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BMI and Revision Surgery for Abdominoplasties: Complication Definitions Revisited Using the Clavien-Dindo Classification

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Background: After body contouring surgery of the lower trunk (CSLT), the definition, rate (4%–70%), and documentation of complications vary.
Objectives: We analyzed the effect of risk factors on the outcome based on the Clavien-Dindo classification (CDC) after CSLT surgery and polled postoperative satisfaction among patients.
Methods: All patients undergoing CSLT from 2001 to 2016 were included and were classified according to the CDC for postoperative events. Statistical analysis included proportional odds logistic regression analysis. We polled patients to grade their satisfaction with the postoperative result and whether they would have the operation performed again.
Results: A total of 265 patients were included: 60 (22.6%), 25 (9.4%), 28 (10.6%), and 21 (7.9%) were in CDC grades I, II, IIIa, and IIIb, respectively. A high preoperative body mass index significantly increased the odds for a postoperative event requiring revision surgery under general anesthesia (CDC grade IIIb, odds ratio 0.93, 95% confidence interval 0.89–0.97, $P = 0.001$). One-hundred twenty-eight patients (48.3%) participated in the poll: 101 (78.9%) were either happy or content with the postoperative results, and 117 (91.4%) would have the procedure performed again, including all nine patients with CDC grade IIIb.
Conclusions: Our results confirm that a high body mass index is a statistically significant risk factor for requiring major revision surgery after CSLT. Despite being a complication prone intervention, postoperative satisfaction after CSLT was ranked favorably in our sample. We recommend that the CDC be used in all surgical specialties to evaluate complications and permit future comparability of pooled data.
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INTRODUCTION

Global obesity is on the rise and has almost tripled since 1975: 39% of adults (≥18 years) were overweight in 2016, and female obesity prevalence is predicted to surpass the 20% mark in 2025,[1,2] highlighting the continued demand for massive weight loss and body contouring surgery. Contouring surgery of the lower trunk (CSLT) aims to reduce excess soft tissues after massive weight loss and leads to improved postoperative quality of life.[3–5] Reported CSLT complication rates vary from 4% to greater than 70%.[6–11] Reports on postoperative events after CSLT lack comparability. With no consensus on how to define postoperative events, most literature sources continue to apply confusing and similar terms like "minor," "major," and "severe" for classification of complications. Studies on postoperative events after CSLT using the Clavien-Dindo classification (CDC), which was introduced over a decade ago, are rare, despite their application in related

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fields.[12–14] Other classifications such as the Pittsburgh Body Contouring Complication Reporting System (PBCCRS) were seldom used.[15]

After the CDC's revision (Table 1) in 2009,[16,17] common events after CSLT, like seroma, continue to be underreported, since most standardized databases do not identify this as an event.[9,18–20] Seroma can result in any of the following management strategies: prolonged requirement for dressing changes, cannula-assisted release under local anesthesia, revision surgery under general anesthesia (GA), and prolonged length-of-hospital stay.[18,21,22] This illustrates that the definition for an event can result in different outcomes for a patient, which can become traceable when applying the CDC. The majority of risk factor analyses for CSLT lack this data.[6,11,19,20,23]

Previous publications on patient satisfaction after CSLT did not consider the effect of these events.[5,24–26] A "wound healing disorder," often classified as a "minor" event, can have a negative impact on patient satisfaction, because of repeated postoperative dressing changes, prolonged down time, or even revision surgery. The aim of our study was to evaluate postoperative events after CSLT using the CDC and to analyze risk factors and patient satisfaction according to the events' severity.

Takeaways

Question: Which postoperative events occur after abdominoplasty and what are their risk factors?

Findings: A retrospective data collection was conducted for patients who underwent contouring surgery of the lower trunk between 2001 and 2016. High preoperative BMI values are a significant risk factor for developing postoperative events that may require major revision surgery under general anesthesia.

Meaning: The Clavien-Dindo classification should be applied more in surgery to allow for comparability of data across studies and to harness potential benefits from its generated knowledge.

METHODS

Retrospective Data Collection

All adult patients (≥18 years) who underwent CSLT at our institution between 2001 and 2016 were included. Following ethical board approval (EK Nr. 28-593ex15/16), we retrospectively collected data from the electronic patient record system MEDOCS (SAP R/3, SAP, Walldorf, Germany). Reports from the electronic patient files were reviewed, and relevant data was transferred into IBM SPSS Statistics Version 22.0 (IBM, Armonk, N.Y.) for evaluation and statistical analysis. Postoperative events, categorized by MeSh terms, were classified by the CDC.

