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ARTICLE

Safety of body contouring surgery in an aging patient population

Yonatan Molad-Hayo, Yair Shachar and Neta Adler

Department of Plastic and Reconstructive Surgery, Hadassah Medical Center, Jerusalem, Israel

ABSTRACT

The fastest-growing age group undergoing cosmetic procedures are those over age 60, i.e. the aging patient group. While advanced age is a known predictor for increased surgical complications, the effects of age on complications in specific plastic procedures have yet to be thoroughly investigated. To determine the relationship between increased age and risk of surgical complications following body contouring procedures, specifically: abdominoplasty, brachioplasty, mastopexy, bilateral reduction, and thigh lift. A retrospective analysis of all patients undergoing body contouring procedures of the categories mentioned above between 2000–2018 at a tertiary university medical center. Patients were divided into two age groups: those below and those above, age 60. Data analysis included: demographics, underlying medical conditions, procedure type, and occurrence of postoperative complications (according to the Clavien-Dindo classification system). 803 body contouring procedures were identified, with 12% performed on the aging population. Aging patients had more underlying medical conditions than the younger ones. While the distribution of procedure type was similar in both groups, mastopexy was more common in aging patients. Of the 107 procedures identified as having complications, 37 were classified as grade I, 38 as grade II, and 32 as grade III. As a categorical variable, no relationship was found between the age of the patients and an increased risk of postoperative complications (age cut-off as 60). However, as a continuous variable, increased age did increase the overall risk of postoperative complications, although no optimal age as a cut-off point was identified. In multivariant analysis, diabetes mellitus with abdominoplasty was identified as a risk factor for postoperative complications. Conclusions: When undergoing body contouring procedures, we found that patients over the age of 60 are not at increased risk for postoperative complications than those under that age. Although age as a continuous variable was found to increase the overall postoperative complications, no optimal age could be defined as a cut-off point.

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Introduction

Over the last few decades, the American Society of Aesthetic Plastic Surgery (ASAPS) annual reports have demonstrated the clear consistent upward trend of surgical and non-surgical aesthetic medical procedures across all ages [1–4]. While the largest age group undergoing aesthetic procedures are 35-50, the fastest growth in the prevalence of aesthetic medical procedures is the aging group. The World Health Organization (WHO) and the Organization for Economic Co-operation and Development (OECD) define the term 'aging patient' as a person aged 60 and above [17,28]. In 1997, the ASAPS reported that 21.7% of aesthetic surgical procedures were performed on persons above 51, while 5.5% were on persons above 65 [1]. By 2016, 23% of all aesthetic surgical procedures were performed on aging patients [2–4]. The consistent upward trend of aesthetic procedures of the aging patient population raises questions regarding anticipated complication rates. It is well known that advanced age is a significant risk factor for surgical and anesthetic procedures. It is also known that the aging patients have a higher prevalence of underlying medical conditions, specifically: cardiovascular issues, decreased pulmonary function, chest wall dysfunction, and neurological decline [5–7]. These medical conditions enhance the risk of both anesthetic and postoperative complications, such as delirium, respiratory tract infections, venous thrombosis, pulmonary embolism, and overall deconditioning [8,9]. Research is scarce in the professional literature regarding the aging population prevalence of complications in surgical body contouring procedures.

This study aims to identify the influence of age on the risk of complications following aesthetic body contouring procedures, including abdominoplasty, brachioplasty, reduction mammoplasty mastopexy, and thigh lift.

Methods

A retrospective analysis of 803 surgical aesthetic operations performed between 2000 and 2018 in the Department of Plastic Surgery at Hadassah Hebrew University Medical Center, Ein Kerem Campus in Jerusalem, Israel, was conducted. We excluded specific procedures, including liposuction, breast augmentation, mastopexy–augmentation, or combination surgeries, as the number of aging patients undergoing these procedures was very small. Additional exclusion criteria included breast reduction due to functional reasons.

