and pulsed suction control.

PATIENTS

Patients selection

Eight female patients with similar physical characteristics, aged between 20 and 40 years, were selected. The patients were previously evaluated and signed an informed consent form.

Procedures for the experiment

The patients attended the clinical laboratory two days before the procedure, fasting, to perform the blood collection. Cryolipolysis vacuum applicator was used to sequentially treat three areas: abdomen, left and right flank, according to figure 1. Patients were properly positioned and the application in the abdomen ensued performing a trunk flexion position and lateral tilt for application in the area of the flanks. Coupling was performed with the parameters of + 5°C in continuous mode for 30 seconds, and after placed in the pulsed mode.

This procedure was maintained for 4 minutes and subsequently transferred to continuous mode again, when the temperature was reduced to - 15 ° C. Immediately following cryolipolysis treatment, the areas were manually massaged to alleviate the congested part of the thermal effect and the thermal blanket was placed. The candidates selected were oriented to wear compression garment and have a normal pace of life after the procedure.

After a period of 7 days, the patients returned to the clinical laboratory to perform blood collection. This same procedure occurred after 14 days.

Photographs

Cryolipolysis results were evaluated using pre- and post-treatment photographs (Ipad Apple® iSight camera 43 MP) of abdomen and flanks.

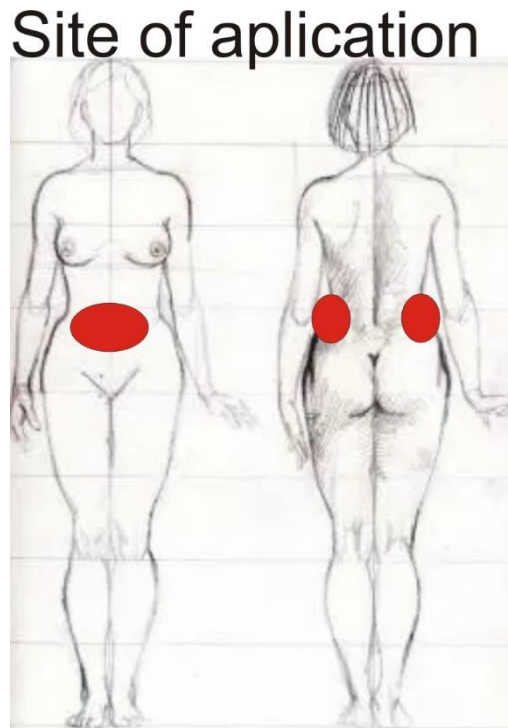


Figure 1: Cryolipolysis treatments were delivered using a vacuum applicator to the abdomen and flanks.

Results

After 14 days, the analysis indicates a satisfactory result. Any procedure (Radiofrequency, Ultrassond and Carboxiterapic) was conducted before the treatment, so we can assign the results to Cryolipolysis.

Figure 2 shows photos taken 14 days post-treatment.