Table 1. Clavien-Dindo Classification

Grade	Definition
I	Deviations from the normal postoperative course without the need for additional pharmacological treatments or operative interventions Allowed are drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, physiotherapy, and rheological therapy. Included are also wound infections opened at the bedside
II	Requiring additional pharmacologic treatment with drugs other than drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, physiotherapy, and rheological therapy, also including blood transfusions and total parenteral nutrition
III	Need for operative intervention
IIIa	No general anesthesia needed
IIIb	Need for general anesthesia
IV	Life-threatening complication (including CNS complications)* requiring intensive care unit Management
Iva	Single organ failure (including dialysis)
IVb	Multiorgan failure
V	Death due to the intervention
Suffix "d"	If the patient has a complication at the time of discharge, the suffix "d" (for "disability") is added to the respective grade of complication. Follow-up is recommended

*Brain hemorrhage, ischemic stroke, subarachnoidal bleeding, but excluding transient ischemic attacks.
CNS, central nervous system.

Perioperative Management Protocol for CSLT

The perioperative management protocol for CSLT included preoperative marking of incisions on the standing patient and a single shot of preoperative antibiotic prophylaxis (second generation cephalosporin). Drains were removed when the fluid output per drain was below 50 mL per 24 hours. Primary dressing consisted of sterile adhesive strips (Suture Strip, Novamedical GmbH, Langenfeld, Germany) or DERMABOND PRINEO Skin Closure System (Ethicon, Somerville, N.J.), depending on the surgeon's preference. Customized compression garments were prescribed for 6 weeks. Follow-up was scheduled after 2 weeks, as well as 3, 6, and 12 months.

Telephone Survey

During outpatient-appointment calls, patients were polled for the postoperative follow-up. Calls were handled by administrative personnel not involved in the treatment. Patients were asked two standardized questions: one rating scale question ("How content are you with the result of the surgery, according to the following scale: unhappy, quite content, content, happy?"), and one dichotomous yes/no question ("Would you have the same procedure performed on you again?")

Statistical Analysis

Data were descriptively summarized using absolute and relative frequencies or mean and standard deviation (SD). To quantify the effect of various risk factors on the severity of the complications, proportional odds logistic regression models were fit using the R function "vglm" from the package VGAM. The results are presented as odds ratios (ORs) and 95% confidence intervals (CIs) for a change from one class to the next higher, and the associated probabilities

for each CD class at any given value of the risk factor are plotted to aid interpretation. *P* values less than 0.05 were considered statistically significant. R version 3.4.4 was used for all analyses.

RESULTS

Demographics and Risk Factors

Age, gender, smoking status, surgical technique, the American Society of Anesthesiologists risk classification (ASA), and physical status classifications system scale are depicted in Figure 1.

