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Article

Circulatory reaction after Water-Jet Assisted Liposuction WAL in Lipedema - Evaluation of 1,000 Surgeries

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Abstract: The surgical treatment of lipedema requires the removal of much larger volumes of fat than usual in aesthetic liposuctions. Often, the limit of 4,000 ml, which has been established as the definition of "large-volume liposuctions", must be exceeded. Many surgeons and practitioners consider this procedure too risky. A high complication rate and especially severe circulatory problems are cited as reasons. However, there are no reliable sources in literature regarding the frequency and course of circulatory reactions during water-jet assisted liposuction WAL in lipedema.

Keywords: lipedema, standardized treatment, water-jet-assisted liposuction, large-volume liposuction, circulatory reaction

Published: 2022-10-10

1. Introduction

According to estimates up to 10% of the female population may suffer from lipedema, a chronic fat distribution disease, which takes a chronic course over life and is often passed on to female family members. Currently, the only long-term solution and treatment is surgery with large-volume liposuction. After first attempts at the end of the 90's, surgery of lipedema has become an everyday routine. With a consistent and competent treatment, surgeons achieve consistently excellent results with only very low risks.

In 2004, liposuction was first introduced as a successful form of treatment for lipedema [1,2]. In the meanwhile, many authors have confirmed the effectiveness of liposuction of lipedema. The Dutch guidelines state that pathological fat in lipedema can only be treated by surgery [3]. In the S1 guidelines by the German Society of Phlebology (DGP), liposuction is mentioned as an option for treatment in every stage of the disease [4].

Further studies confirm the usefulness of the liposuction and additionally prove its long-term effectiveness [5,6,7].

For an effective Lipo-Decompression, the removal of large fat volumes is necessary. Depending on the initial situation of the patient, often large-volume liposuctions with removals of more than 4,000 ml are necessary to achieve the desired freedom from pain. Many doctors consider this procedure as too risky and hint to an intolerable complication rate and heavy circulatory reactions. In this context, reference is often made to the guidelines of the American Society for Dermatologic Surgery from the year 2006 [8] as well as the guidelines of the American Academy of Dermatology from the year 2001 [9]. In these guidelines, the limit for aesthetic liposuctions is set at 4,000 or 4,500 ml respectively. Furthermore, these guidelines have been developed under the sole use of the TLA (tumescent local anaesthesia) method and almost exclusively refer to aesthetic indications. The treatment of lipedema is not mentioned in these guidelines.

Nevertheless, no reliable data on the frequency, intensity and transgression of circulatory reactions after Lipo-Decompression of lipedema using the water-jet assisted liposuction (WAL) can be found in the literature.

2. Patients and Methods

Between 2012 and 2018, an analogue scale has examined the circulatory reactions of 1,000 surgeries in the authors' clinic. Since this is a retrospective analysis of data collected as part of the quality assurance of our surgical method, according to §15 (1) of the professional code for physicians in North Rhine-Westphalia no ethics vote is required.

The patients who were treated were suffering from lipedema stages I-III. Average age was 35.9 years (16 - 77).

A water-jet assisted liposuction according to a standardised surgery protocol was performed in the following areas:

- lower legs circularly (386 surgeries)
- complete thighs circularly (286 surgeries)
- front side of the thighs (92 surgeries)
- backside of the thighs including buttocks (87 surgeries)
- arms circularly (149 surgeries)

Depending on the distribution pattern of fat, it was noticeable that the thighs/ buttocks area was too affected for a one-staged surgery, so that we then opted for a two-staged surgery. In these cases, the thighs were not decompressed circularly, but first aspirated on the front side, inner side and outer side and then in another surgery on the backside and buttocks. The arms and lower legs could always be operated completely in a circular surgery.

All patients received an analgosedation with Propofol and Remifentanil by our team of anaesthetists. A single shot antibiosis (Cephazolin 2g i.v.) was administered perioperative. After surgery, all patients received a thrombosis prophylaxis with a low-molecule heparin for 7 days, in cases with additional risk factors sometimes for a longer time.

Immediately after surgery, patients were put into their flat knit compression garments with an additional bandaging of the extremity, which had been treated. Patients were monitored during the night. The time span between two surgeries was at least 8 weeks.

After surgery, the patients received two questionnaires (Figure1 and Table 1).

Question 1: How did you feel in the first 24 hours after surgery?

Question 2: How did you feel the day up to 1 week after surgery?

1 = everything was perfect, no limitations

2 = you felt fine, nearly no limitations

3 = you suffered from dizziness, headache, nausea, you felt weak

4 = you suffered from real problems like fainting, but a doctor was not needed

5 = you felt really bad, you had to stay in hospital for 1 night

6 = you felt really bad, you had to stay in hospital an needed blood transfusion

Question 3: Did you feel well taken care of at home? **(yes** / **no)**

Question 4: Would you undergo the same procedure again? **(yes** / **no)**

Figure 1. Patient's Questionnaire.

