Scientific Research Publishing

Journal of Biosciences and Medicines, 2023, 11, 171-181
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Surgical Complications in Breast Reconstruction: Assessment and Associations

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How to cite this paper: De-Luna-Gallardo, D., García-Espinoza, J.A., Márquez-Espriella, C., Arámbula-Sánchez, B.Y., Cuervo-Vergara, M.A., Dávila-Diaz, R., García-Corral, R., Barbosa-Villarreal, F., Recio-España, F.I. and Cahuana-Quispe, A.I. (2023) Surgical Complications in Breast Reconstruction: Assessment and Associations. *Journal of Biosciences and Medicines*, **11**, 171-181.
https://doi.org/10.4236/jbm.2023.116014

Received: May 4, 2023
Accepted: June 22, 2023
Published: June 25, 2023

Abstract

Introduction: Breast cancer represents a pathology that generates catastrophic impact and has recently increased its incidence and survival due to timely diagnosis and treatment. Therefore, improving the quality of life of cancer survivors has become a priority, offering reconstructive procedures that reduce complications, costs, hospital stay, and optimize resources. **Material and methods:** 264 patients reconstructed with autologous tissue (TRAM flap and latissimus dorsi) and alloplastic (breast tissue expander—breast implant and direct breast implant) were included. Variables such as demographic, anthropometric, and histologic type were collected. **Results:** 62% were reconstructed through the use of alloplastics and 38% with autologous tissue. The risk factors related to a greater probability of immediate postoperative complications (surgical site infection, surgical wound dehiscence and reconstruction failure) were obesity (OR: 2.1, CI: 1.5 - 2.7), preoperative radiation (OR: 1.89, CI: 1.75 - 1.92), arterial hypertension (OR: 1.2), Diabetes Mellitus (OR: 1.78) and smoking (OR: 1.31). **Conclusions:** The reconstructive process is complex and influenced by patient factors, surgeon experience and the hospital center. However, when choosing the reconstructive strategy, risk factors present in each patient must be considered, since radiation and obesity present a greater probability of postoperative complications.

Keywords

Breast Cancer, Breast Reconstruction, Obesity, Radiotherapy, TRAM

1. Introduction

The breast represents since ancient times a central feature of femininity and a

distinctive characteristic of beauty. The diseases that affect this organ are multiple; however, cancer represents a spectrum with a high incidence that has catastrophic repercussions in the personal, economic and social spheres [1]. In 2020, Globocan reported breast cancer as the first place of cancer incidence worldwide, with more than 2.2 million cases and it was the fifth cause of death in cancer patients with more than 600 thousand cases. In Mexico, it's also ranked first in incidence with more than 29 thousand cases, and occupies the first cause of death from cancer with 7931 deaths [2].

Due to prevention and screening programs implemented in Mexico, the expectation and quality of life after breast cancer has improved significantly; however, the diagnosis, mastectomy and oncological follow-up are not enough. In recent years, the quality of life after mastectomy has been studied and compared with those who have undergone breast reconstruction, reporting that reconstructed women experience a better quality of life, less pain, better perception of body image, greater sexual satisfaction and better self-esteem [3]. Therefore, breast reconstruction has become an integral part of breast cancer treatment in Mexico and many countries around the world.

Breast reconstruction constitutes a therapeutic challenge for which there are several options, with myths and dogmas, and which is carried out in different ways in each hospital, based on its economic, human and infrastructure resources [4].

Breast reconstruction is a staged process of surgical interventions which has as primary objectives the creation of a consistent breast mound, contralateral symmetrization, and finally the reconstruction of the nipple-areola complex. Recent studies aim to show what is the best time for reconstruction (immediate vs late), type of reconstruction (autologous and prosthetic), duration of the reconstruction, and the short and long-term results [5]. However, it is not possible to generalize in this regard since reconstruction is a complex process in which specific factors are involved like stage of the disease, age, race, religious, geographical aspects, access to health services and intrinsic factors of the plastic surgeon (training and experience) [6].

2. Objective

Describe the experience of the breast reconstruction protocol in two specialized centers in Mexico City over a 2-year period with autologous tissue and alloplastic (expander—breast implant and direct breast implant).

3. Material and Methods

A retrospective, descriptive and observational study was carried out in two national reference centers, with prior approval of the ethics committee of each institution. All the patients of the database between with breast cancer and undergoing a breast reconstruction protocol were included between 2000-2022. Demographic variables, tumor variables, laterality, type of reconstruction, reconstruction time (immediate or late), duration of reconstruction, immediate post-

operative complications (<7-day PO) and late (>7-day PO), comorbidities and adjuvant therapies were taken into account. Patients who did not have the information in the clinical record and who did not complete their reconstruction process were excluded.

