Original Contribution

Journal of Cosmetic Dermatology, **15**, 484–492

Quality survey on efficacy of carboxytherapy for localized lipolysis

Georgia S. K. Lee, MBBS, MD

TLC Lifestyle Practice, Singapore, Singapore

Summary

Background A survey was conducted to ascertain the efficacy of carboxytherapy for localized lipolysis.

Methods Patients on physical, dietary, or drug concurrent therapy were excluded. Paired measurements (initial versus 8th course) between treated (right) and untreated (left) sides were compared for braline, upper arm, abdomen, and thigh.

Results Ten women, age range 23–37 years, were reviewed. Weight and body mass index were unchanged. Significant reductions ($P < 0.01$) were obtained for braline and abdominal caliper and ultrasound measurements. Mean (SD) decreases in caliper braline and abdomen measurements were 6.9 (5.9) and 4.3 (3.0) mm, respectively. Mean (SD) changes in ultrasound abdominal readings were −6.6 (3.8), −7.4 (3.2), and −6.8 (3.5) mm for upper, lower, and flank, respectively.

Limb girth measurements were significant for the thigh (−1.3 [0.8] mm) but not for the upper limb.

Conclusion These results are in agreement with those reported originally and demonstrate that carboxytherapy is locally effective in reduction of subcutaneous fat.

Keywords: carbon dioxide, carboxytherapy, localized lipolysis

Introduction

Carbon dioxide (CO_2) therapy or carboxytherapy is the transcutaneous administration of CO_2 for therapeutic purposes. Although liposuction remains the recognized method of more definitive body contouring, it is, however, associated with higher risk, downtime, and death as serious adverse outcomes.[1] Liposuction is also not suitable for maintenance therapy for body contouring. Repeated treatment in the same area is associated with higher risk due to scar tissue formation. Brandi and colleagues[2] provided histological evidence of the effects of CO_2 gas infiltration on subdermal adipose tissue.

Correspondence: Georgia S. K. Lee, TLC Lifestyle Practice, 9 Scott Road, Scotts Medical Center at Pacific Plaza, #11-04/05, Singapore S228210, Singapore. E-mail: tlcfc@singnet.com.sg

Accepted for publication May 9, 2016

The aim of this survey was to assess the efficacy of carboxytherapy at localized sites, comparing with the untreated side as controls, in the same subjects.

Patients and methods

Patients

For inclusion into the analysis, 10 patients had to consent to undergo a minimum of eight carboxytherapy sessions twice a week initially on the right side followed subsequently by the left. They should not be under special dietary restrictions, not taking diet pills nor be on other body-contouring modalities. Contraindications include phlebitis, significant cardiac, respiratory, renal and hepatic impairment, uncontrolled hypertension, and pregnancy.

Methods

CO_2 was infused subcutaneously into the affected areas using the Carbomed Programmable Automatic Carbon

Dioxide Therapy apparatus (Carbossi, Milan, Italy) and 30GA ½, 0.3 × 13 microlance needles. The depth of infusion is between 10 and 13 mm. The device regulates the flow rate and the infusion pressure and is calibrated to measure the dosage in cc. The infusion velocity administered was standardized to 100 cc/min

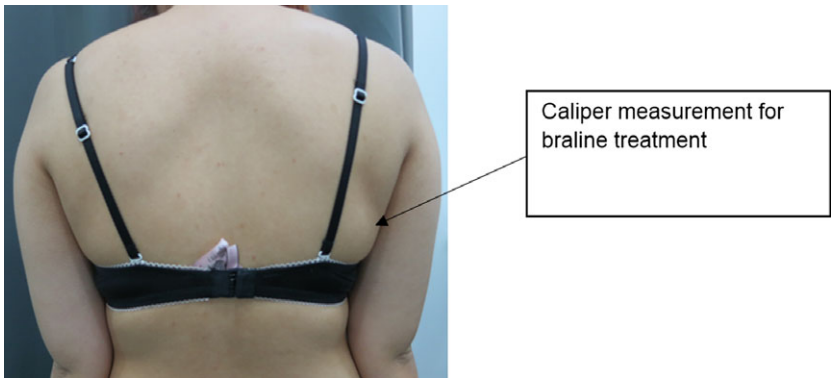

Figure 1 Placement site for braline caliper measurements.