The indication for surgery was aesthetic; Although this is a university hospital, the setup allows for aesthetic surgery done by senior surgeons, usually without being reimbursed or paying a

CONTACT Yonatan Molad-Hayo yonatanmh@gmail.com Department of Plastic and Reconstructive Surgery, Hadassah Medical Center, Hebrew University, POB 12000, Jerusalem, il-91120, Israel
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discounted price, knowing a resident under supervision will operate. The definition between aesthetic or functional body contouring such as breast reduction due to upper back pain or after weight loss may be sometimes blurred, and some of the patients were reimbursed by their insurance.

Following approval by the Institutional Review Board of the Hadassah Hebrew University Medical Center, patients were divided into two groups based on age – those below 60 years and those 60 years and above.

For each patient, the following data was gathered: demographics (age, sex) and detailed medical history, including perioperative hypertension, diabetes status (type 1, type 2, or gestational), ischemic heart disease, thyroid disease (hypothyroidism or hyperthyroidism), chronic lung disease (asthma or COPD) and smoking status (active, past or none). Additional information regarding the type of surgery, dates, surgical complications, and length of stay were also gathered and analyzed.

Surgical complications were divided into five groups according to the Clavien-Dindo classification system [10]: Any deviation from the normal postoperative course, without the need for pharmacological, surgical, or radiological interventions (except for simple bedside wound infections openings) were classified as Grade I. Cases that required pharmacological treatment with other drugs than antiemetics, antipyretics, analgesics, diuretics, electrolytes or physiotherapy, were classified as Grade II. Those cases included chiefly the use of antibiotics and blood transfusions due to a decrease in hemoglobin levels. Any other cases that required surgical or radiological intervention classified as Grade III – those that were performed under general anesthesia were classified as Grade IIIb and those that were not, as Grade IIIa. No cases were classified as Grade IV or higher in our study group. A comparison was conducted between age and complications, and the effect of additional variables potentially affecting the risk of postoperative complications. Variables found to be correlated with higher risk a multivariate logistic regression model was applied.

Results

We reviewed 803 procedures that were performed on 678 patients between the years 2000 and 2018. The patient's age ranged between 11-75, with an average of 42.20 (median = 43.00, SD = 14.72). Of all the procedures, 12.83% were performed in the aging patient population (103 procedures, mean = 64.57, SD = 3.71), while 87.17% were performed in a younger population (700 procedures, mean = 38.90, SD = 12.73).

Over the years, there was a clear upward trend in the number of performed procedures across all ages ($y = 2.063x-4102.399$, $R^2 = 0.285$, p-value = 0.019). This trend was demonstrated also in the younger patients group ($y = 1.564x-3105.079$, $R^2 = 0.237$, $p = 0.035$) and the aging patients group ($y = 0.499x-997.32$, $R^2 = 0.339$, $p = 0.009$) (See Figure 1).

There were significantly more patients with underlying medical history in the aging patient population group, including hypertension, diabetes, ischemic heart disease, and thyroid disease. While the aging patient population had more underlying medical diagnoses, smoking prevalence was higher in the younger population. In both age groups, the distribution of procedure type was similar, with the three most common procedures being mastopexy, bilateral reduction, and abdominoplasty (See Table 1).