4. Results

264 patients were included in the study, divided into four groups according to the type of reconstruction, and demographic variables were measured. Mean age at the start of breast reconstruction in general was 53.7 years (IQR 47 - 60.3). Most of the groups were in the age range except for the reconstruction group with latissimus dorsi flap where the mean was 45.3 years (IQR 41 - 48). The average weight of the general population was 67.3 kilograms, being higher in the reconstruction group with latissimus dorsi flap; with an average general height of 1.58 meters and similar between all the reconstruction groups. The mean general BMI was 26.7, being very similar between the types of reconstruction, except for the latissimus dorsi group, where the mean was 30.7. When analyzing the origin of the patients, it was observed that 56% came from the central region of the country, followed by the southern region (32%), and finally the northern region of the country (12%) (Table 1).

The average time since they underwent the mastectomy and the beginning of the breast reconstruction was 20.8 months, being drastically less in the group of reconstruction with expander in which the average was 5.2 months. The average duration of the breast reconstruction in the four groups was 15.01 months, being less in the group of reconstruction with direct breast implant with a mean of 1.2 months (Table 1).

According to the oncological characteristics, 86.3% of the patients had a histological diagnosis of invasive ductal carcinoma (IDC), and 6.06% had ductal carcinoma in situ (DCIS). The behavior by reconstruction group was similar except for the reconstruction group with TRAM and expander, where most of the patients had histological diagnosis of IDC (Table 2).

It was observed in the laterality analysis that 52.2% affected the right side, 40.9% left, and only 6.8% bilateral. The TRAM and breast tissue expander group had a predominance of left breast affection, and the group with the highest percentage of bilateral cases (50%) was the TRAM group. When analyzing the presence of receptors, 70.45% were estrogen-receptor-positive (ER+), 61.3% were progesterone-receptor-positive (PR+), and 54.4% for HER2/neu positive (Table 2).

The risk factors were described and it was observed that the most prevalent were diabetes mellitus with 31.06%, arterial hypertension 27.6% and obesity 34.09%. In general, it was observed that 22.7% of the patient's received radiotherapy and 54.4% neoadjuvant chemotherapy (Table 3).

The obese population experienced a greater probability of complications (OR: 2.1, CI 1.5 - 2.7), being surgical infection the one that had the greatest incidence

Table 1. Demographic variables and the start and duration of reconstruction, general and by type of reconstruction.

Variables	GENERAL (264 = 100%)	LATISSIMUS DORSALIS (18 = 6.8%)	TRAM (84 = 31.8%)	TISSUE EXPANDER (138 = 52.2%)	DIRECT BREAST IMPLANT (24 = 9.09%)
Demographics					
Age (mean, ICR)	53.7 (47 - 60.3)	45.3 (41 - 48)	53.5 (50 - 57)	54.6 (45 - 64.5)	56 (53 - 57.3)
Wight Kg (mean, ICR)	67.3 (60.7 - 73.2)	74 (67 - 85)	67.5 (62 - 72.2)	66.1 (58 - 73.5)	68.7 (63 - 73.3)
Height meters (mean, ICR)	1.58 (1.55 - 1.63)	1.53 (1.50 - 1.58)	1.5 (1.50 - 1.6)	1.59 (1.56 - 1.64)	1.54 (1.5 - 1.6)
BMI Kg/m^2 (mean, ICR)	26.7 (23.9 - 28.7)	30.7 (27.9 - 36.3)	26.6 (24.5 - 28)	25.9 (23.4 - 26.6)	29.2 (23.7 - 32.7)
Origin					
North (%)	12%	0%	6%	6%	0%
Center (%)	56%	12%	22.50%	52%	48%
South (%)	32%	88%	71.50%	42%	52%
Reconstruction					
Mastectomy time at the beginning of reconstruction (months)	20.8 (0 - 32)	22.6 (0 - 40.5)	48.6 (22.7 - 63.1)	5.2 (0 - 8.9)	30 (11 - 32)
Total reconstruction time (months)	15.01 (5.4 - 17.6)	12.8 (5 - 21.2)	18.7 (10.8 - 25.8)	12.8 (6 - 15)	1.2 (0 - 2.2)

ICR, Interquartile Range.

Table 2. Oncological demographics.