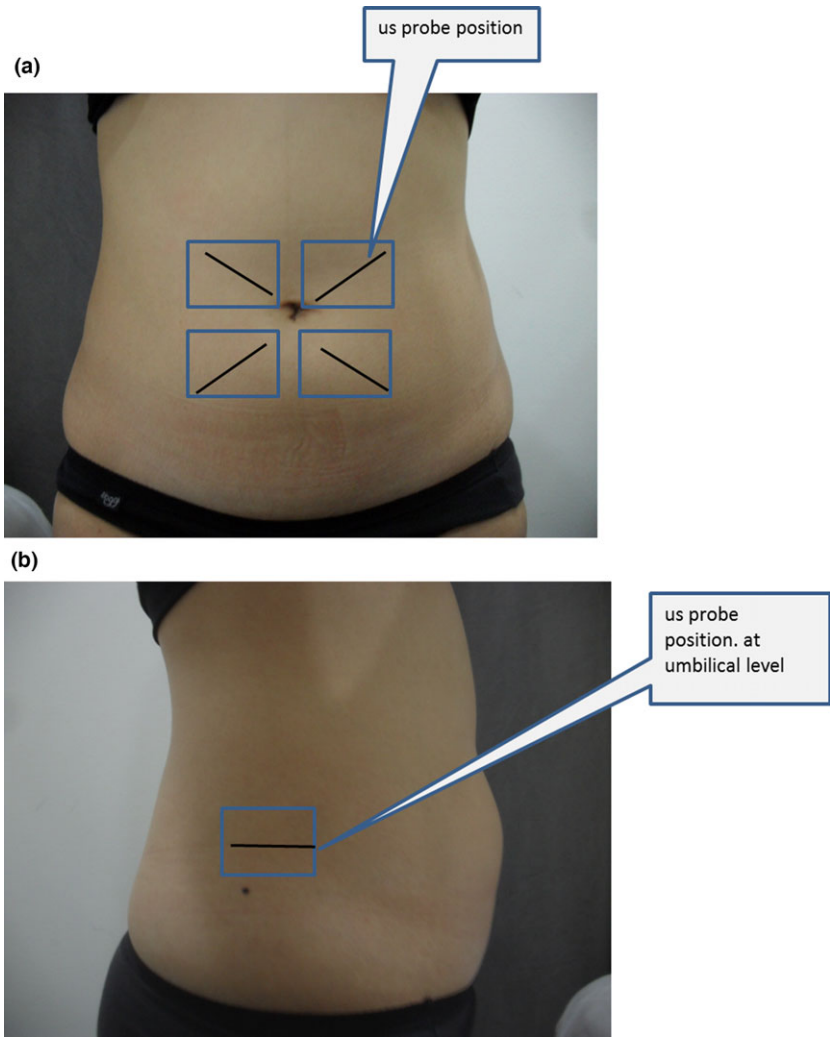

Figure 2 Placement site for abdomen and flank ultrasound measurements.

and the total quantity of CO_2 infused was 50–75 cc for right upper arm, 20–30 cc for right braline, 150–250 cc right side of the abdomen, 150–250 cc for right flank, and 200–300 cc for right thigh.

Same undergarments were worn for each assessment to standardize measurements and photography.

The contralateral left side of the same sites were not treated and served as controls. Subsequently, these areas were treated too.

Therapy was continuously monitored by qualified medical personnel.