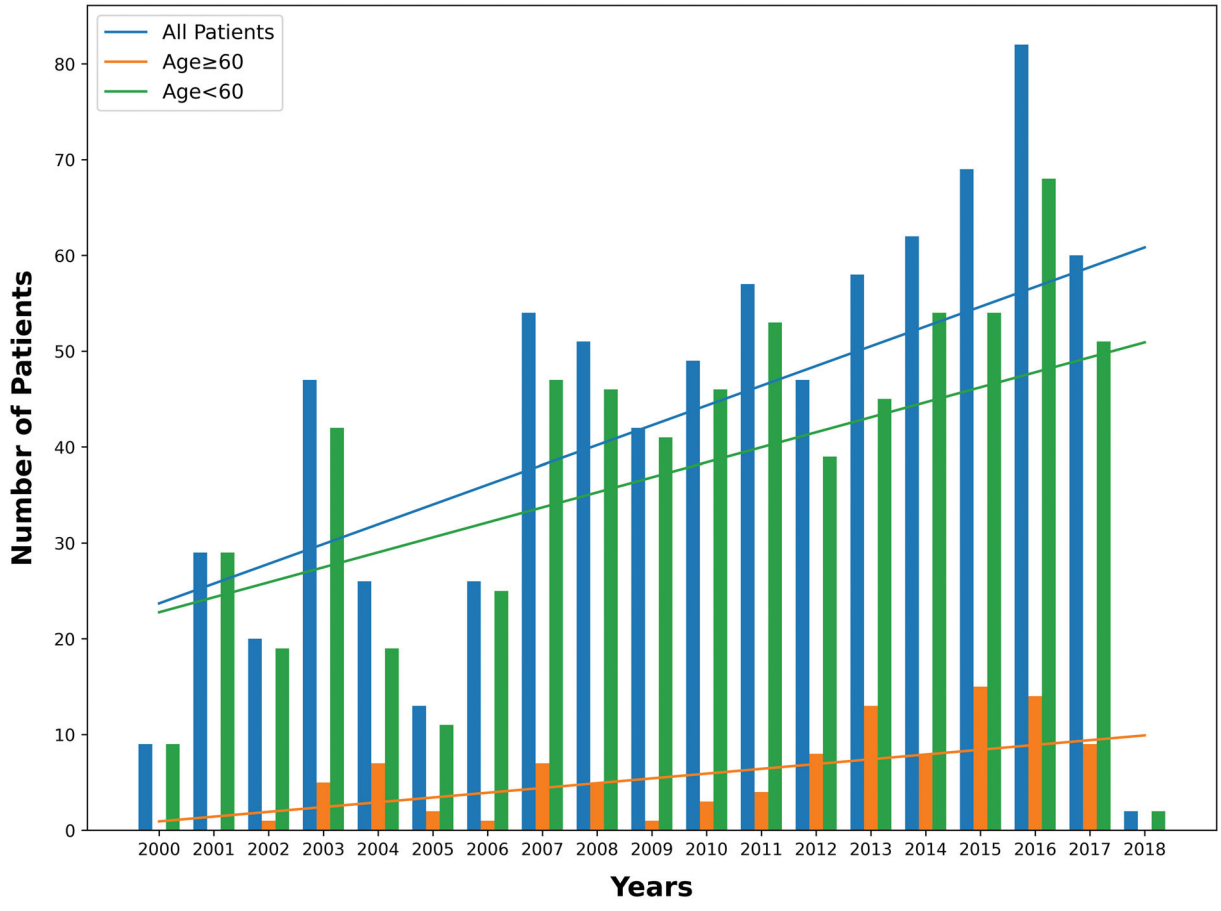

Figure 1. Number of procedures per year for different age groups.

Postoperative complications were found in 107 procedures, of which 37 were classified as Clavien-Dindo Grade I, 38 as Grade II, 6 as Grade IIIa and 26 as Grade IIIb.

No significant correlation was found between patient age (as a categorical variable – above and below 60) and Clavien-Dindo complication (See Table 2).

A statistically significant difference was found with regards to the relationship between age and risk of any Clavien-Dindo Grade complication ($t(801) = -2.36$, $p = 0.018$). The mean age of those who developed complications was 45.32 (SD = 10.101), while the mean age of those who did not develop complications was 41.72 (SD = 14.770) (See Figure 2).

Table 1. Study group demography.