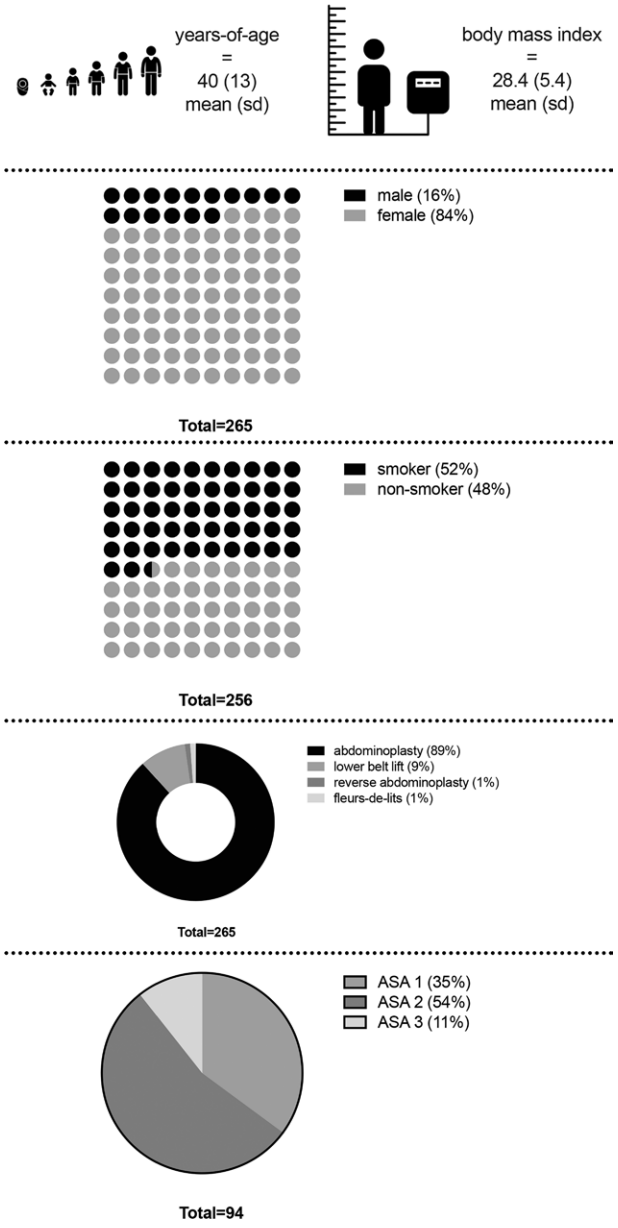

Fig. 1. Age, gender, smoking status, surgical technique, and American Society of Anesthesiologists risk classification, physical status classifications system scale (Total = absolute number of available observations/datapoints).

Clavien-Dindo Classification

A total of 130 (49%) patients were CDC grade 0 and 135 (51%) were at least CDC grade I ("*any* deviation from normal postoperative course"). When multiple events were reported for one patient, the most severe was used for the CDC. Of the 135 patients with events, the majority (22.6% = 60/265) were CDC grade I. Twenty-five (9.4% of n = 265) were CDC grade II ("additional pharmacological management"), and 50 (18.9% of n = 265) CDC grade III ("operative take back"). In one patient with CDC grade III, no data on the event management was available, and this observation was excluded from the risk factor analysis. Of the remaining 49 patients with CDC grade III, 28 (10.6% of n = 265) were grade IIIa ("surgical take-back without requirement for GA") and 21 (8% of n = 265) grade IIIb ("surgical revision under GA"). There was no CDC grade IV or V event in our collective (Table 2).

Assessment of Risk Factors

There was no statistically significant effect of sex (female: OR 0.85, 95% CI 0.46–1.57, $P = 0.607$), age (OR

Table 2. Different Management Strategies Ranging from CDC I-IIIb for the Same Event Type Per Row

CDC	I	II	IIIa	IIIb	IV	V
Patients Total, n	N = 60	N = 25	N = 28	N = 21	N = 0	N = 0
Wound healing disorder	53	11	26	21	0	0
Necrosis	5	3	18	14	0	0
Fistula	23	3	11	5	0	0
Seroma	2	1	12	14	0	0
Hematoma	21	1	5	5	0	0
Wound dehiscence	7	4	10	3	0	0
Postoperative infection	3	4	8	7	0	0

The CDC offers a refined analysis of event types based on the resultant management strategy. For example, seroma reveals operative take back in 26 versus three conservatively managed cases.

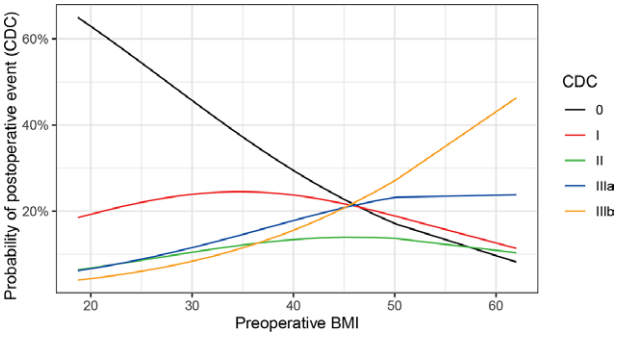

Fig. 2. Odds ratio of preoperative BMI on the probability of developing events defined by the CDC: The higher the BMI the more likely the odds for developing postoperative events requiring operative take back with (CDC IIIb, yellow curve) or without general anesthesia (CDC IIIa, blue curve). Low-grade postoperative events (CDC 0, black curve) were less likely to occur with increasing BMI. Events graded CDC I (red curve) or CDC II (green curve) were almost unaffected by the BMI.