Measurements

Weight, caliper measurements for the braline, abdomen, ultrasound measurement of the subcutaneous adipose layer, and abdominal and thigh circumference measurements were recorded at baseline and following each treatment session and also 1 week after the 8th treatment. Measurements for the treated and untreated side in mirror sites were duly recorded. Caliper measurement was taken from the braline (Fig. 1). For the abdomen, caliper measurement was also taken from midpoint of the line plotted between the umbilicus and anterior superior iliac spine. For all caliper measurements, an average of 3 was recorded before each treatment and 1 week after. Ultrasound measurement using ultrasound model Sonoace X1 (Samsung Medison Co., Ltd., Seoul, Korea) of subcutaneous fat thickness over the abdomen was taken at midpoint of the line plotted from umbilicus and anterior superior iliac spine and also the mirror image position for the

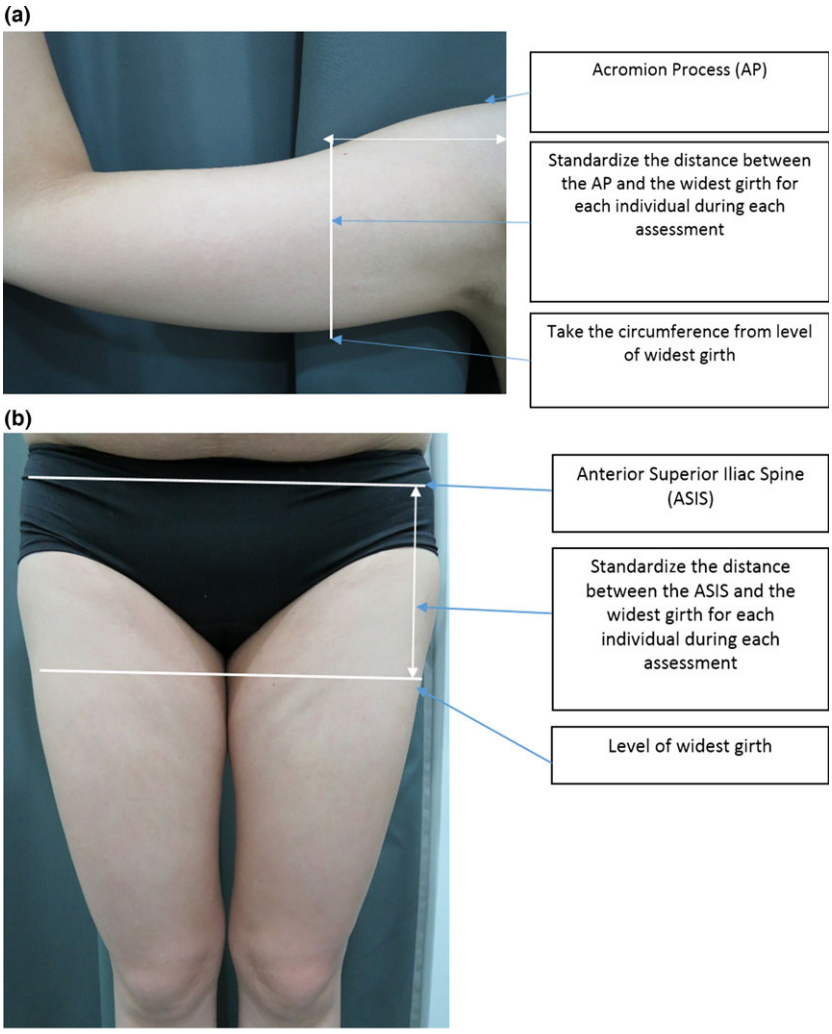

Figure 3 Landmarks for circumferential measurement of the upper arm and thigh.

BEFORE AND AFTER STUDY INVOLVING: Carboxtherapy (carbon dioxide therapy)

2

PATIENT FEEDBACK FORM

You are taking part in a before & after study in which your treatment outcome and results will be monitored and recorded so that they can be further assessed and evaluated. It is very important that you read the questions in this feedback form, and provide as accurate a response as you can.

Carboxytherapy

Session No. : _____
Date : _____

1. Did you feel any pain or discomfort *while the carboxytherapy treatment was being carried out*?

   ☐ Yes
   ☐ No

   If no, please proceed to question 4.