	Younger patients (<60)		Aging patient population (≥60)		Total		
Characteristic	*N*	%	*N*	%	*N*	%	*p* Value
Surgery records	700	87.17%	103	12.83%	803	100%	
Gender							0.004[a]
Male	78	11.14%	2	1.94%	80	9.96%	
Female	622	88.86%	101	98.06%	723	90.04%	
Medical background[d]							
Smoking status							0.085[a]
YES	192	27.43%	20	19.42%	212	26.40%	
Active[e]	121	17.29%	2	1.94%	123	15.32%	
Past	71	10.14%	18	17.48%	89	11.08%	
NO	508	72.57%	83	82.8%	591	73.60%	
Hypertension							<0.001[a]
YES	49	7.00%	41	39.81%	90	11.21%	
NO	651	93.00%	62	60.19%	713	88.79%	
Diabetic mellitus							0.007[a]
YES	35	5.00%	12	11.65%	47	5.85%	
Type I	2	0.003%	0	0.0%	2	0.002%	
Type II	27	3.86%	12	11.65%	39	4.86%	
GDM	6	0.009%	0	0.0%	6	0.007%	
NO	665	95.00%	91	88.35%	756	94.15%	
Ischemic heart disease							<0.001[b]
YES	3	0.43%	6	5.83%	9	1.12%	
NO	697	99.57%	97	94.17%	794	98.88%	
Thyroid disease							<0.001[a]
YES	41	5.86%	20	19.42%	61	7.60%	
Hypothyroidism	40	5.71%	18	17.48%	58	7.22%	
Hyperthyroidism	1	0.14%	2	1.94%	3	0.37%	
NO	659	94.14%	83	80.58%	742	92.40%	
Lung disease							0.763[b]
YES	22	3.14%	4	3.88%	26	3.24%	
COPD	2	0.29%	1	0.97%	3	0.37%	
Asthma	20	2.86%	3	2.91%	23	2.86%	
NO	678	96.86%	99	96.12%	777	96.76%	
Surgery type							0.018[b]
Abdominoplasty	160	22.86%	14	13.59%	174	21.67%	0.040[c]
Brachioplasty	12	1.71%	1	0.97%	13	1.62%	1.000[c]
Mastopexy	273	39.00%	58	56.31%	331	41.22%	0.001[c]
Reduction bilateral	242	34.57%	28	27.18%	270	33.62%	0.148[c]
Thigh Lift	13	1.86%	2	1.94%	15	1.87%	1.000[c]

[a]The *p*-value was calculated using a Pearson Chi-Square Test.
[b]The *p*-value was calculated using a Fisher's Exact Test.
[c]The *p*-value was calculated using a Fisher's Exact Test for a specific surgery type versus other surgery types.
[d]The *p*-value was calculated for each characteristic variable relates to Yes (having) versus No (not having).
[e]Active smokers were asked to stop smoking at least two weeks before surgery.

Table 2. Postoperative complications.

	Younger patients (<60)		Aging patient population (≥60)		Total		
Postoperative complications	*N*	%	*N*	%	*N*	%	*p* Value
Surgery records	700	87.17%	103	12.83%	803	100%	
Any postoperative complication[c]	91	13.00%	16	15.53%	107	13.33%	0.480[a]
Clavien-Dindo Grade I	35	5.00%	2	1.94%	37	4.61%	0.212[b]
Clavien-Dindo Grade II	28	4.00%	10	9.71%	38	4.73	0.011[a]
Clavien-Dindo Grade IIIa	5	0.71%	1	0.97%	6	0.75%	0.562 [b]
Clavien-Dindo Grade IIIb	23	3.29%	3	2.91%	26	3.24%	1.000 [b]
Clavien-Dindo Grade Iva	0	0%	0	0%	0	0%	
Clavien-Dindo Grade IVb	0	0%	0	0%	0	0%	
Clavien-Dindo Grade V	0	0%	0	0%	0	0%	
No complication[c]	609	87.00%	87	84.47%	696	86.68%	

[a]The *p*-value was calculated using a Pearson Chi-Square Test.
[b]The *p*-value was calculated using Fisher's Exact Test.
[c]Complication was defined according to Clavien-Dindo classification.