Table 3. Postoperative Level of Patients' Satisfaction (Telephone Survey) Grouped by the CDC

	CDC						
Level of Satisfaction	**0**	**I**	**II**	**IIIa**	**IIIb**	**III**	**Total**
Happy	34 (59.6%)	17 (50.0%)	6 (54.5%)	8 (50.0%)	5 (55.6%)	1 (100%)	71 (55.5%)
Content	12 (21.1%)	8 (23.5%)	3 (27.3%)	4 (25.0%)	3 (33.3%)	0 (0.0%)	30 (23.4%)
Quite content	3 (5.3%)	8 (23.5%)	1 (9.1%)	3 (18.8%)	1 (11.1%)	0 (0.0%)	16 (12.5%)
Unhappy	8 (14.0%)	1 (2.9%)	1 (9.1%)	1 (6.2%)	0 (0.0%)	0 (0.0%)	11 (8.6%)

0.99, 95% CI 0.97–1.01, $P = 0.157$), smoking (OR 1.20, 95% CI 0.76–1.89, $P = 0.437$), or ASA score ($P = 0.067$) on the CDC grade. However, a high preoperative body mass index (BMI) significantly increased the odds for developing higher grade postoperative events (OR 0.93, 95% CI 0.89–0.97, $P = 0.001$, Fig. 2).

Telephone Survey

A total of 128 (48.3%) patients agreed to take part in the telephone survey (Table 3). Of the 128 patients, 117 (91.4%) would and 11 (8.6%) would not have the procedure performed again. Among the polled patients, the nine with the highest CDC grade (IIIb) were in favor of having the procedure performed again.

DISCUSSION

Our results confirm that a high BMI is a statistically significant risk factor for requiring major revision surgery under GA after CSLT. Previous studies reported similar effects of high BMI values on postoperative event rates in body contouring surgery.[10,11,21,22,27–29] None of these studies used the CDC or any other objective, standardized scale for classification of postoperative events. A high BMI was the only statistically significant risk factor; we found no significant effect of age, gender, ASA score, or smoking on the CDC grade of postoperative events. Contradicting conclusions on the effects of the aforementioned risk factors can be found in the literature.[9,10,19,20,23,30–32]

There was no consensus on how to define and how to classify postoperative events in the previous literature on CSLT. The following terms were widely used to describe and classify postoperative events: "major," "minor," "local," "systemic,"[31] or "minor wound," "major surgical" and "medical" or "general" complication. However, these categories lack a uniform definition and are subjective in nature. This disagreement led to underreporting of postoperative event rates, as shown by previous retrospective studies, despite the high case numbers of included patients. This is suggestive of "common" event types not being recorded due to the lack of coding for this event type, notably in the absence of reimbursement options.[6,9,19,20,33] For example, delayed wound healing and seroma were not documented in the National Surgical Quality Improvement Program database[19] (Table 4). However, these events were reported to be the leading postoperative complication after abdominoplasty.[18,21,22] Other reporting systems such as the PBCCRS were seldom used for the reviewed operation types.[9,15]

Based on the current literature findings, we hypothesize events with grade CDC I or CDC II to be underreported. A numerical example from our collective can illustrate this: by simply "ignoring" events with grade CDC I or CDC II, the overall event rate would be reduced to 18.9% (comparable to Table 4).

Table 4. Overall Complication Rates after Abdominoplasty and Contouring Surgery of the Lower Trunk as Documented in the National Surgical Quality Improvement Program

Publication	Patients (n)	Overall Complication Rate (%)
Vu (19)	2499	10.8
Familusi (9)	3637	12
Massenburg (20)	2946	19.5
Winocour (6)	25,000	4

The benefits of standardized postoperative event reporting by use of the CDC include improved quality of informed patient consent,[34] healthcare provider benchmarking, and strategic advantages for negotiating reimbursement schemes following CSLT. Another advantage of the standardized event rating using the CDC is the decision-making for patients opting for a procedure as well as for surgeons opting to perform the operation in the first place: the probability of not developing a postoperative event is low for patients with high BMIs. This can trigger surgeons to postpone CSLT and motivate patients to reduce their BMI before reconsidering surgery.

In conjunction with previous reports, we found a high postoperative satisfaction among our patients,[5,24–26,35] this observation was irrespective of our patients' CDC grading. Reducing the preoperative BMI should be pursued to minimize the postoperative events, and patients should be educated before planning surgery.

Limitations of our report include its retrospective design and the participation rate in the telephone survey. No standardized patient reported outcome measures were available before our observation period (the BODY-Q was published after 2018) to include pre- and posttesting for subjective variables.

CONCLUSIONS

A high preoperative BMI was a statistically significant risk factor for developing postoperative events that require major revision surgery under GA after CSLT. Patient education should become an important part of the first consultation with the patient. Even among the event prone patients with CDC IIIb that needed secondary surgery, postoperative satisfaction after CSLT was high. We recommend the CDC to be applied in surgery to allow comparability of data across studies and to harness benefits from its generated knowledge (improved informed consent,

provider benchmarking, negotiating reimbursement for events after CSLT, patient selection).

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