2. If yes, on a scale of 1 to 5, please grade the degree of pain and/or discomfort you experienced during the treatment.

Bearable/Tolerable	1	2	3	4	5	Unbearable/Intolerable
Pain	☐	☐	☐	☐	☐	
Discomfort	☐	☐	☐	☐	☐	

3. If you experienced feelings of discomfort during the treatment, apart from pain, please describe as best as you can what the feelings of discomfort felt like:

   Answer : _____
   _____

3

4. *After the carboxytherapy treatment was completed*, did you feel any pain or discomfort at the site of your body where the treatment had been performed?

   ☐ Yes
   ☐ No

   If no, please proceed to question 7.

5. If yes, on a scale of 1 to 5, please grade the degree of pain and/or discomfort you experienced after the treatment.

Bearable/Tolerable	1	2	3	4	5	Unbearable/Intolerable
Pain	☐	☐	☐	☐	☐	
Discomfort	☐	☐	☐	☐	☐	

6. If you experienced feelings of discomfort after the treatment, apart from pain, please describe as best as you can what the feelings of discomfort felt like:

   Answer : _____
   _____

7. Did you experience any skin redness or other problems at the treatment site?

   ☐ Yes
   ☐ No

   If no, please proceed to question 9.

4

8. If you experienced any skin redness or any other problems at the treatment site, please state how long this persisted from the time you first developed such problems.

   Symptoms : _____ Duration : _____

   Symptoms : _____ Duration : _____

9. Did you feel that the treatment experience was generally comfortable and tolerable?

   ☐ Yes
   ☐ No

10. Can you perceive any difference in the treatment site after the treatment you underwent?

    ☐ Yes
    ☐ No
    ☐ Not sure

    If yes, please describe what difference you have noticed: _____

    _____

    _____

11. Do you have any other concerns about your treatment experience that you wish to highlight?

    ☐ Yes. Describe : _____
    ☐ No

12. Do you wish to stop the treatment now?

    ☐ Yes
    ☐ No

    [*If your answer is Yes, the clinic will arrange for you to speak to Dr Lee*]

Name of Patient:_____ NRIC No:_____

_____ _____
Signature of Patient Date

Figure 4 Post-CO_2 survey forms for patients after completing 10th, 30th, 60th, and 100th sessions.

upper quadrant for all patients undergoing abdominal treatments (Fig. 2a,b). For the upper arm and thigh, the maximum circumferences for both right and left sides were recorded. The level where the arm circumference was measured was recorded from the acromion, and subsequent measurements were taken from the same level for each patient (Fig. 3a). Similarly, the level where the thigh circumference was measured was recorded as the distance from the anterior superior iliac spine, and subsequent measurements were taken from the same level for each patient (Fig. 3b). All measurements were recorded in the same manner for treated (right) and untreated (left) sides for all investigated sites.

Analysis

Measurements at baseline and 1 week after the eighth carbon dioxide therapy sessions were compared using Student's *t*-test and significance set at $P < 0.01$. Paired measurements on the untreated (left) side were made for comparison. Patients were given a qualitative survey form to complete (Fig. 4).

Results

Ten women, age range: 23–37 years, underwent upper arm, braline, abdomen, flank, and thigh treatment on the right side (Table 1).

Significant results were obtained for braline (Fig. 5) and abdominal caliper (Fig. 6) and ultrasound measurements (midpoint of the line plotted from umbilicus and anterior superior iliac spine and mirror image position for the upper quadrants for all patients undergoing abdominal treatments – Fig. 2a,b) following the course of carboxytherapy. Results were significant ($P < 0.01$) as compared to the untreated left side (Table 1) (Fig. 7).