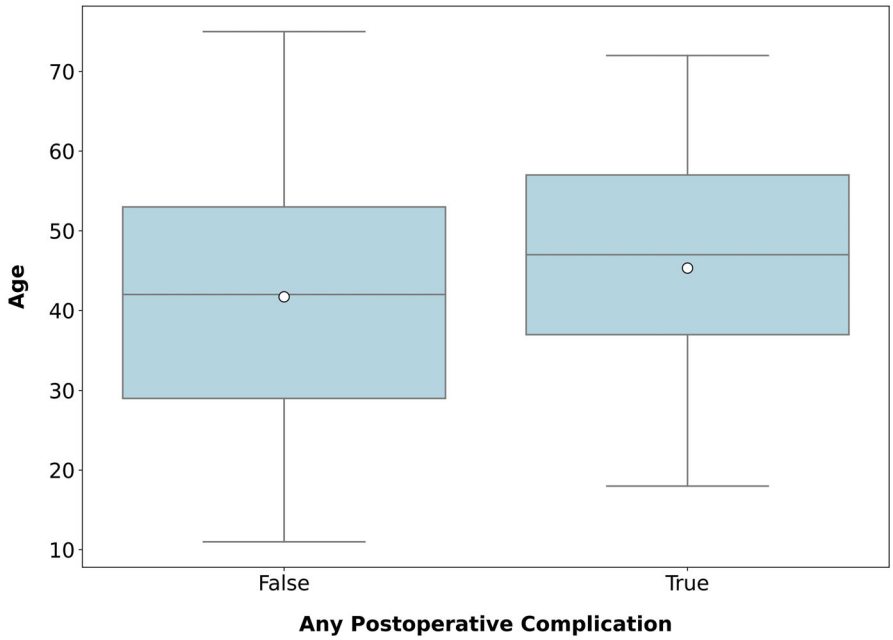

Figure 2. Box plot of patients age as a continuous variable and the existence of complications.

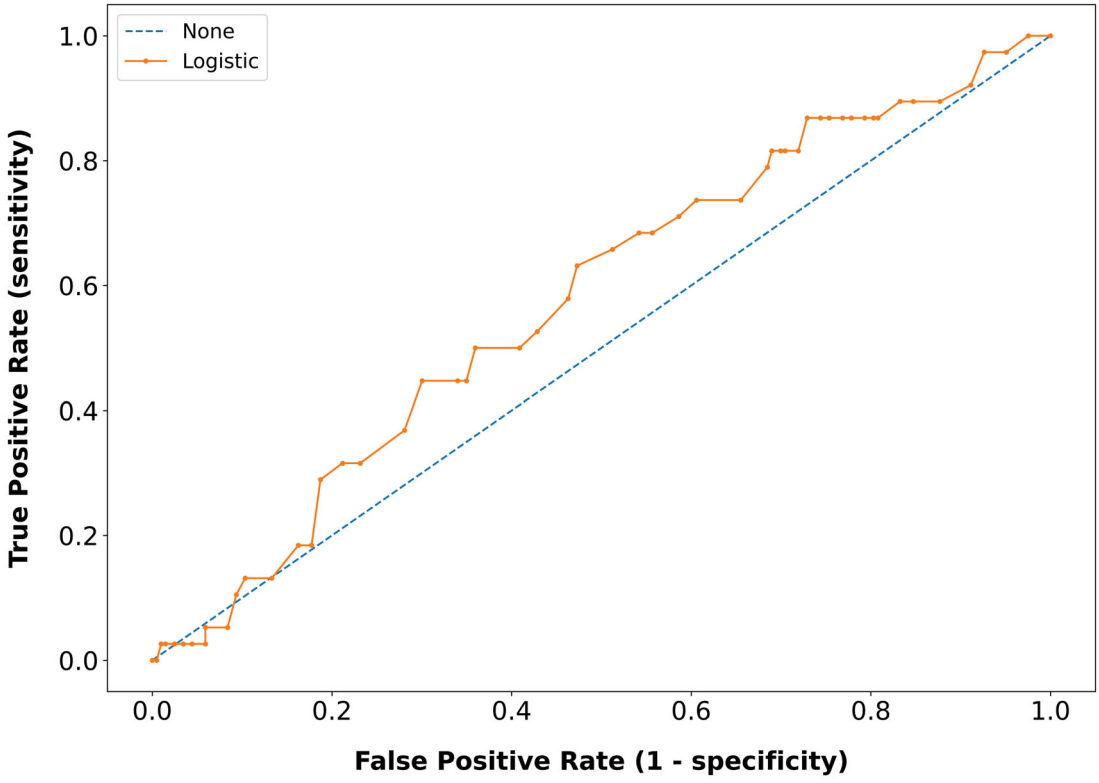

Figure 3. Receiver Operating Characteristic (ROC) curves of patients age when predicting the overall risk of postoperative complications.

A statistically significant difference was found with regards to the relationship between age (as a continuous variable) and risk of Clavien-Dindo Grade II complication ($t(801) = -3.97$, $p < 0.001$).

No other statistically significant relationship was found between age and other Clavien-Dindo complications.

Given the correlation between age and the risk of any Clavien-Dindo complication, we performed ROC analysis to define an optimal cut-off age. However, no age was pinpointed (the area under the age variable curve (AUC) was 0.577) (See Figure 3).