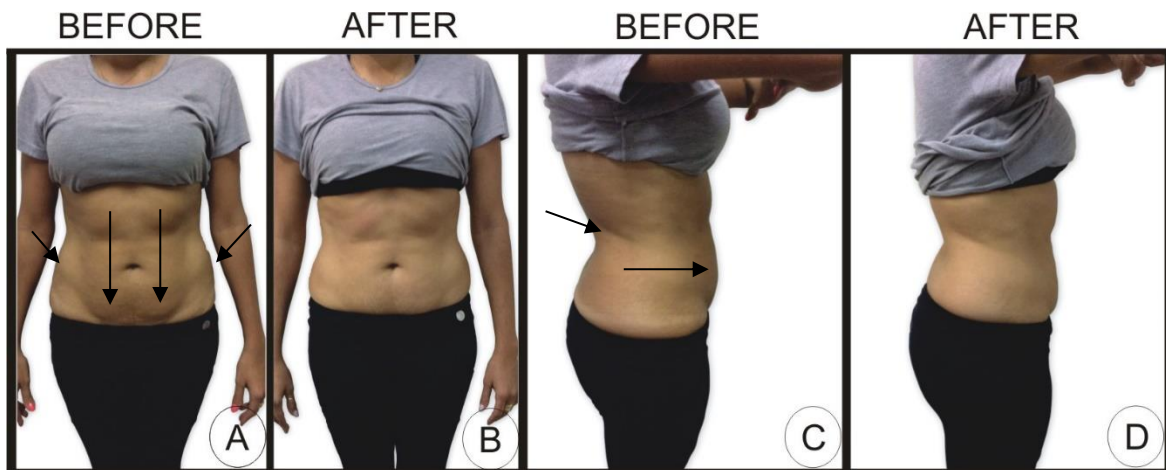
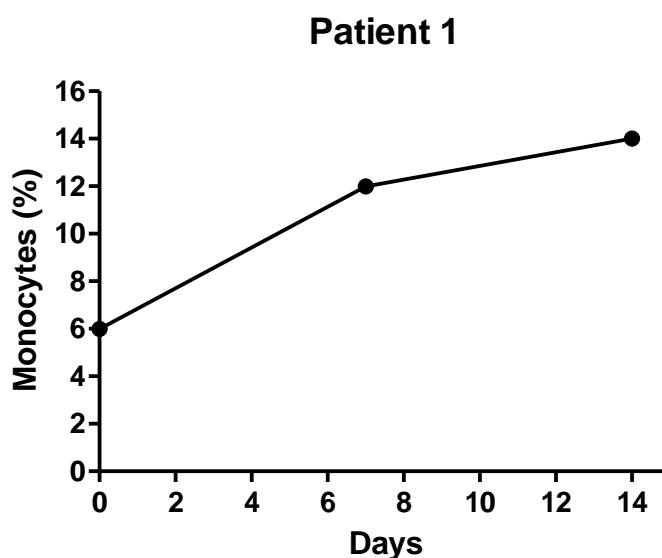


Figure 2: Subject 4 representative photo of Cryolipolysis results in the abdomen and flanks. Photographic analysis shows the reduction of localized fat in rectus abdominis muscle area after 14 days (B and D). In C and D, the side view, shows the reduction of flanks in the rectus abdominis

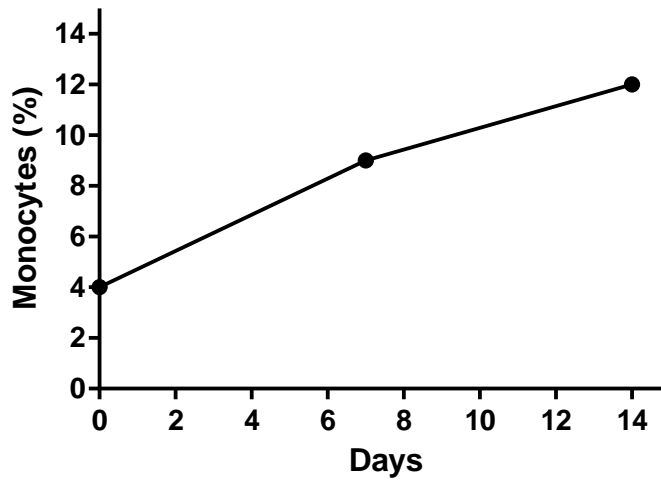
Graphs 1-8 shows the results of blood test performed to quantify the monocytes. Monocytes are 3% to 10% of the circulating leukocytes and on tissue or organ parenchyma give rise to macrophages and myeloid dendritic cells. Monocytes and macrophages are efficient phagocytes, engulfing pathogens and cell debris. Unlike other immune cells such as neutrophils, macrophages can remain indefinitely in tissue, ranging from days to months, acting as true sentinels.

In all cases were noted monocytoses (increase above 10% monocytes). Monocytosis is observed mainly in the recovery phase of inflammation, when monocytes begin the work of "cleansing" in inflamed area. The results of 7 and 14 days refer to the samples collected after Cryolipolysis procedure in the respective periods.



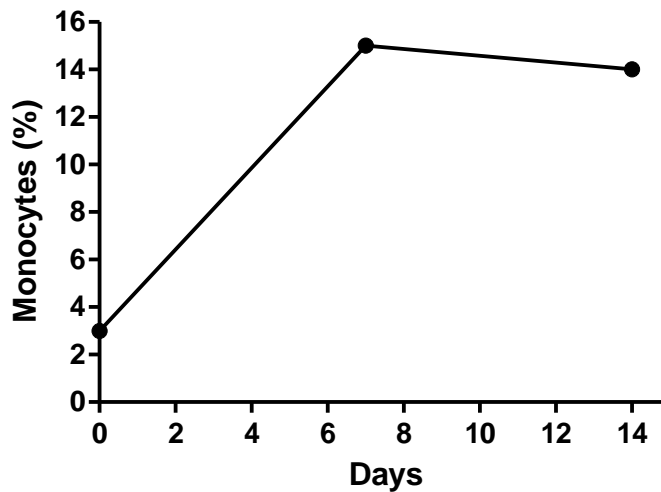
Graphic 1: Blood collected before proceeding with 6% monocytes. At 7 days after treatment showed 12% (monocytosis) and 14 days after treatment showed 14% (monocytosis).