Table 1 Demographics and results (statistical significance was set at $P < 0.01$*)

Demographics: $N = 10$, age range 23–37 years	Before	After 8th session	Change	*P* value
Weight (kg)	55.2 (7.5)	54.1 (6.8)	−1.1 (1.3)	0.03
BMI	21.6 (3.6)	21.2 (3.2)	−0.4 (0.5)	0.03
Braline caliper (treated – mm)	19.7 (6.6)	12.8 (4.7)	−6.9 (5.9)	0.005*
Braline caliper (untreated – mm)	20.1 (6.4)	16.7 (4.2)	−3.5 (5.0)	0.06
Upper arm girth (treated – mm)	26.9 (3.2)	26.6 (3.0)	−0.4 (0.6)	0.09
Upper arm girth (untreated – mm)	26.8 (3.3)	27.0 (3.3)	0.1 (0.4)	0.28
Abdomen caliper (treated – mm)	23.9 (6.1)	19.7 (5.6)	−4.3 (3.0)	0.001*
Abdomen caliper (untreated – mm)	23.9 (5.3)	23.1 (5.5)	−0.8 (3.0)	0.45
Upper abdomen US (treated)	26.1 (6.5)	19.5 (5.7)	−6.6 (3.8)	0.0003*
Upper abdomen US (untreated)	25.6 (7.1)	23.5 (5.7)	−2.1 (3.4)	0.08
Lower abdomen US (treated)	28.5 (5.6)	21.3 (5.4)	−7.4 (3.2)	0.00005*
Lower abdomen US (untreated)	27.3 (5.9)	26.1 (5.0)	−1.2 (2.9)	0.22
Flank abdomen US (treated)	25.2 (5.0)	18.4 (3.8)	−6.8 (3.5)	0.0002*
Flank abdomen US (untreated)	25.0 (6.2)	24.0 (5.2)	−1.1 (2.7)	0.25
Thigh girth (Treated)	56.3 (4.3)	55.0 (4.4)	−1.3 (0.8)	0.0008*
Thigh girth (Untreated)	55.9 (4.8)	55.6 (4.6)	−0.3 (0.7)	0.19

Figure 5 Braline before and after 8th CO_2 therapy (same undergarment worn and brassiere hook for standardized photographs).

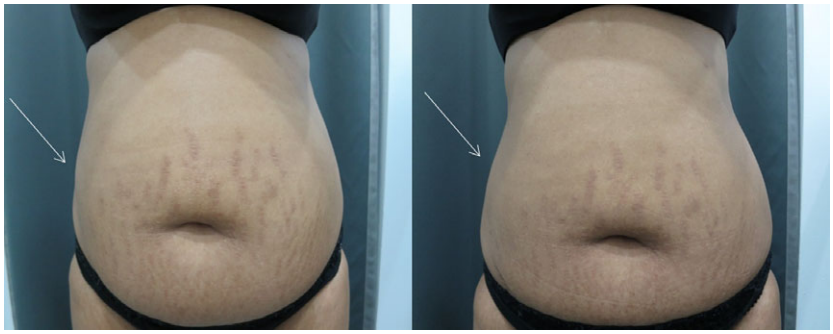

Figure 6 Abdomen before and after 8th CO_2 therapy (same undergarment worn and brassiere hook for standardized photographs).