Surgery Area	Average volume	Question 1 (up to 24hs after surgery) Volume < 4000ml	Question 1 (up to 24hs after surgery) Volume > 4,000ml	Question 2 (first week after surgery) volume < 4,000ml	Question 2 (first week after surgery) volume > 4,000ml
Lower legs n=386	3,520ml (800 - 10,000)	2.2 (SD 0.83)	2.2 (SD 0.83) p > 0.05	2.2 (SD 0.87)	2.4 (SD 0.87) p > 0.05
Thighs complete n = 286	4,778 ml (1,200 - 10,200)	2.4 (SD 0.99)	2.7 (SD 0.99) p < 0.05*	2.1 (SD 0.9)	2.4 (SD 0.9) p < 0.05*
Front side thighs n = 92	6,645 ml (3,200 - 10,700)	2.2 (SD 0.9)	2.6 (SD 0.9) p > 0.05	2.4 (0.87)	2.7 (SD 0.87) p > 0.05
Back side thighs/ buttocks n = 87	5,157 ml (2,000 - 10,100)	2.1 (SD 0.79)	2.2 (0.79) p > 0.05	1.9 (SD 0.79)	2.2 (SD 0.79) p > 0.05
Arms n = 149	2,957 ml (800 - 7,200)	1.6 (SD 0.64)	2.0 (SD 0.64) p > 0.05	1.6 (SD 0.64)	2.0 (SD 0.64) p < 0.05*

Table 1. Average volume aspirated and circulatory reaction distinguished according to large-volume (> 4,000 ml per surgery) and low-volume liposuction (< 4,000 ml per surgery). Significant differences ($p < 0.05$) for circulatory reaction were seen after large-volume liposuctions of the complete thighs as well as during the first postoperative week after high-volume liposuction of the arms.

* Significant difference, SD standard deviation.

In the first questionnaire, they were asked to rate their circulatory reaction during the first 24 hours after surgery.

In the second one, the questions concerned the first week after surgery. Furthermore, patients were asked if they felt comfortable being cared for by a family member or friend at home being instructed by the surgeon or nurse and whether they were to undergo the same surgery again (table 2). The last question was also considered as a rating of the overall procedure. In addition, postoperative complications as well as the impact of the patient's age on the circulatory reaction were examined. To determine possible significant differences depending the age, patients were divided up into patients under and over 50 years of age (table 3).

Surgery Area	Question 3 Satisfaction with care at home	Question 4 Satisfaction with the overall procedure
Lower legs n=386	98 %	97 %
Thighs complete n = 286	96 %	94 %
Front side thighs n = 92	96 %	97 %
Back side thighs/ buttocks n = 87	98 %	98 %
Arms n = 149	91 %	90 %

Table 2. Satisfaction with home care as well as the overall procedure.

Age	Circulatory reaction during first 24 hours	Circulatory reaction during first week
younger patients < 50 years n = 845	2.3	2.3 p > 0.05
older patients > 50 years n = 155	2	2 p > 0.05

Table 3. Circulatory reaction depending on age at time of surgery.

3. Results

In the evaluation, questionnaires of 1,000 surgeries were taken into consideration.

- 386 decompressions of the lower legs
- 286 decompressions of the complete thighs
- 92 decompressions of the front side of the thighs
- 87 decompressions of the back sides of the thighs including the buttocks and
- 49 decompressions of the arms were considered.

There was a normal distribution of the variables. As expected, the smallest average liposuction volume was on the arms. The largest average liposuction volume was on the front side of the thighs.

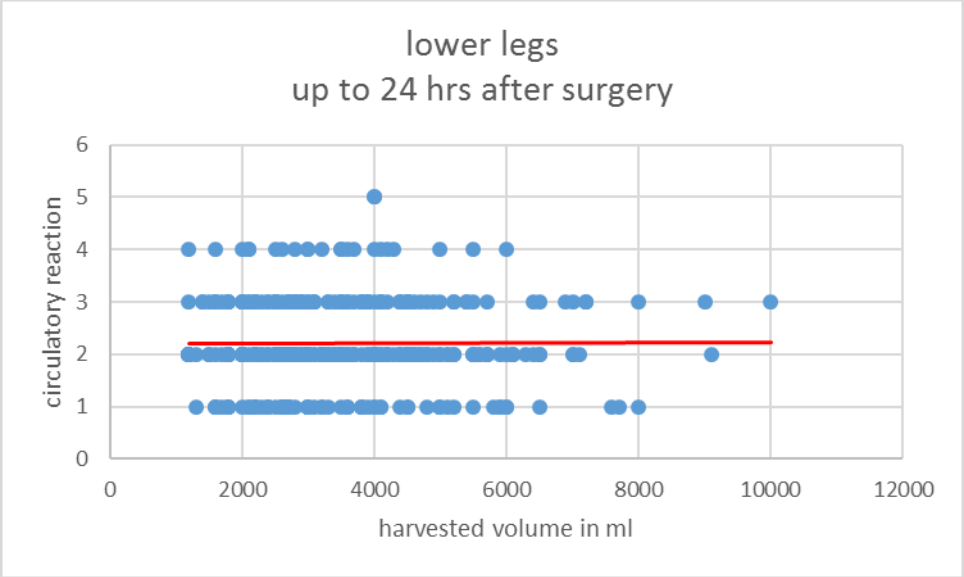
On the overall collective, small to moderate circulatory reactions could be observed. The smallest circulatory reaction could be seen on the arms during the first 24 hours after surgery with a value of 1.6 ("you felt well, almost no restrictions"). The most pronounced circulatory reaction could be seen after large-volume liposuctions during the first 24 hours after decompression of the complete thighs. Those reactions were also seen after large-volume liposuction of the front sides of the thighs during the first week after surgery with a value of 2.7 ("You suffered from a bit of dizziness or headache or nausea and felt weak").