The effect of other variables on the risk of developing any postoperative complications demonstrated a dependence between the risk of developing any postoperative complications and type of operation ($\chi^2(4)=49.295$, $p < 0.001$), and the presence of diabetes mellitus ($\chi^2(1) = 14.938$, $p < 0.001$) or hypertension ($\chi^2(1) = 5.320$, $p = 0.021$).

A logistic regression analysis was performed to assess the significance of the relationship between each independent variable with 'any complication'. The adjusted odds ratios (ORs) were calculated for variables that significantly affected the complication. Statistical significance was found for the development of any complication in diabetic versus non-diabetic patients, with an OR of 2.469 ($1.208 < CI < 5.046$, $p = 0.013$). However, no statistical significance was found for those with hypertension than those without ($p = 0.333$) (See Table 3).

Type of surgery

According to the sample size and rate of complications, analysis of surgery type yielded the highest rates of any complications in two specific surgical procedures: thigh lift (46.667%) and abdominoplasty (24.713%). However, it should be noted that the overall number of thigh lift procedures ($n = 15$) and brachioplasty procedures ($n = 13$) were notably low (See Table 4).

Diabetic patients

When focusing on diabetes mellitus patients, correlations were found between the risk of developing any postoperative complication and surgery type as a categoric variable ($\chi^2(3) = 9.617$, $p = 0.022$).

A logistic regression analysis was performed to assess the significance of the relationship between each surgery type with 'any complication'. A statistically significance difference was found regarding the risk of developing any complication in patients with diabetes who underwent abdominoplasty surgery versus other surgeries, with an adjusted-OR of 14.667 ($1.590 < CI < 135.322$, $p = 0.018$) (See Table 5).

Abdominoplasty patients

Among abdominoplasty patients, a correlation was found between the risk of developing any postoperative complications and age (as a categorical variable, $\chi^2(1) = 5.233$, $p = 0.022$), as well as between the risk of developing any postoperative complications and the presence of diabetes ($\chi^2(1) = 11.141$, $p = 0.001$) and hypertension ($\chi^2(1) = 5.196$, $p = 0.022$).

A logistic regression analysis was performed to assess the significance of the relationship between these independent variables' values and the 'any complication' variable. The adjusted-ORs were calculated for variables that significantly affected the complication. Statistical significance was found for the development of any complication in diabetic versus non-diabetic patients, with an adjusted-OR of 3.292 ($1.152 < CI < 9.407$, $p = 0.026$) (See Table 6).

When examining the relationship between the different background variables and the presence of any Clavien-Dindo complication grade among abdominoplasty patients, a correlation was found between Clavien-Dindo Grade II complication risk and age (as a categorical variable, $\chi^2(1) = 5.007$, $p = 0.025$), diabetes ($\chi^2(1) = 18.785$; $p < 0.001$), hypertension ($\chi^2(1) = 16.111$; $p < 0.001$) and any thyroid disease ($\chi^2(1) = 7.693$; $p = 0.050$). In a multivariant model analysis, age and thyroid disease were found to be insignificant. Statistical significance was found for the development of Clavien-Dindo grade II complication in diabetic patients who underwent abdominoplasty surgery versus non-diabetic patients, with an adjusted-OR of 4.906 ($1.119 < CI < 21.508$, $p = 0.035$), and in hypertensive patients underwent abdominoplasty surgery versus normotensive patients, with an adjusted-OR of 4.915 ($1.261 < CI < 19.158$, $p = 0.022$) (See Table 7).

Discussion

In recent years there has been a consistent rise in aesthetic surgeries in the aging patient population due to several reasons. First, advancements in medicine and technology have increased

Table 3. Any Complication and age/diabetes/surgery type/hypertension.

	Sig.	Adjusted OR	95% CI for OR Lower	95% CI for OR Upper
Age (cut-off 60)	0.480	1.268	0.657	2.447
Diabetes Mellitus	0.013	2.469	1.208	5.046
Surgery Type				
Abdominoplasty	0.003	2.155	1.291	3.596
Brachioplasty	0.370	1.866	0.479	7.274
Mastopexy	0.011	0.471	0.264	0.841
Thigh Lift	<0.001	6.836	2.316	20.181
Hypertension	0.333	1.376	0.721	2.620

Table 5. Any complications and surgery type among diabetics.