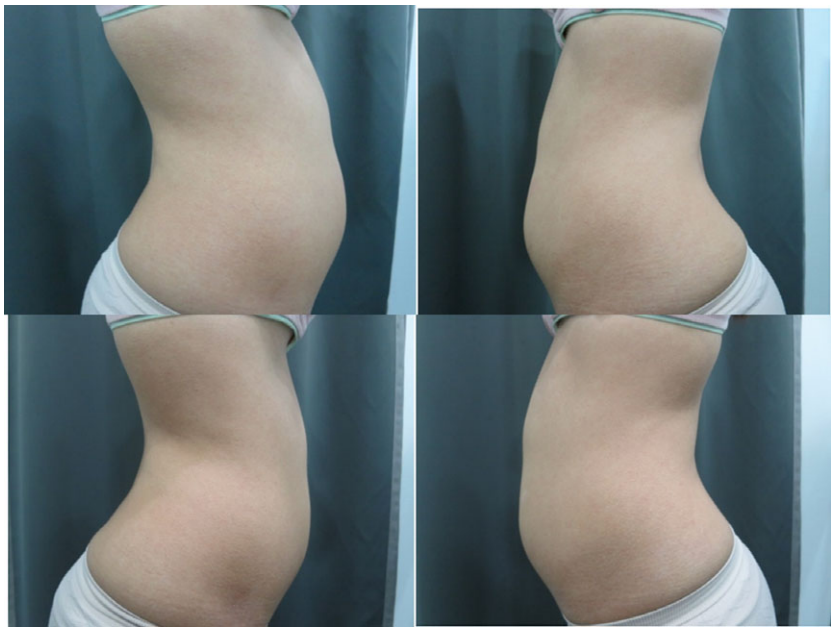

Figure 7 Before after CO_2 therapy: Right flank. Untreated: Left flank.

Limb girth measurements were significant for the thigh (Fig. 8) but not for the upper arm.

Figure 9 shows typical ultrasound evidence of decreased subepidermal thickness following eight sessions of carboxytherapy.

Patients' qualitative feedback was recorded after completing the eight sessions (Table 2).

Complications

These were minor and include pain at injection site, crepitus, and minor aches, which did not last more than 30 min. Some needle entry bruising were noted and resolved within 7–10 days. No other side effects were observed.

Discussion

There was a significant reduction in treated sites in the 10 women. This was not reflected in the untreated sites. This comparison is valid as we the same subject serve as control for each site.

Weight loss is not the primary objective of carboxytherapy, which is aimed at treating localized adiposities and improving skin texture.[3]

Complications

There have been few reports of serious complications from carboxytherapy. This is hardly surprising as CO_2 is widely used in medicine as the mainstay of

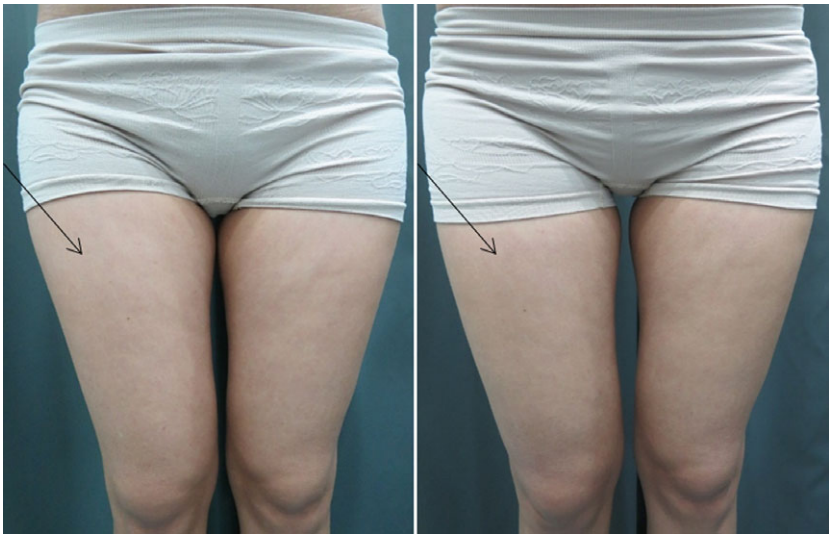

Figure 8 Thigh appearances following CO_2 therapy (Before: left and right after 8th CO_2 therapy session).

