Characteristics of Women Who Have Had Cosmetic Breast Implants That Could Be Associated with Increased Suicide Risk: A Systematic Review, Proposing a Suicide Prevention Model

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Literature indicates an increased risk of suicide among women who have had cosmetic breast implants. An explanatory model for this association has not been established. Some studies conclude that women with cosmetic breast implants demonstrate some characteristics that are associated with increased suicide risk while others support that the breast augmentation protects from suicide. A systematic review including data collection from January 1961 up to February 2014 was conducted. The results were incorporated to pre-existing suicide risk models of the general population. A modified suicide risk model was created for the female cosmetic augmentation mammoplasty candidate. A 2–3 times increased suicide risk among women that undergo cosmetic breast augmentation has been identified. Breast augmentation patients show some characteristics that are associated with increased suicide risk. The majority of women reported high postoperative satisfaction. Recent research indicates that the Autoimmune syndrome induced by adjuvants and fibromyalgia syndrome are associated with silicone implantation. A thorough surgical, medical and psycho-social (psychiatric, family, reproductive, and occupational) history should be included in the preoperative assessment of women seeking to undergo cosmetic breast augmentation. Breast augmentation surgery can stimulate a systematic stress response and increase the risk of suicide. Each risk factor of suicide has poor predictive value when considered independently and can result in prediction errors. A clinical management model has been proposed considering the overlapping risk factors of women that undergo cosmetic breast augmentation with suicide.

Keywords: Cosmetic surgery / Silicone / Breast implants / Mammaplasty / Suicide

INTRODUCTION

According to the National Institute of Mental Health in the US, suicide is a major, preventable public health problem as the tenth leading cause of death, accounting for 34,598 deaths per annum [1,2]. With an overall rate of 11.3 suicide deaths per 100,000
people and an estimated 11 attempted suicides per actual suicide death [1,2]. Recent research indicates an increased risk of suicide among women who have had cosmetic breast implants [3-9]. This unanticipated finding has caused a conflict regarding the safety of cosmetic breast augmentation and has led to several empirical explanations [10,11].

Among them the specific characteristics of women who have had cosmetic breast implants and their association with raised suicide risk has been encountered as a reasonable explanation while others support that the breast augmentation confer protection from suicide [10-15]. McLaughlin et al. [12] recommended further epidemiological studies in order to identify whether or not there is a causal relationship between breast implantation and suicide and large-scale retrospective cohort studies to compare the suicide risk in women with and without implants. Joiner [13] estimated that the suicide risk in women with cosmetic breast augmentation should be four times greater than the general population's rate and concluded that the cosmetic augmentation operation may suppress suicidality.

The current challenge is to demonstrate an explanatory model and identify specific predisposing suicide risk factors in those women. The aim of this article is to review the literature regarding the characteristics of women who have had cosmetic breast implants that could be associated with increased suicide risk and to attempt to devise a conceptualized suicide risk model for the women candidates of cosmetic breast augmentation. Before discussing that it is necessary to review the studies that investigate the association between cosmetic breast augmentation and suicide risk.

**METHODS**

A systematic review [16-20] was conducted investigating the association between cosmetic breast augmentation and suicide risk and the characteristics of the breast augmentation female patient and their relation with suicide. Our data collection period was from January 1961 until February 2014. The review included prospect cohort studies, retrospective cohort studies, randomized clinical trials, case-control studies clinical trials and excluded systematic reviews.

Our review grouped the identified studies in 3 different categories based on their investigation subject: 1) Epidemiological studies that were investigating the relationship between cosmetic breast augmentation and suicide in women; 2) Studies that evaluated the psychosocial and psychological status both before and after breast augmentation procedures were grouped together; 3) Epidemiological studies that were focusing on psychiatric history, demographic characteristics, life-style characteristics and reproductive history of women with cosmetic breast implants.

We excluded studies that evaluated the usage of breast implants for reconstructive purposes, studies that evaluated general cosmetic surgery rather than cosmetic breast augmentation and studies that included breast augmentation in men. Database was collected from: PubMed, MEDLINE, CINAHL, PsycINFO, Web of Science, OvidSP, ScienceDirect, JAMA Psychiatry, with the keywords: Cosmetic surgery, Suicide and/or predictor factors, Silicone breast implants/breast augmentation and/or self-esteem, Body image, Psychosocial outcomes. Further studies were yielded from the reference lists used in the identified articles. After exporting the data, we evaluated them based on the scientific question and exclusion criteria. Evaluation of each result separately was followed and studies were organized according to the degree of similarity among them and reference tables were created. The results were incorporated to pre-existing suicide risk models of the general population and a modified suicide risk model was created for the female cosmetic augmentation mammoplasty candidate.