3.1. Lower Legs

Liposuction volumes of 800 - 10,000 ml, average of 3,520 ml.

We could not observe a relevant circulatory reaction, regardless of the amount of lipo aspirate. The evaluation of the patients was on average between 2 ("you felt well, almost no restrictions") to 3 ("you suffered from a bit of dizziness or headache or nausea and felt weak"). There could not be seen a relevant difference between a low-volume liposuction < 4,000 ml and a large-volume liposuction > 4,000 ml.

A medical treatment due to circulatory reactions was not necessary in any of the cases after liposuction of the lower legs. 98% of the patients felt comfortable with home care, 97% would undergo the same procedure under the same circumstances again.(Figure 2)



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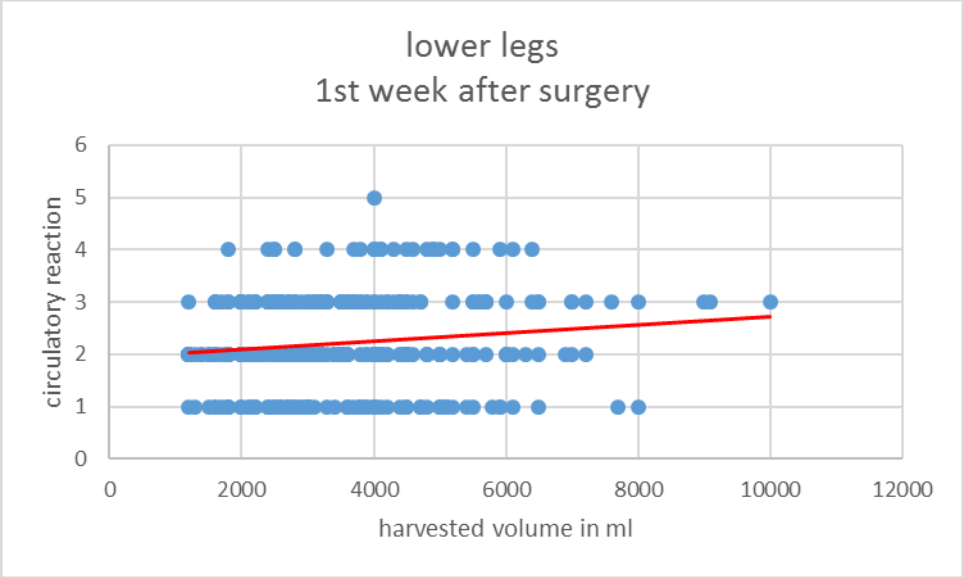

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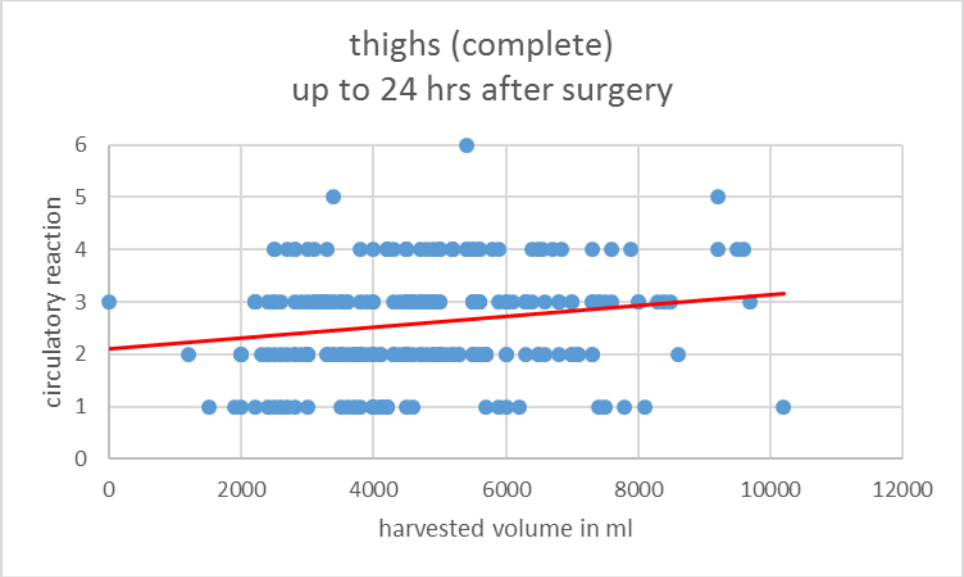
Figure 2. Circulatory reaction after Lipo-Decompression of the lower legs during the first 24 hours or first week after surgery.