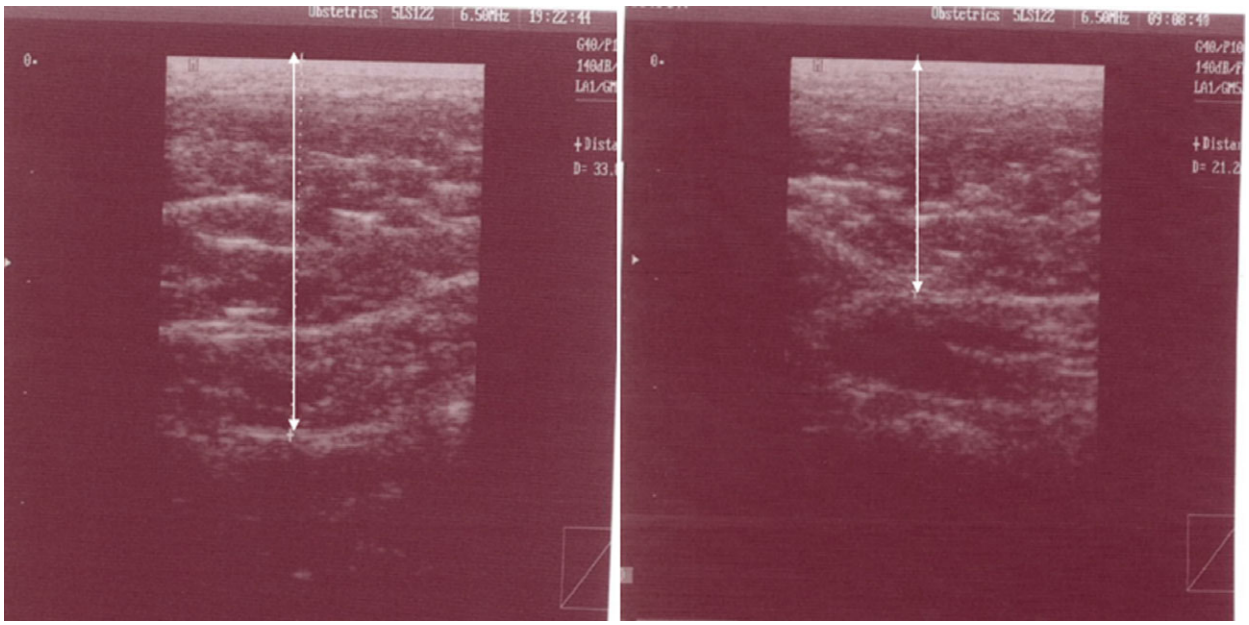

Figure 9 Ultrasound scan of subcutaneous tissue (Before: Left at 33.8 mm and after at 21.2 mm.).

Table 2 Summary of feedback after series of eight sessions by respondents (*same respondents)

Number of respondents = 10	Yes	No	Not sure
Pain during treatment	7	3	
Pain after treatment	2*	8	
Redness after treatment	1	9	
Noticeable difference after treatment	6	2*	2
Subjects wanting to stop treatment	2*	8	

minimally invasive surgery. During laparoscopic procedures, CO_2 is routinely used inside body cavities to provide a superb view and access for the ever growing list of surgical procedures being performed. Hypercapnia, which incidentally does not occur during carboxytherapy,[4] is very well tolerated. Localized swelling due to CO_2 resolves within 30 min in this setting. This duration is similar to that reported by Ozan Balik *et al.*[5] who reported localized swelling lasting up to 48 h

when air is substituted in an experiment involving Wistar rats. There has been one reported case of subcutaneous emphysema but the method of treatment administration: in particular, the flow velocity and the volume of gas injected were not known.[6] Equipment employed in this study is manufactured in Italy and is CE (European Community) approved for medical use.

Mechanism of action

There are sound physiological principles underlying possible mechanisms of action of CO_2 in modulating its effects on the skin and subdermal layers. In a histological study, Brandi *et al.*[2] report fracturing of the adipose tissue with release of triglycerides in the intercellular spaces and adipocytes presenting thin fracture lines in the plasma membrane. These lines did not involve the connective spaces where the major vascular structures are located. The dermis presented a thicker appearance than before the treatment, with the collagen fibers distributed more diffusely. The same authors report microcirculatory changes following CO_2 therapy as reflected by increased perfusion as measured by laser Doppler flow metry and increased oxygen tension as measured by transcutaneous oxygen tension. This is to be expected from the Bohr effect on the oxygen dissociation curve. Ferreira and colleagues,[7] in a blind, interventional, cross-sectional study, investigated CO_2 injection in the dermis of Wistar rats. Treated rats showed intense collagen turnover in their skin samples when compared to controls, which had saline injections. These findings support the subjective clinical findings of improved skin texture following CO_2 therapy. In another study in Wistar rats, Ozan Balik *et al.*[5] also demonstrated a statistically significant decrease in adipocyte diameters during both the early and late phases of subjects injected with CO_2 as compared with injection with air