**RESULTS**

Our literature search identified 7 epidemiological cohort studies addressing the issue of cosmetic breast augmentation and suicide, which are presented in chronological order in Table 1 [3-9].

This demonstrates available data such as the follow up period, the age and the outcome after cosmetic breast augmentation. Among these studies, only Villeneuve et al. [8] didn’t find any relationship between cosmetic breast augmentation and high risk of suicide. The other studies found a two to three fold increased risk of suicide in women with cosmetic augmentation implants compared to the general population. Three of the studies [7-9], suggest that the rate of suicide is higher in women who underwent breast augmentation after the age of 40 and for women who had their implants for longer period of time (> than 10 years). Several proposed explanations for this association include the higher prevalence of psychopathology [4], mental illness history that required hospital treatment [6] and significant underlying psychiatric morbidity in the above groups [9]. The non prospective study design with regards to the association between suicide and cosmetic breast implants limits any definitive conclusions on causality in this relationship [15].

The impact of patients postoperative expectations and the level of postoperative satisfaction, have been associated with poor psychosocial outcomes that could potentially relate with the increased rate of suicides among cosmetic breast augmentation patients [21,22]. Ten studies focusing on the psychosocial outcomes (self-esteem, body-image, postoperative satisfaction, qual-
In summary the majority of women reported high postoperative satisfaction and some of them would have surgery again [21]. Beale et al. [26] using the Rosenberg Self-esteem Scale and the Cesarec-Mark personality Schedule for a 12 months follow-up period tried to assess the predictors of successful outcome from augmentation mammoplasty and concluded that 78% of women were completely satisfied. They also resulted that patients with unrealistic expectations and psychiatric problems are more likely to be related with poor outcome such as low self-esteem [26]. Kilman et al. [27] concluded that breast mammoplasty enhances body image and increases sexual interest of the patient’s partner. Meyer and Ringberg [28], assessed the personality, the psychosocial and psychiatric characteristics of those women and concluded that 86% were satisfied and that their social and psychological expectations had been fulfilled [28]. Young et al. [29] reported postoperative increased self-confidence among 88% of the women and 95% postoperative rates of satisfaction. Cash et al. [31] found that more than 90% of women were satisfied with the outcome and attained expectations of enhanced body image. The above studies demonstrate that the postoperative outcome is unlikely to contribute to the increased suicide risk among those women.

The specific characteristics of women that undergo cosmetic breast augmentation have been assumed to be linked with the increased suicide risk of this population [15,21]. Several researchers have conducted studies in order to identify characteristics (demographic, lifestyle, psychiatric and reproductive history) of women with cosmetic breast implants. 10 studies were identified as demonstrated in Table 3 in chronological order [22,26,33-40].

Most studies agree that the typical breast augmentation female patient [34-39] is more often, Caucasian, between 28 to 44 years of age, thin and tall, smoker, consuming alcohol, with good education backgrounds [33-35,37,40] and likely to have history of depression, anxiety and neurotic personality. They seek for psychiatric consultations more often than the general population and have increased rate of psychiatric hospital admissions prior to the cosmetic surgery [22,26,37-40]. Regarding their reproductive history they have younger age at menopause, greater number of full pregnancies and are more likely to have had an induced abortion [34,36,37]. Studies remain inconclusive regarding their marital status [26,33,35,40].