3.2. Thighs (complete)

Volumes between 1,200 – 10,200 ml were aspirated. The average amount was 4,778 ml. There was a correlation between the volume that was aspirated and the postoperative circulatory reaction. With $p < 0.05$, a significant difference between low-volume liposuction < 4,000 ml and large-volume liposuction > 4,000 ml was seen.

Throughout, low-volume liposuctions were rated better during the first 24 hours as well as during the first week after surgery. Nevertheless, the average evaluation of patients were in the lower part of the scale from 2 ("you felt well, almost no restrictions") and 3 ("you suffered from a bit of dizziness or headache or nausea and felt weak"). In two cases, a hospitalization due to circulatory reactions was necessary.

96% of the patients felt comfortable with home care, 94% would undergo the same procedure under the same circumstances again.(Figure 3)



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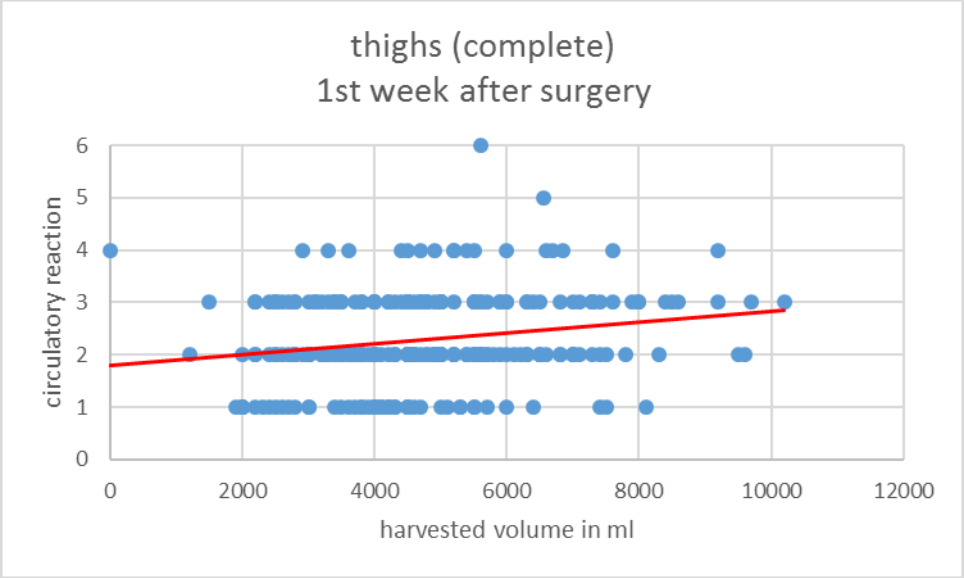

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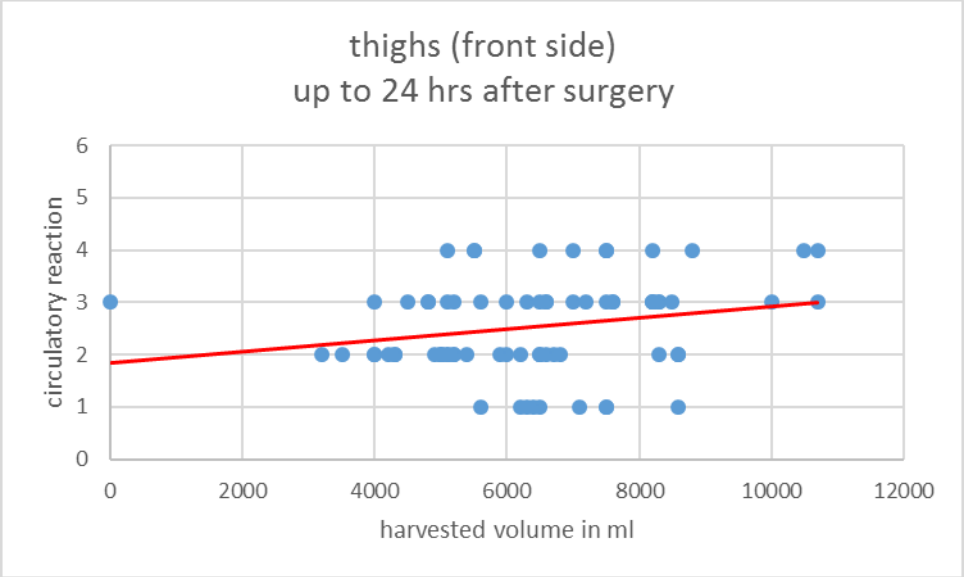
Figure 3. Circulatory reaction after Lipo-Decompression of the complete thighs during the first 24 hours and during the first week after surgery.

3.3. Front Sides of the Thighs

Liposuction volumes were between 3,200 – 10,700 ml, average of 6,675 ml.

There was no significant difference of the circulatory reaction in low-volume and large-volume liposuctions. The average evaluation of the patients was between 2 and 3 (see above) as well, so that in these cases, too, we only observed average moderate circulatory reactions. In none of the cases, medical treatment was necessary on any of the circulatory reaction. The overall satisfaction with home care was 96%. 97% were content with the overall procedure.