Patient 2



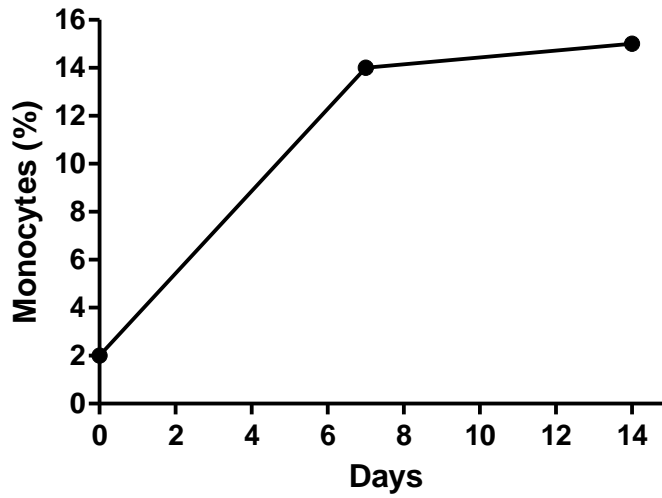
Graphic 2: Blood collected before the procedure with 4% Monocytes. At 7 days after treatment showed 9% and 14 days after treatment showed 12% (monocytosis).

Patient 3



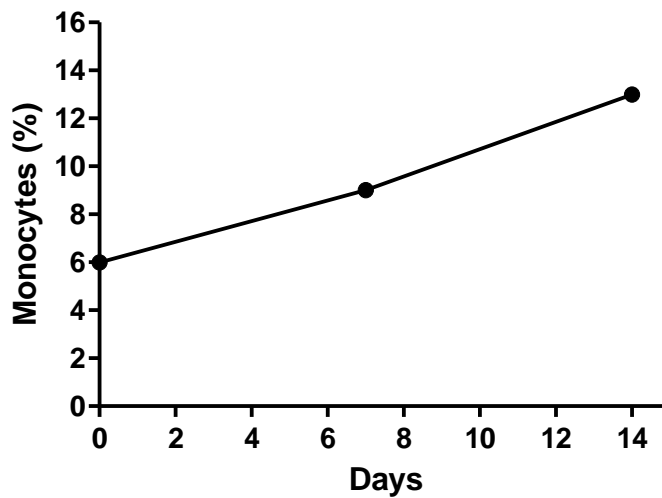
Graphic 3: Blood collected before the procedure with 3% Monocytes. At 7 days after treatment showed 15% (monocytosis) and 14 days after treatment showed 14% (monocytosis).

Patient 4

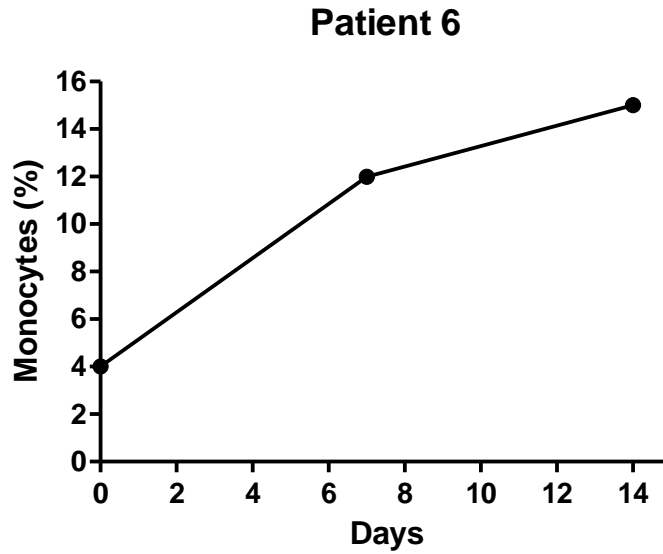


Graphic 4: Blood collected before the procedure with 3% Monocytes. At 7 days after treatment showed 14% (monocytosis) and 14 days after treatment showed 15% (monocytosis).