### Table 1. Suicide in women with cosmetic breast implants

| Author(s) study | Study objective | Outcome | Age (yr) | Follow-up period (yr) | Suggestions/associated factors and/or possible explanations given |
|-----------------|----------------|---------|---------|----------------------|---------------------------------------------------------------|
| Brinton et al. [3], 2001, Retrospective cohort study | Mortality among augmentation mammoplasty patients | Excess mortality from suicide and other external causes of death among women with cosmetic breast implants | 2–3 times higher suicide rate (SMR = 1.54; 95% CI, 1.0–2.4). | 34 (mean) | 13 | Mood disorders, low self-esteem marital difficulties older age at implantation |
| Koot et al. [4], 2003, Prospective study | Mortality among Swedish women with cosmetic breast implants | Increased risk of suicide (SMR = 2.9; 95% CI, 1.6–4.8). | 3.16 (mean) | 28 | Greater prevalence of psychopathology |
| Pukkala et al. [5], 2003, Cohort study | Causes of death among Finnish women with cosmetic breast implants | 2-fold increase risk from suicide (SMR = 3.19; 95% CI, 1.5–5.9). | < 30 | 30 Mean length, 10.3 | Underlying psychopathology. Further investigation required |
| Jacobsen et al. [6], 2004, Cohort study | Mortality and suicide among Danish women with cosmetic breast implants | 2-fold increased risks of suicide (SMR = 3.1; 95% CI, 1.7–5.2). | 31 (mean) | 22 | Mental illness history requiring hospital admission |
| Brinton et al. [7], 2006, Retrospective cohort study | Mortality rates among augmentation mammoplasty patients an update | Excess risk of suicide. Risk of suicide increased after the first postoperative decade (SMR = 1.63; 95% CI, 1.1–2.3). | 34 (mean) | Followed their initial cohort for additional 5 | Reasons remain unclear predisposing personality characteristics, low self-esteem, anxiety, depression |
| Villeneuve et al. [8], 2006, Cohort study | Mortality among Canadian women with cosmetic breast implants | No differences in suicide rates between implant patients and other cosmetic plastic surgery patients. Higher standardized mortality ratios for suicide for women who received breast implants ≥ 40 years and for those who had for longer period their implants. | 32 (mean) | 15 | Further studies are needed to evaluate detailed risk factors between suicides and breast implant patients |
| Lipworth et al. [9], 2007, Cohort study | Excess mortality from suicide and other external causes of death among women with cosmetic breast implants | 3 fold excess risk of suicide (SMR = 3; 95% CI, 1.9–4.5). The increased risk of suicide was not apparent until 10 years after implantation. | 32 (mean) | 18.7 | Significant underlying psychiatric morbidity rather than a causal association with silicone implants |

SMR, standardized mortality ratio; CI, confidence interval.
Table 2. Psychosocial outcomes/psychological characteristics

| Author(s), study | Study objective | Scales used | Age (yr) | Follow-up period | Associated factors with poor outcomes | Outcome |
|------------------|-----------------|-------------|----------|------------------|---------------------------------------|---------|
| Edgerton et al. [23], (1961) | Positive effects on perceived risks | Guilford-Zimmerman Temperament Survey, Morale-Loss Scale, Tennessee Dept of Health Self-Concept Scale, Sentence Completion Test | 17–52 | 6 mo to 3 yr | Depression, Unrealistic expectations, Marital difficulties, Patients asking for operation urgently | Enhanced self-esteem, Patients generally satisfied with outcome |
| Shipley et al. [24], (1978) | Psychosocial effects of cosmetic augmentation mammoplasty | California Psychological Inventory, Ziller Social Self Esteem Test, Dress Popularity and Activity Questionnaire | 30.5 (mean) | 3 mo | Not stated | The augmented women showed improved body image |
| Sihm et al. [25], (1978) | Psychological assessment before and after augmentation mammoplasty | Activity Questionnaire, Unspecified measures of body image, identity, intellectual level, personality integration | 21–45 | 12 mo | Not stated | Improvement of self confidence |
| Beale et al. [26], (1985) | Identify predictors of successful outcome from augmentation mammoplasty | Rosenberg Self-Esteem scale, Cesarec-Mark Personality Schedule | Not stated | 12 mo | Unrealistic expectations, Patients scoring high on neurotic personality scale, Goal of surgery is to improve relationship | 78% completely satisfied |
| Kilman et al. [27], (1987) | Assess impact of augmentation mammoplasty on personal and relationship functioning including sexual life and body image | Author’s questionnaire | 35 (mean) | 3 mo to 3 yr | Not stated | Positive effects on perceived attractiveness body and self-image, Partner showing greater sexual interest due to perceiving women to be more attractive |
| Meyer and Ringberg [28], (1987) | Evaluate personality, psychosocial and psychiatric characteristics of women that undergo augmentation mammoplasty | Cesarec-Marke Personality Schedule, Marke-Nyman test | 38.4 (mean) | 1 yr | Specified personality characteristics | 86% satisfied with the results of social and sexual life improved |
| Young et al. [29], (1994) | Evaluate impact of surgery on psychological parameters including: body image, self confidence and interpersonal functioning | Author’s questionnaire | 33 (mean) | 5 yr | Not stated | 88% improved self confidence, 95% felt better about themselves, 86% operation was a success, 95% surgery met their expectations |
| Rankin et al. [30], (1998) | Examine quality of life after cosmetic surgery including breast augmentation | Presurgical and postsurgical self-report questionnaire | 31–50 (mean) | 1.6 mo | Not stated | Improved quality of life |
| Cash et al. [31], (2002) | To examine the psychosocial outcomes of breast augmentation in females with silicone gel-filled implants | Questionnaire at initial consultation to evaluate the reasons and expectations of surgery, as well as the concerns regarding the perceived risks | 32 (mean) | 6, 12, 24 mo | Postoperative complications such as capsular attrition which compromise the aesthetically desired outcome, Less obvious events did not not reduce satisfaction. | >90% were satisfied with surgery and the consequent body image alterations, 75%–85% considered benefits of surgery exceeded the risks |
| Sarwer et al. [32], (2008) | To evaluate the patient satisfaction and psychosocial status following cosmetic surgery (including breast augmentation) | Patients completed psychometric measures of body image, depressive symptoms and self-esteem before surgery and at 3, 6, 12, 24 months postoperatively | Not stated | 3, 6, 12, 24 mo | Not Stated | Postoperative satisfaction as well as self rated attractiveness at the 4 postoperative assessment point. Two years after surgery 93% reported that they would have surgery again |