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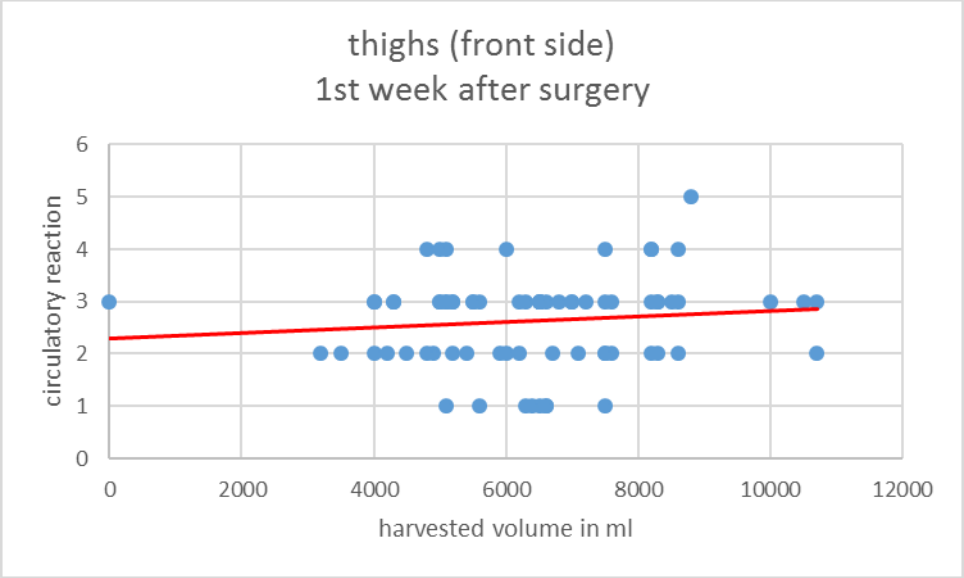

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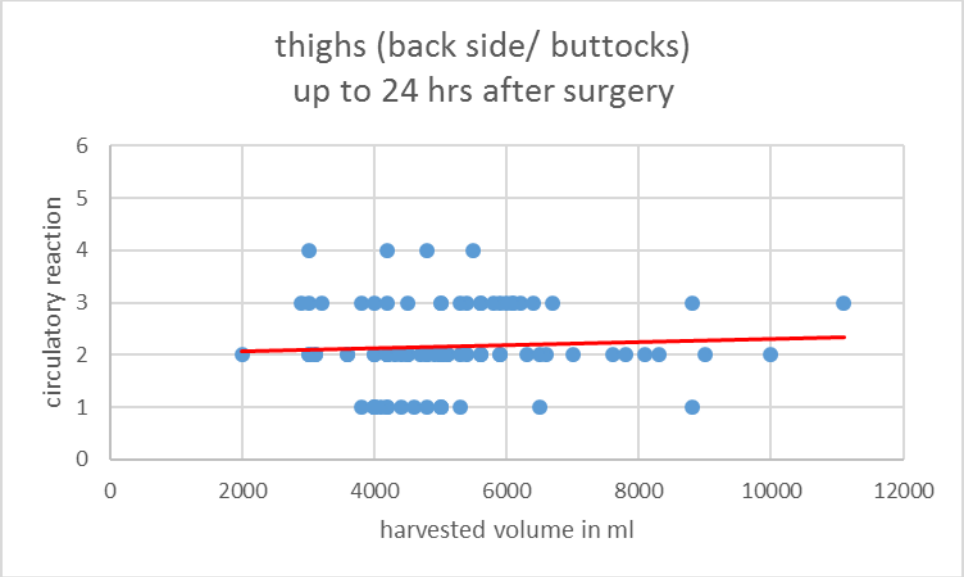
Figure 4. Circulatory reaction after Lipo-Decompression of the front sides of the thighs during the first 24 hours and first week after surgery.

3.4. Back Sides of the Thighs/ Buttocks

Volumes between 2,000 and 10,100 ml were aspirated, average of 5,157 ml.

Again, a significant difference between low-volume and large-volume liposuctions was not noticeable. On average, the patients' evaluation was better than the evaluation of liposuction on the complete thighs and front sides of the thighs and had an average of 2 ("you felt well, almost no restrictions").

A medical treatment due to circulatory reactions was not necessary in any of the cases. The home care was considered good with 98%, also 98% were content with the overall procedure.