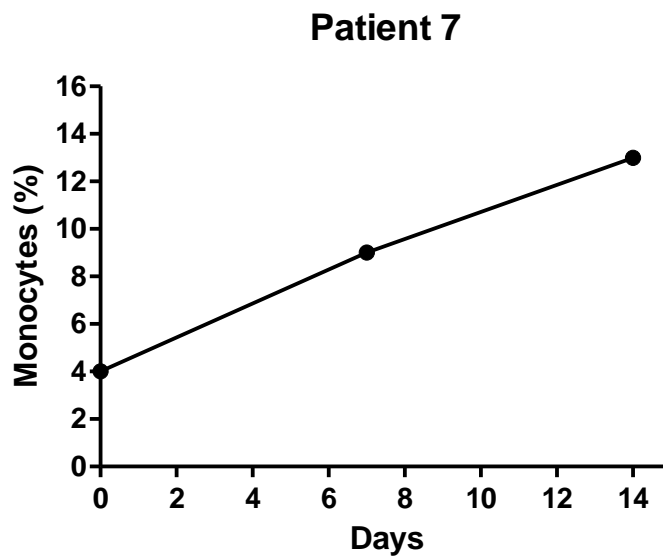
Patient 5



Graphic 5: Blood collected before proceeding with 6% monocytes. At 7 days after treatment showed 11% (monocytosis) and 14 days after treatment showed 13% (monocytosis).

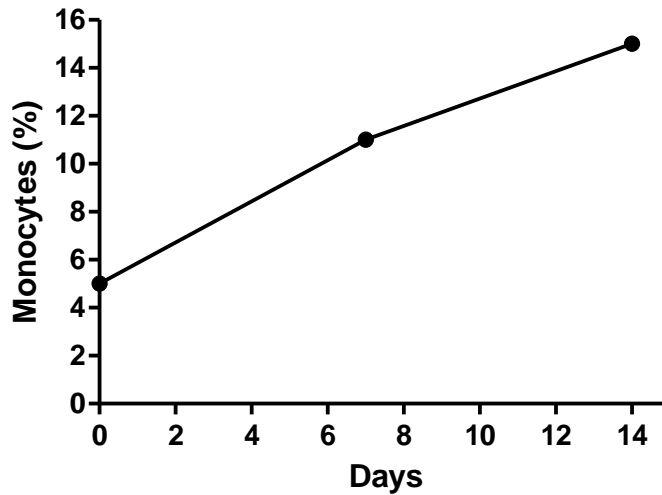


Graphic 6: Sangue coletado antes do procedimento com 4% de Monocitos. Com 7 dias após o tratamento apresentou 12% (monocitose) e com 14 dias após o tratamento apresentou 15% (monocitose).

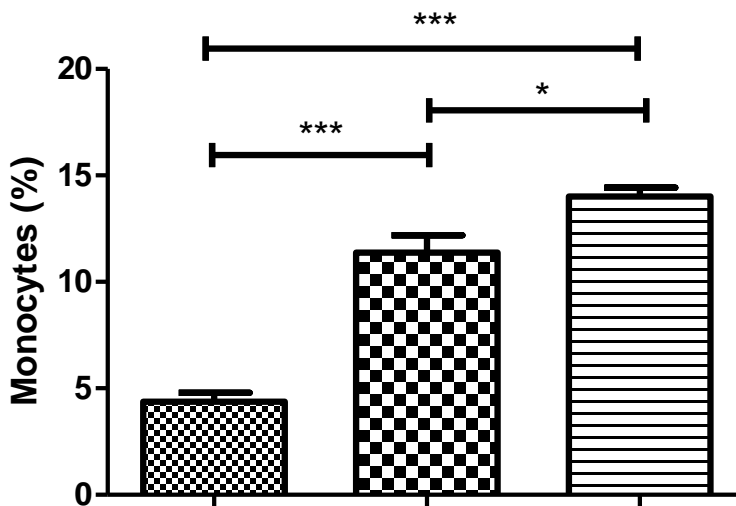


Graphic 7: Blood collected before the procedure with 4% Monocytes. At 7 days after treatment showed 12% (monocytosis) and 14 days after treatment showed 15% (monocytosis).

Patient 8



Graphic 8: Blood collected before proceeding with 5% monocytes. At 7 days after treatment showed 11% (monocytosis) and 14 days after treatment showed 15% (monocytosis).