Table 3. Other characteristics (demographic/lifestyle/psychiatric/reproductive history)

| Author(s), study | Study objective | Mean age at breast augmentation (yr) | Characteristics of women with breast implants |
|------------------|-----------------|-------------------------------------|-----------------------------------------------|
| Schlebusch and Levin [22], (1983) Cohort study | To identify the psychological profile of women with cosmetic augmentation mammoplasty | Not stated | - Depression  
- Anxiety  
- Poor body-image  
- Psychosexual problems |
| Beale et al. [26], (1985) Cohort study | A psychological study attempting to identify the characteristics of patients seeking augmentation mammoplasty | 28.4 | - More negative towards their parents  
- More strained marital relationship  
- More often divorced  
- More often visits to psychiatrists  
- More neurotic personalities |
| Schlebusch [33], (1989) Cohort study Psychological assessment Interviews | To identify the characteristics of patients who request augmentation mammoplasty | 30.4 | - White  
- Well-educated  
- Married  
- Varying degrees of depression |
| Cook et al. [34] (1997) Case control study Interview information | To compare selected characteristics of women with and without breast augmentation mammoplasty | 34 | - More likely to have had high school education  
- Higher household income  
- Consumption of alcohol  
- More common history of smoking  
- Taller and thinner  
- Younger age at first pregnancy and full birth  
- History of terminated pregnancies  
- Use of oral contraceptives for longer period of time  
- Greater lifetime number of sexual partners |
| Brinton et al. [35], (2000) Retrospective cohort study Questionnaire data | To identify the characteristics of women with cosmetic breast implants with women seeking other types of plastic surgery | 33.2 | - White Caucasian  
- Higher education  
- Married  
- Taller and thinner  
- Younger age at first pregnancy or birth  
- More often use of contraceptives |
| Fryzek et al. [36], (2000) Cohort Questionnaire data | To determine the characteristics of women with cosmetic breast implants compared with breast reduction patients and women in the general population | 44 | - Smokers  
- Taller and thinner  
- More pregnancies  
- More likely to have experienced an early termination of pregnancy  
- Younger at first birth |
| Kjeller et al. [37], (2003) Clinical follow up study Questionnaire data | To identify the characteristics of women with cosmetic breast implants compared with women with other types of cosmetic surgery | 41 | - Smokers  
- Thinner  
- Younger age at menopause  
- Greater number of full pregnancies  
- More likely to have an induced abortion  
- More likely to have used oral contraceptives  
- More likely to have treatment for depression preoperatively |
| Breiting et al. [38], (2004) Cohort Questionnaire data | To identify the characteristics of women with cosmetic breast implants compared with women with breast reduction and women in general population | 31 | - Lower body mass index  
- More full term pregnancies  
- Younger at the time of first delivery  
- More likely to use antidepressants, antianxiety, hypnotic drugs and hormone replacement therapy |
| Lipworth et al. [39], (2009) Cohort-epidemiologic follow up Questionnaire data | To identify the psychological characteristics of women with cosmetic breast implants | 32 | - 2 times more likely to have sleeping disturbances after surgery  
- More frequently reported having ever been treated for depression but not apparent after implantation  
- More likely to have prior the cosmetic surgery psychiatric hospital admission |
| Nikolić et al. [40], (2013) Prospective study Questionnaire data | Psychosocial characteristics and motivational factors in woman seeking cosmetic breast augmentation surgery compared with women who didn’t have any aesthetic operation before and didn’t want augmentation mammoplasty | 28.7 | - Thinner  
- Married  
- Higher education level |