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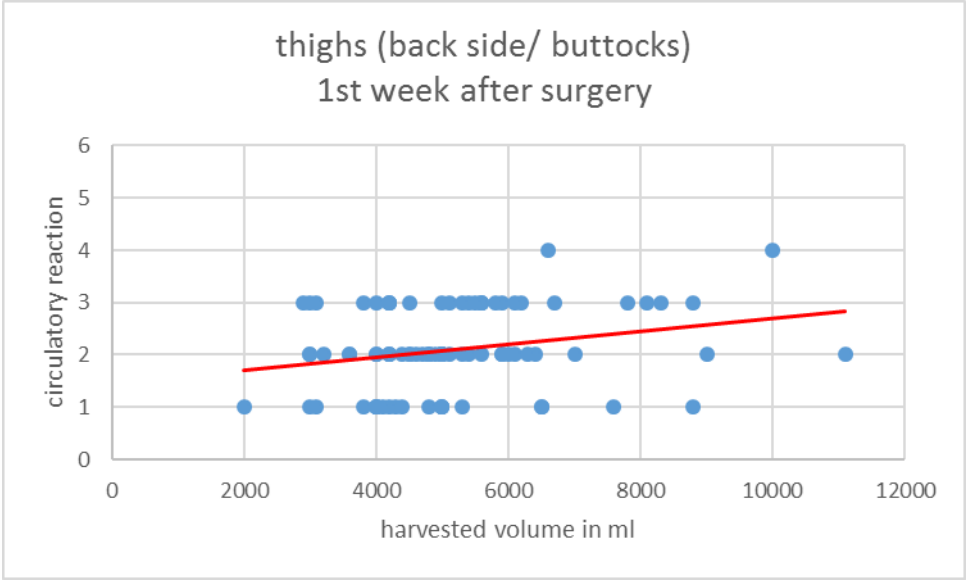

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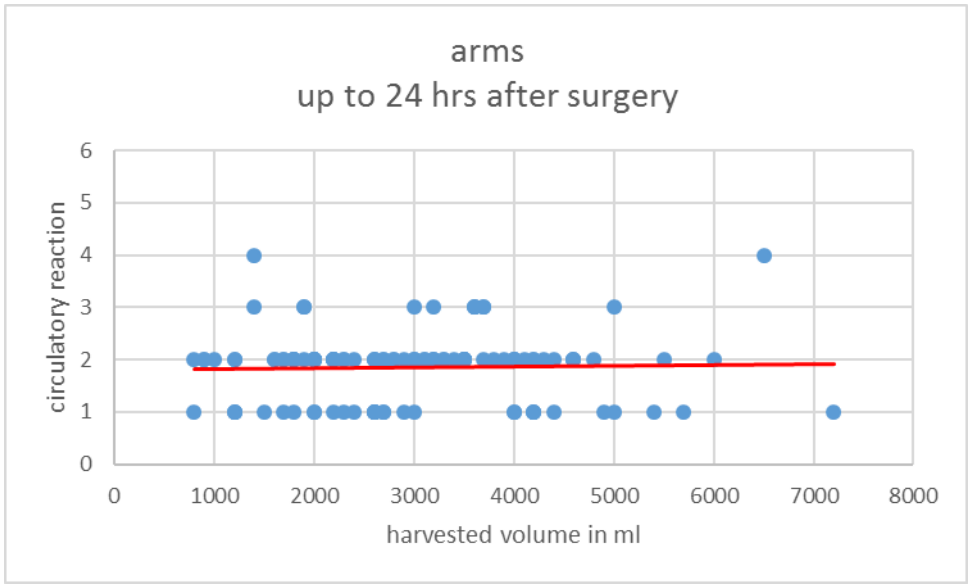
Figure 5. Circulatory reaction after Lipo-Decompression of the back sides of the thighs including the buttocks during the first 24 hours and the first week after surgery.

3.5. Arms

Liposuction volumes of 800 - 7,200 ml, average of 2,957 ml.

A significant difference between large-volume and low-volume liposuctions could not be seen in the circulatory reaction during the first 24 Hours. However, surprisingly we could observe a significant difference in the first week after surgery. The evaluation for a liposuction over 4,000 ml per setting was between 1 ("you felt great, no restrictions") and 3 ("You were suffering from dizziness, headache or nausea and felt weak").

Again, no medical attention was necessary. Despite the significant difference, the reactions were tolerable and did not have consequences or made necessary an alteration of the procedure. 91% were content with home care, 90% were very content with the overall procedure.



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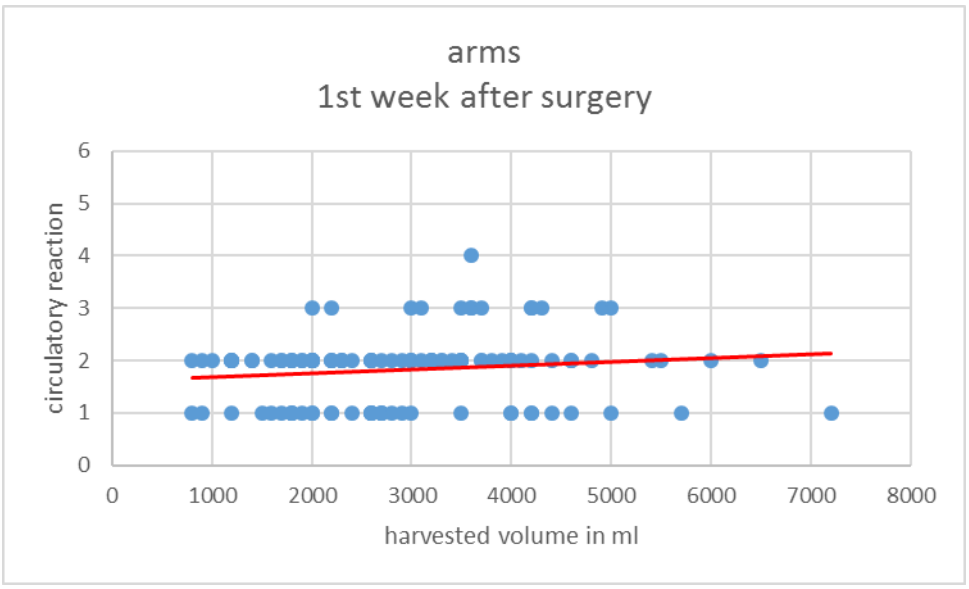

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Figure 6. Circulatory Reaction after Lipo-Decompression of the arms during the first 24 hours and the first week after surgery.