	Sig.	Adjusted OR	95% CI for OR Lower	95% CI for OR Upper
Surgery Type				
Abdominoplasty	0.018	14.667	1.590	135.322
Brachioplasty	1.000	0.000	0.000	
Reduction Bilateral	0.262	4.000	0.355	45.100

Table 6. Any complications, age and diabetes among abdominoplasty patients.

	Sig.	Adjusted OR	95% CI for OR Lower	95% CI for OR Upper
Age (Cutoff 60)	0.241	2.079	0.612	7.055
Diabetic Mellitus	0.026	3.292	1.152	9.407
Hypertension	0.269	1.691	0.667	4.288

Table 7. Grade II complication, age, hypertension and thyroid disease among abdominoplasty patients.

	Sig.	Adjusted OR	95% CI for OR Lower	95% CI for OR Upper
Age (Cutoff 60)	0.655	1.486	0.262	8.446
Hypertension	0.022	4.915	1.261	19.158
Diabetes Mellitus	0.035	4.906	1.119	21.508
Thyroid disease	0.562	1.626	0.314	8.408

Table 4. Postoperative complications and surgery types.

	Total Patients		Clavien-Dindo Classification									
			Grade I		Grade II		Grade IIIa		Grade IIIb		Any	
Surgery Type	N	%	N	%	N	%	N	%	N	%	N	%
Abdominoplasty	174	21.669%	13	7.471%	12	6.900%	4	2.300%	14	8.046%	43	24.713%
Brachioplasty	13	1.619%	2	15.385	0	0.000%	0	0.000%	1	7.692%	3	23.077%
Mastopexy	331	41.220%	5	1.511%	15	4.532%	0	0.000%	1	0.302%	21	6.344%
Reduction Bilateral	270	33.623%	12	4.444%	9	3.333%	2	0.741%	10	3.703%	33	12.222%
Thigh Lift	15	1.868%	5	33.333%	2	13.333%	0	0.000%	0	0.000%	7	46.667%

life expectancy and quality of life for the aging population. As such, patients desire to match their outer appearance with their physical state and overall feeling of well-being. Secondly, aesthetic procedures can have an enormous practical influence on life, enabling patients to stay relevant in our youth glorifying world. A change in the social perception of such procedures also contributes to this. The shift is being more accepting, and such procedures are no longer being viewed negatively as a sign of vanity or insecurities. Furthermore, technological advancements in the surgical field yield newer techniques leading to safer and less invasive procedures with shorter recovery times.

Despite all this, aging is a known risk factor for postoperative and anesthetic complications. Although studies have been previously reported in the literature on the effect of aging in aesthetic surgery, these studies are relating to specific body contouring procedures, and their results are inconclusive. In a study of 9000 abdominoplasty patients, Winocour et al., found the risk for complications in adults under age 60 to be 3.9%, while the risk in aging patients (60 and above) was 5.3% [11]. Nelson et al. in their study of 3500 female patients who went through a bilateral reduction, found no significant implication of age on complications [12]. While Kaye et al. reviewed over 150,000 patients following different surgical procedures, they found a correlation between older age and a higher risk for surgical site infection [13]. In a study by Roehl et al, of 180 female patients following breast reduction, no significant implication of age on the risk of developing postoperative complications was found [14]. Moreover, other studies found a low and similar risk of postoperative complications among different age groups [6,15,16].

In our study, no correlation was found between patient age as a categorical variable, above and below 60, and an increased risk of any Clavien-Dindo grade of postoperative complications. However, age as a continuous variable was found to increase the overall risk of postoperative complications, but no optimal cut-off age was found to set apart low and high risk. This finding is of great significance in candidates' decision-making process for aesthetic body shaping surgeries and their surgeons. Such findings have a greater significance due to the growing demand in recent years for aesthetic surgery in the general population and the older population in particular [1–3,17]. It is important to note that these findings stand in contradiction to the results of many previous studies, which state that the age of the patient is a negative predictor for postoperative complications [18–21]. One possible explanation for the contradiction is that the aging patients present for such aesthetic procedures are generally in good medical condition. It is also possible that the biological and psychological age of the aging patients is lower than their chronological age or that the plastic surgeons themselves perform some pre-screening process. Although no significant correlation was found between age and risk of complications, this study revealed several findings that emphasize the possible impact of pre-existing health status on the risk of postoperative complications.