**DISCUSSION**

Women who have had cosmetic breast implants postoperatively report high overall satisfaction and experience good outcomes in psychological and psychosocial terms (Table 2) [23-32]. These benefits can be compromised due to postoperative com-
Complications such as infection, pain, hematoma, silicone implant hemorrhage, capsular contracture and loss of nipple sensation [41-49]. Complications and unreasonable expectations from the operation could contribute to affective disorders and impair the quality of life although this association has not been studied adequately [31].

According to the National Institute of Mental Health in the United States [2,50] risk factors for suicide in general population are:

- Current ideation, intent, plan, access to means
- Previous suicide attempt or attempts
- Alcohol/Substance abuse
- Current or previous history of psychiatric diagnosis
- Impulsivity and poor self control
- Hopelessness—presence, duration, severity
- Recent losses—physical, financial, personal
- Recent discharge from an inpatient psychiatric unit
- Family history of suicide
- History of abuse (physical, sexual or emotional)
- Co-morbid health problems, a new diagnosis or worsening symptoms
- Age, gender, race (elderly or young adult, unmarried, white, male, lives alone)
- Same-sex sexual orientation

Pregnant women [51], having a child of less than 2-year-old [52] has been associated with lower suicidal risk. On the contrary, women of age range 35–44 years [53], unmarried, divorced or single women without strong social support and occupational instability [53-56] have increased suicide risk. Miscarriage has also been linked to an increased maternal suicide risk especially when induced [57-60]. Less studied dimensions that might be related to suicide in the female population are: living in urban areas [2,50,61] infertility [62,63], the familial clustering of suicidal behaviors and chronic physical illness [64-66]. The overlapping characteristics among the general population and the female cosmetic breast implant patient that constitute predisposal factors for suicide according to this study are: alcohol consumption, history of psychiatric diagnosis and admission to psychiatric unit, relationship problems, patient’s age, Caucasian race and reproductive history.

Silicone implants have been associated with the development of autoimmune diseases such as scleroderma, systemic erythematous lupus, mixed disorders of the connective tissue, rheumatoid arthritis and Sjögren’s syndrome but this findings remain debatable [67-71]. More interestingly the implant explantation results in symptoms remission [72,73]. Less studied dimensions that could be related with the implant and its potential contribution to suicide risk are the autoimmune syndrome induced by adjuvants (ASIA) and fibromyalgia syndrome (FMS) (Table 4). Maijers et al. [73] conducted a descriptive cohort study investigating 80 women with silicone breast implants and unexplained systemic symptoms (fatigue, arthralgia, myalgia and cognitive symptoms). Most women had pre-existent allergies and the majority of them (89%) had silicone for cosmetic reasons. The median exposure time to the silicone implant was 14.5 years.