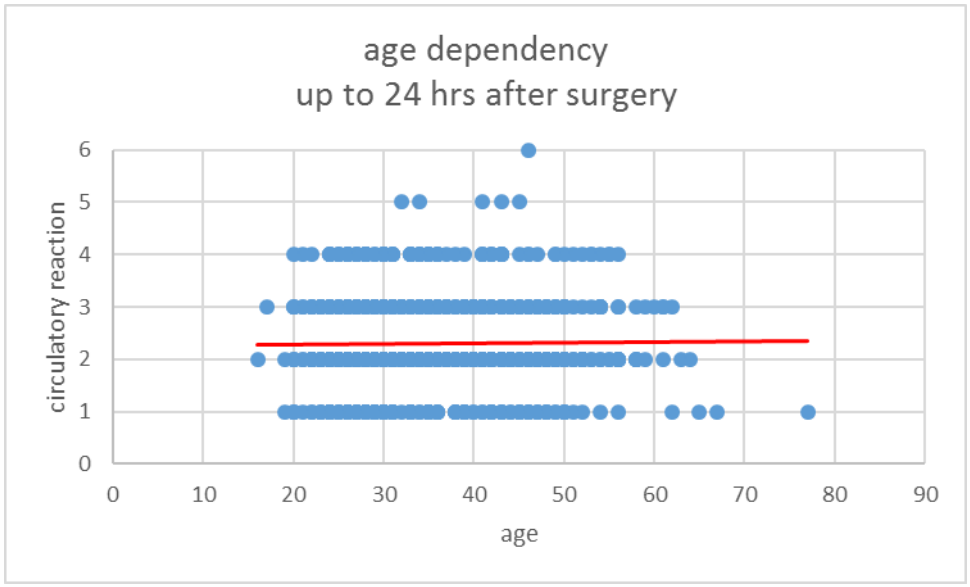
3.6. Circulatory Reaction Depending on Age

We performed surgery on patients between 16 and 77 years. The average age was 35.5 years.

Considering all surgeries, there was not a significant difference of the circulatory reaction on patients under 50 years (n = 845) and the ones over 50 years (n = 155).

The average liposuction volume of the younger patients < 50 years was 4,181 ml. the average liposuction volume of the older patients > 50 years was even 4,375 ml.

The circulatory reaction during the first 24 hours after surgery was rated 2.3 both by the younger and older patients. During the first week after surgery, circulatory reaction was rated 2 in both groups.



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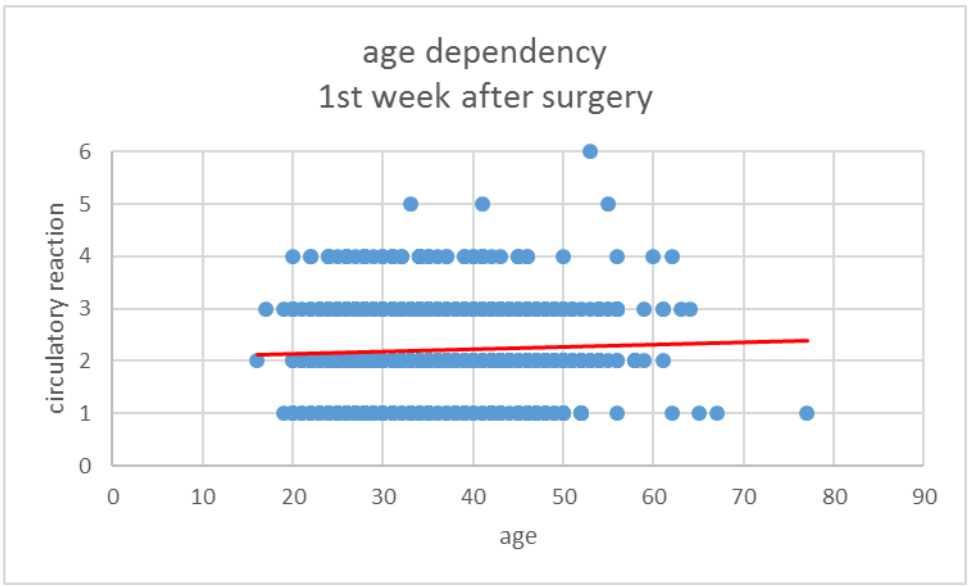

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Figure 7. Circulatory reaction depending on patient's age.