First, we found that diabetes mellitus is correlated with an increased risk of developing any postoperative complications. This risk was 2.5 times higher than patients without diabetes and 14.7 times higher in patients with diabetes undergoing abdominoplasty surgery (compared to other types of body contouring procedures).

The fact that diabetes is, in and of itself, a risk factor for postoperative complications is well recognized in the scientific literature [22–27]. There are several possible explanations for this phenomenon [28]: stressful situations (such as surgery) stimulate the release of neuroendocrine hormones that contribute to the development of insulin resistance and hyperglycemia [17], rapid fluid loss [1], sudden discontinuation of drugs [2], and steroid use, which are common in the surgical treatment setting [29,30]. Furthermore, hyperglycemic states interfere with wound healing by inhibiting blood flow. Thus, endothelial cells are damaged, and a prolonged inflammatory state is developed [31]. Moreover, the role of phagocyte neutrophils responsible for protection against various contaminants may be impaired [32]. Specifically, abdominoplasty surgery was found to be a risk factor among patients with diabetes, as this surgery is characterized by a sizeable surgical dissection involving an extensive area of the body, resulting in a relatively significant cut-off of blood supply to the abdominal wall. Furthermore, it is often combined with other procedures such as liposuction. Combining these characteristics with the effects of diabetes might explain the increased risk. Additionally, variables such as BMI, surgical time, and weight of tissue resected may be significant predictors of complications. A limitation of this study includes inconsistent measurement of these specific variables, which should be included in future studies, as their contribution may be significant.

Secondly, we found that among patients undergoing abdominoplasty procedures, diabetic patients were 3.4 times more likely to develop postoperative complications than non-diabetic. In addition, abdominoplasty patients with hypertension were 4.9 times more likely to develop Clavien-Dindo grade II complications than those without hypertension. No significant results were found regarding other grades. As mentioned above, the increased risk found in diabetic abdominoplasty patients is not surprising due to the nature of the surgery and the characteristics of the disease. Regarding the relationship between hypertension and grade II complications in abdominoplasty patients, it may be a coincidental error due to a small number of hypertensive patients in the sample ($n = 29$, of whom 6 are younger patients and 23 are aging patients).

Interestingly, smoking was not found to be a risk factor for complications. However, this may be due to our departmental policy asking all active smokers to stop smoking completely at least two weeks before surgery.

The findings of this study have to be seen in the light of some limitations [28]: All reported cases were performed in the same tertiary university hospital responsible for treating more complex cases comparing to smaller medical centers, which may tend to get complicated more frequently [17]. Having different surgeons utilizing various surgical techniques for a given body contouring procedure were subject to an inherent performance bias. As such, no inference was made between surgical technique and complication rate; Correlation between particular surgical technique and associated complication rate was beyond the scope of this study [1]. Due to a limited number of cases, we did not relate specifically to the subgroup of patients above 70, which may have shown different complication rates.

Considering these findings, further research focusing on this issue and conducting a statistical examination of larger samples is in need. In addition, concerning the limitations of the study, follow-up studies should be conducted among a broader and more diverse sample (from different hospitals and cities), thus minimizing the impact of selection bias, performance bias, and reporting bias that may have taken place in this study, and improving the validity of the study.

Conclusion

In recent years, there is a clear consistent rise in the performance of aesthetic body shaping procedures, with the fastest-growing

age group of a variety of cosmetic procedures being aging patients. Despite the general assumption that increased age is an adverse prognostic factor predicting a generally higher risk of postoperative complications, our study found no relationship between the age of the patients (as a categorical variable) and an increased risk of postoperative complications. However, age as a continuous variable was found to increase the overall risk of postoperative complications. The presence of underlying medical conditions such as diabetics and hypertension and the type of procedure (specifically abdominoplasty) were found to affect the risk of postoperative complications.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Neta Adler http://orcid.org/0000-0002-1518-6851

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