| Types of suicide risk factors | Suicide risk factors in general population [50] | Suicide risk factors that can be related with the cosmetic breast augmentation patient |
|-----------------------------|-----------------------------------------------|--------------------------------------------------------------------------------|
| Psychological and psychosocial factors | Hopelessness—presence, duration, severity Impulsivity and poor self control Current ideation, intent, plan, access to means Current or previous history of psychiatric diagnosis Recent discharge from an inpatient psychiatric unit Current or previous history of psychiatric diagnosis Previous suicide attempt or attempts Alcohol/Substance abuse Family history of suicide | Low self esteem-Body image [26] Unrealistic expectations [21,22,26] Depression, Anxiety, Neurotic personally [37-40] Psychiatric unit admissions [22,26] Alcohol consumption [33-35,37,40] |
| Demographic factors and reproductive history | Age, gender, race i.e., elderly or young adult, unmarried, white, male, living alone Recent losses—financial, personal Same-sex sexual orientation | Caucasian women of age range 35–44 years, unmarried, divorced or single women [33-35,37,53] Induced miscarriage [34,36,37,57-60] Relationship problems [74] |
| Other factors i.e., stimuli that can trigger stress response | Co-morbid health problems, especially a newly diagnosed problem or worsening symptoms Recent losses—physical | Augmentation mammoplasty operation/postoperative complications [41-49,75,76] Atopy-hyperimmune state in women with breast implantation-augmentation >10 years [73] Fibromyalgia syndrome (FMS) and low levels of 5-hydroxyindoleacetic acid (5-HIAA) in the Cerebrospinal fluid [77-84] Autoimmune/Inflammatory Syndrome Induced by Adjuvants (ASIA) [50,74-76,85] |
and most women did not have any past medical history. The authors [73] resulted that all women had the typical clinical manifestations of ASIA (i.e., fatigue, night sweats, morning stiffness, joint and muscle pain, dermatological manifestations). Explanation of the implants was showed to reduce the symptoms. Maijers et al. [73], concluded that silicone breast implants may cause systemic symptoms in women with hyperimmune state or atopy. They suggested that this is line with intolerance to silicone. The authors highlighted that the probable association between the silicone breast implants and unexplained systemic symptoms should be taken seriously but acknowledged that strong associations between silicone implants and connective tissue diseases have not been demonstrated [73,86-90].

Furthermore silicone is often associated as one of the possible causes of FMS [91-93], an idiopathic, yet common chronic condition characterized by widespread musculoskeletal pain [93]. Stisi et al. [77], reviewed the literature in an attempt to determine pathoetiological mechanisms of FMS and found, that patients with FMS have decreased levels of 5-Hydroxyindoleacetic acid (5-HIAA) a serotonin metabolite in the cerebrospinal fluid (CSF). This finding is significant because decreased levels of 5-HIAA in CSF has been identified as a possible suicide risk predictor in several independent studies [77-84].

In summary the current literature highlights the importance of preoperative psychiatric screening with particular interest in any previous psychiatric admissions and in current or previous mental disorders such as depression. The reason of the increased suicide risk among women with cosmetic breast augmentation remains unclear [13,14] and further well designed epidemiological research is necessary.

Recently in the study of Overholser et al. [74] who investigated 148 individuals who died from suicide compared to adults who died from medical problems or accidents using psychological autopsy to assess Axis I psychiatric diagnosis concluded that a thorough evaluation of psychiatric diagnosis (i.e., depression), recent stressful life events (e.g., relationship, financial, work issues) and demographic characteristics are mandatory fields to be completed in every proper suicide risk assessment. These authors created a suicide risk model by conceptualizing the combination of demographic factors, psychiatric symptoms and recent stressful events highlighting the significance of the interactions between the variables. Moreover, they suggested that each demographic predictor on itself (e.g., unmarried, age) is not precise and results in false positive prediction errors. However they concluded that the identification of high suicide risk groups is not unrealistic and it can play an important role in the prevention of suicide if a holistic approach is taken into account especially with regards to stressful life events and precipitating factors. In the current literature addressing the issue of cosmetic breast augmentation and suicide, emphasis has been given to the importance of psychiatric history and demographic factors like independent variables associated with higher suicide risk.

Taking into account the recent studies of Overholser et al. [74], Maijers et al. [73], Stisi et al. [77], and from our systematic re-

**Fig. 1. Suicide risk model**

(A) Psychological and psychosocial factors i.e., unrealistic expectations, mood disorders, low self esteem, body image, anxiety, depression, psychiatric unit admission, recent stressful life events, relationship problems, financial issues. (B) Demographic factors and reproductive history i.e., white, age, education, marital status, infertility, history of terminated pregnancies. (C) Stimulants that can trigger stress response i.e., augmentation mammoplasty operation/postoperative complications, atopy/ > 10 years of implantation in cosmetic breast augmentation women/hyperimmune state, ASIA, FMS, and low levels of 5-HIAA in CSF. ASIA, autoimmune syndrome induced by adjuvants; FMS, fibromyalgia syndrome; 5-HIAA, 5-hydroxyindoleacetic acid; CSF, cerebrospinal fluid.
view (Tables 1-3), we have synthesized Fig. 1 below.