4. Discussion

Liposuction as a form of treatment for lipedema is discussed in medical literature for more than 10 years. First long-time studies have shown great effects [5,6,7]. Nevertheless, medical knowledge of the disease and its forms of treatment are shockingly low. The diagnosis is subjective, and currently there is no technical method to diagnose lipedema.[10,11].

Conservative therapy is long established, even there is no evidence for the usefulness of flat-knit compression garments or manual lymphatic drainage [12]. From our perspective, it is an essential cofactor for the surgical preparation and post-treatment.

The choice of the surgery technique remains ambiguous. Almost all clinics use the water-jet assisted liposuction "WAL" or the tumescence local anaesthesia "TLA". Both surgical procedures give good results when used by a qualified surgeon.

After 10 years of using the TLA technique in our clinic, we switched to the WAL technique. We see its advantages in the patients' comfort and safety. Because the tumescence essence is being aspirated directly after its injection, the drugs in the essence cannot

or only in small amounts, enter the circulation. Particularly toxic doses of lidocaine are not reached with the water-jet assisted liposuction. In literature, further hints to a lower tendency to swellings, fewer symptoms of pain as well as a shorter recuperation time can be found [13,14]. As it is proven, there is no augmented risk for damage on the lymphatic system [15].

Repeatedly, the maximal aspiration volume of fat is subject of discussion. There are no dependable sources in literature on this topic, especially not for the treatment of lipedema. Often the limit of max. 4,000 ml is considered. From the authors' point of view, a significantly larger volume is necessary for the consequent treatment of pathologically altered fat tissue. In our clinic, a limit of 8% of the patient´s body weight in liter has proven to be a safe and effective upper limit.

The limit of 4,000 ml is taken from the American guidelines for liposuction, which were created 16 and 21 years ago, mainly for aesthetic liposuctions [8, 9]. Lipedema and especially liposuction as a form of treatment were mainly unknown at the time, thus lipedema is not mentioned in these guidelines. Neither WAL as a safe form of treatment is considered, so that the mentioned guidelines cannot be taken into consideration for the treatment of lipedema. The S1-Guideline for lipedema of the German Association for Phlebology mentions liposuction as a form of treatment in every stage of lipedema, a limit for volume cannot be found.

There does not exist a precise definition of large-volume liposuction in literature. In general, volumes of 4,000 - 5,000 ml per session are considered to be high-volume liposuctions in various sources [16, 17, 18]. In Germany, a limit of 4,000 ml has been established in the general vocabulary, thus we have chosen it as the limit in our study.

Various authors describe the safe feasibility of large-volume liposuction [16, 17]. In a study by Albin from the year 1999, which was carried out on 181 patients, there could not be seen a correlation between the volumes aspirated and calculated blood loss in large-volume liposuctions [17].

In our data collection, after 1,000 liposuctions of lipedema we could observe mild to moderate circulatory reactions on average. As expected, the best results were obtained after Lipo-Decompression of the arms. Moderate to severe circulatory reactions could be observed after Lipo-Decompression of the complete thighs and front sides of the thighs. With larger aspiration volumes, only for the treatment of the complete thighs in one session with $p < 0.05$ a relevant, significant difference between a large-volume liposuction > 4,000ml and a low-volume liposuction < 4.000ml could be observed.

The methodology is simplistic and lacks objective parameters to better assess the impact on the physiology of the body. The data collected was initially only intended for internal quality control. A correlation to objective parameters such as blood pressure or pulse rate was not foreseen at that time and is therefore not evaluated here.

At the start of the study, two anaemias which required transfusions were documented, which could not be explained by the intraoperative blood loss alone. This observation fits in with the results from the study carried out by Albin [17]. Maybe dilution effects due to the intravasal volume therapy played a part. In both patients, the risk factors age > 50 years and the prominence of varices were documented. The evaluation of the circulatory data showed no increased circulatory reactions with higher age in the overall collective. Nevertheless, since then we have had strict guidelines in the case of venous insufficiencies. If a varicosis is existent, it has to be treated by surgery before liposuction. We also altered our surgery standard to the effect that we have determined a volume limit of 8% of the body weight in kg. The amount of volume that needs to be aspirated to obtain a significant reduction of the symptomatology is subject of current studies. To this day, there is no data concerning this question. According to our experience, as a rule we consider a liposuction volume of 8% of the body weight in kg as sufficiently effective and at the same time minimizing the risk profile as mentioned above.

Summed up, our data shows that also a large-volume liposuction in lipedema can be carried out safely by sticking to a standardised surgery procedure and the use of water-

jet assisted liposuction "WAL". The observed circulatory reaction require an overnight stay and should not be performed by discharge on the same day. In individual cases, the patient and the caregiver could be overwhelmed by treating dizziness, fainting, loss of fluid and postoperative pain by themselves. Nevertheless, there are no problems carrying it out with monitoring overnight. Postoperative circulatory reactions are common, but on average, their intensity is light to moderate-severe. The procedure can be carried out with a high patient's satisfaction.

Funding: This research received no external funding.

Conflicts of Interest: The author carried out presentation for human med AG, Schwerin, Germany

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