Graphic 9: Analysis of Monocytes percentage after the Cryolipolysis treatment indicate a significative increase in the course of time (0, 7 and 14 days after Application analysis of variance) P <0,0001.

Discussion

Cryolipolysis is a safe treatment of all skin types, without reported pigmentary changes, being safe for repeated applications (Stevens et al., 2013) after 60 days, time in which the results has a lower evolution.

The best candidates are those within ideal weight range, those who are involved in regular exercise, healthy diet, have visible fat protruding from the trunk or places to be alert, are realistic in your expectations, and who are willing to keep the results of Cryolipolysis with an active and healthy lifestyle (Krueger et al., 2014). It is also important to emphasize that the evaluation of the indication of the tip to the thickness of the fold must be consistent with the handle width.

If the thickness pass the width of the handle may cause a kind of "friction" and can occur vesicles due to vacuum action along with the lack of space in the cooling compartment. If it meets the above recommendations the patient will be able to receive the treatment Cryolipolysis.

This clinical procedure is performed under vacuum pressure applicators of different sizes, capable of extracting heat from both sides of a skinfold, reducing blood flow through the tissue compression and vasoconstriction induced by cold.

Our results indicate that the trapped folds, at different locations, with -15°C and 40 mm Hg vacuum, showed erythema and looks normal in all cases. Similar experiment was conducted using an equivalent device without armored tip, where the cooling during the session reached approximately -10°C within one hour, but no reports of skin conditions (Bueno 2012). In both cases they were employed membrane / mat antifreeze brand Freezefats®

Histological results were evaluated in several studies and showed no evidence of fibrosis (Boey & Wasilenchuk, 2014). Accordingly, our study showed very clear results related to measurements loss and also did not lead to any case of fibrosis. Most studies demonstrate an inflammatory response at various stages after Cryolipolysis treatment, with inflammatory cell infiltrates reaching the maximum at 30 days (Boey & Wasilenchuk, 2014), leading to apoptosis of adipocytes (Ferraro et al., 2012).

In another study, crystallization and injury of adipocytes by cold ischemia induced apoptosis of these cells and a pronounced inflammatory response that occurred in the weeks following Cryolipolysis treatment (Manstein et al., 2008, Mulholland et al., 2011; Dobke et al., 2012). Along the same line, this study demonstrated the quantification of monocytes in the first 14 days, cells that play a central role in the inflammatory process. An inflammatory reaction is initiated in different situations, trauma (including the application of Cryolipolysis), surgery, burns, infection and cancer in advanced stages. The systemic response is accompanied by fever (occurring site fever in the case of Cryolipolysis), increased hormones synthesis and production of leukocytes, neutrophils and monocytes, the last two being the main cells released during acute inflammation. Monocytes and their precursors (monoblasto and pro-monocytes)

are not stored in the bone marrow and released into immature blood flow (equivalent to a myelocyte), circulate for 12 hours and differentiate into macrophages into tissues, where they survive up to 100 days (Ciarline, 2015).

Monocytes are 3% to 8%, and in connective tissue or organ parenchyma give rise to macrophages and myeloid dendritic cells. Monocytes and macrophages are efficient phagocytes, engulfing pathogens and cell debris. Unlike neutrophils, macrophages can remain in the tissue for months to years, acting as true sentinels (Abbas & Lichtman, 2003).

In inflammation, macrophages act as APCs (antigen-presenting cells), and release proinflammatory cytokines such as IL-1, IL-6, IL-12, TNF- α and chemokines. They also produce reactive oxygen species (ROS) such as superoxide anion, hydroxyl radical and hydrogen peroxide (H_2O_2), and reactive nitrogen intermediates, whose main representative is nitric oxide (NO). NO is produced by inducible nitric oxide synthase, iNOS, absent in resting macrophages (monocytes), but induced activation, especially in the presence of IFN- γ (Abbas & Lichtman, 2003).

Ultimately, the use of armored tip brought safety and quality in Cryolipolysis treatments. Application of temperatures below $-15^\circ C$ with this technology resulted in fewer traumas to the skin and prevents accidents such as burns. The place where it was performed the procedure had only erythema and in some cases and regions, such as the flanks, slight bruising. The use of continuous-pulsed-continuous protocol, provided a better result and complacency of skinfold inside the freezer compartment, avoiding complications.

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