The above suicide risk model includes three interacting ellipses and each of them contains independent risk suicide variables. The model is specific for women seeking augmentation mammoplasty because it synthesizes the combination of suicide predictors in general population and incorporates the specific independent risk factors for suicide that are encountered in the cosmetic breast augmentation candidate (i.e., unrealistic expectations, postoperative complications). It includes the factors of atopy/hyperimmune state and low levels of 5-HIAA which is considered to be related with the development of ASIA syndrome and FMS respectively. Although it remains disputable, ASIA particularly in women with pre-existing allergies cannot be excluded from being an independent risk factor associated with the implant that can increase the risk of suicide in terms of being a stressful life event and a chronic physical illness, both risk factors for suicide [2,50,74-76,85].

**CONCLUSIONS**

Suicide prediction is a complex task. A combination of demographic variables, psychiatric history, social, biological and other factors must be evaluated individually and in the context of the patient’s whole environment. Women with underlying psychopathology, especially depression requiring previous hospital admission, medical history of terminated pregnancies should be considered high risk for suicide. Recent life stressors (financial, relationship or other personal issues) [74] that are not always part of a typical medical history might be important in predicting suicide risk and should be included in preoperative patient assessment. Breast augmentation surgery can stimulate a systematic stress response in several ways [41-49,75,76] and increase the pre-existing risk of suicide in women who seek cosmetic mammoplasty. ASIA particularly in women with pre-existing allergies and FMS cannot be excluded from being independent risk factors. Each risk factor of suicide (i.e., unmarried, age, depression) has poor predictive value when considered independently and can result in false positive prediction errors. The suicide risk model we devise with interacting ellipses could be a helpful tool for plastic surgeons daily practice.

Our review concludes that there is 2 to 3 fold increased suicide risk among patients with augmentation mammoplasty. Although it remains unclear whether or not the augmentation mammoplasty operation can act as a trigger factor of suicide, it is more clear that women candidates have various degree of underlying psychopathology, demographic and psychosocial factors that are strongly related with increased suicide risk preoperatively. From this review no strong evidence that relates the augmentation mammoplasty operation itself with increased suicide risk occurs. ASIA and FMS syndrome despite being linked with systematic stress response which constitutes a suicide risk factor, do not cause increased suicide risk directly based on the existing evidence. It has not been excluded that factors such as: the operation itself, FMS, ASIA syndrome and > 10 years of implantation in women with hyperimmune state can affect the suicide risk of the mammoplasty patient postoperatively. However this requires further exploration. Our research concludes that there are overlapping risk factors to the breast augmentation candidate that can predispose to suicide (Table 4). The plastic surgeon needs to be aware of those factors and attempt to detect

| Types of suicide risk factors | Suicide risk factors that can be related with the cosmetic breast augmentation patient/Suggested guidelines and checklist for the augmentation mammoplasty patient |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Psychological and psychosocial factors | 1. Low self-esteem–Body image [26]  
2. Unrealistic expectations [21,22,26]  
3. History or current symptoms of Depression, Anxiety or Neurotic personality [37-40]  
4. History of psychiatric unit admissions [22,26]  
5. The familial clustering of suicidal behaviors [64-66]  
6. Alcohol consumption [33-35,37,40] |
| Demographic factors and reproductive history | 7. Caucasian women  
8. Age range 35–44 years  
9. Unmarried, divorced or single women [33-35,37,53]  
10. Living in urban areas [21,41]  
11. Infertility [32,42,70]  
12. Induced miscarriage [34,36,37,57-60]  
13. Relationship problems  
14. Financial issues [74] |
| Postoperative factors i.e., stimuli that can trigger stress response | 15. Augmentation mammoplasty operation/postoperative complications [41-49,75,76]  
16. Atopy-hyperimmune state in women with breast implantation-augmentation > 10 years [73]  
17. Fibromyalgia syndrome (FMS) and low levels of 5-hydroxyindoleacetic acid (5-HIAA) in the Cerebrospinal fluid [77-84]  
18. Autoimmune/Inflammatory Syndrome Induced by Adjuvants (ASIA) [50,74,76,85] |
them preoperatively and postoperatively. We created a pre and postoperative check list in an attempt to screen the mammoplasty patient in relation to suicide risk (Table 5).

It should be noted 10.2% of suicides do not have any of the suicide risk factors according to the study by Overholser et al. [74] This disconcerting observation should draw our attention to the fact that although doctors can always attempt to assess the risk for suicide they are unable to predict it with complete accuracy.

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