Clinical practice

Carboxytherapy is a well-recognized treatment for improving various conditions ranging from localized adiposity, wound healing, and also cellulite.[7–11] The subjects in this survey recognized the post-treatment differences, in particular to the treated braline, abdomen, and thighs. These areas correspond to areas where clothing may be more fitting and hence the noticeable difference to the subjects. Clearly, patients who enroll in wellness programs receive thorough counseling. In our practice, patients undergo basic health screening and most undergo concurrent dietary, lifestyle, exercise therapies, and also feedback surveys upon completing 10th, 30th, 60th, and 100th sessions (Fig. 4). As part of a holistic approach, carbon dioxide, and drug treatment may be added. An audit of carbon dioxide therapy should exclude the majority of patients who enroll in a holistic program. Difficulty in restricting monotherapy in clinical practice probably explains why there are few published studies of this popular treatment. Conversely, it is likely this survey may underestimate the results as physical, drug, or dietary modalities are excluded.

Conclusion

The results are in agreement with those reported previously in the same setting[12] and recognized that carboxytherapy is safe and effective within treatment guidelines. The localized effect on adiposities has been quantified in a comparative setting and explains the clinical usefulness of CO_2 therapy in treating skin irregularity and as a complement to liposuction.[13]

Acknowledgment

We are grateful to clinic staff for their help in retrieving the data.

References

1 Khanna A, Filobbos G. Avoiding unfavourable outcomes in liposuction. *Indian J Plast Surg* 2013; **46**: 393–400.
2 Brandi C, D'Aniello C, Grimaldi L *et al.* Carbon dioxide therapy in the treatment of localized adiposities: clinical study and histopathological correlations. *Aesthetic Plast Surg* 2001; **25**: 170–4.
3 Paolo F, Nefer F, Paola P *et al.* Periorbital area rejuvenation using carbon dioxide therapy. *J Cosmet Dermatol* 2012; **11**: 223–8.
4 Ochiai R, Takeda J, Noguchi J *et al.* Subcutaneous carbon dioxide insufflation does not cause hypercarbia during endoscopic thyroidectomy. *Anesth Analg* 2000; **90**: 760–2.
5 Balik O, Yilmaz M, Bagriyanik A. Does carbon dioxide therapy really diminish localized adiposities? Experimental study with rats. *Aesthetic Plast Surg* 2011; **35**: 470–4.
6 Calonge WM, Lesbros-Pantoflickova D, Hodina M *et al.* Massive subcutaneous emphysema after carbon dioxide mesotherapy. *Aesthetic Plast Surg* 2013; **37**: 194–7.
7 Ferreira JCT, Haddad A, Tavares SAN. Increase in collagen turnover induced by intradermal injection of carbon dioxide in rats. *J Drugs Dermatol* 2008; **7**: 25–30.
8 Amuso D. Combined benefits. The use of carbon dioxide and oxygen in aesthetics. 2014. Available at: www.aestheticsjournal.com/features . Accessed November 1, 2014.

9 Campos V, Bloch L, Cordeiro T. Carboxytherapy for gynoid lipodystrophy treatment: the Brazilian experience. *J Am Acad Dermatol* 2007; **56**: AB196.
10 Koutna N. Carboxytherapy – a new non-invasive method in aesthetic medicine. *Cas Lek Cesk* 2006; **145**: 841–3.
11 Sinozic T, Kovacevic J. Carboxytherapy – supportive therapy in chronic wound treatment. *Acta Med Croatica* 2013; **67** (Suppl 1): 137–41.
12 Lee SK. Carbon dioxide therapy in the treatment of cellulite: an audit of clinical practice. *Aesthetic Plast Surg* 2010; **34**: 239–43.
13 Brandi C, D'Aniello C, Grimaldi L *et al.* Carbon dioxide therapy: effects on skin irregularity and its use as a complement to liposuction. *Aesthetic Plast Surg* 2004; **28**: 222–5.