VARIABLES	Demographics (264 = 100%)	Latissimus Dorsi (18 = 6.8%)	TRAM Flap (84 = 31.8%)	Tissue Expander (138 = 52.2%)	Direct-to-implant (24 = 9.09%)
Type of breast cancer					
Invasive ductal carcinoma (n/%)	228 (86.3%)	18 (100%)	6 (7.14%)	6 (4.5%)	6 (20%)
Ductal carcinoma in situ (n/%)	16 (6.06%)	0	66 (78.57%)	126 (95.5%)	10 (33.3%)
Invasive lobular carcinoma (n/%)	14 (5.03%)	0	6 (7.14%)	0	8 (26.66%)
Lobular carcinoma in situ (n/%)	6 (2.2%)	0	6 (7.14%)	0	6 (20%)
Receptor					
Estrogen receptor positive (n/%)	186 (70.45%)	12 (66.6%)	54 (64.2%)	102 (77.2%)	12 (50%)
Estrogen receptor negative (n/%)	78 (29.55%)	6 (33.4%)	30 (35.8%)	30 (22.8%)	12 (50%)
Progesterone receptors positive (n/%)	162 (61.3%)	6 (33.3%)	54 (64.2%)	96 (72.7%)	6 (25%)
Progesterone receptors negative (n/%)	102 (38.6%)	12 (66.6%)	30 (35.7%)	42 (27.3%)	18 (75%)

Continued

HER2-positive (n/%)	144 (54.5%)	6 (33.3%)	36 (42.8%)	96 (72.7%)	6 (25%)
HER2-negative (n/%)	120 (45.4%)	12 (66.6%)	48 (57.1%)	42 (27.3%)	18 (75%)
Laterality					
Right (n/%)	138 (52.2%)	12 (66.6%)	0	66 (50%)	18 (75%)
Left (n/%)	108 (40.9%)	6 (33.3%)	42 (50%)	54 (40.9%)	6 (25%)
Bilateral (n/%)	18 (6.8%)	0	42 (50%)	12 (9.09%)	0

Table 3. Risk factors.

VARIABLES	GENERAL (264 = 100%)	LATISSIMUS DORSALIS (18 = 6.8%)	TRAM (84 = 31.8%)	Tissue Expander (138 = 52.2%)	Direct breast implant (24 = 9.09%)
Risk factors					
HBP (n)	73 (27.6%)	15	21	22	15
Alcoholism (n)	15 (5.6%)	2	7	3	3
Drugs (n)	2 (0.75%)	1	1	0	0
DM (n)	82 (31.06%)	21	48	13	0
Neurological (n)	2 (0.75%)	1	1	0	0
Obesity (BMI > 30) (n)	90 (34.09%)	12	18	50	10
Radiotherapy + (n)	60 (22.7%)	15 (83.3%)	42 (50%)	0	3 (12.5%)
Chemotherapy + (n)	144 (54.5%)	18 (100%)	82 (97.6%)	23 (16.6%)	21 (87.5%)

HBP, High blood pressure; DM, Diabetes Mellitus.

(OR: 1.9, CI: 1.3 - 2.5), followed by flap loss and surgical wound dehiscence (Table 4). When performing the analysis by reconstruction groups in the obese population, the latissimus dorsi group had a greater propensity for surgical site infection (OR: 1.8, CI: 1.2 - 2.4) (Table 5), as in the TRAM flap. In the breast tissue expander group, higher rates of reconstruction failure were observed (OR: 1.16, CI: 1.08 - 1.27) (Table 6). In the direct breast implant group, higher rates of wound dehiscence and reconstruction failure were found compared with two-stage breast reconstruction (OR: 1.45; OR: 1.51) (Table 7, Table 8).

Diabetes, hypertension and smoking were analyzed in relation to the probability of developing postoperative surgical complications, observing that all of them were related by increasing the probability of complications, in which diabetes stands out (OR: 1.78, CI: 1.73 - 1.81). When each of these factors was analyzed separately, it was observed that Diabetes Mellitus was associated with a higher probability of surgical site infection (OR: 1.92, CI: 1.90 - 2.2), arterial hypertension with surgical site infection (OR: 1.21, CI: 1.18 - 1.27), and smoking with surgical wound dehiscence (OR: 1.58, CI: 1.55 - 1.61) (Table 9).

Finally, patients undergoing preoperative radiation and breast reconstruction experienced a greater probability of complications (OR: 1.89), the most important being reconstruction failure (either due to flap necrosis or exposure of alloplastic material) and secondly surgical wound dehiscence (Table 10).

Table 4. Complications in the obese general population (BMI 30 kg/m^2).

	OR	CI	P value
Total complications	2.1	1.5 - 2.7	<0.001
Surgical site infection.	1.9	1.3 - 2.5	<0.001
Surgical wound dehiscence	1.7	1.1 - 2.3	<0.001
Flap/implant failure	1.6	0.997 - 2.2	0.1

OR: Odds Ratio; CI: confidence interval.

Table 5. Complications in the latissimus dorsi group with BMI >30 kg/m^2.

	OR	CI	P value
Total complications	1.18	1.11 - 1.32	<0.001
Surgical site infection.	1.8	1.2 - 2.4	<0.001
Surgical wound dehiscence	1.5	1.1 - 1.7	<0.001
Flap/implant failure	1.3	0.997 - 1.41	0.1

OR: Odds Ratio. CI: confidence interval.

Table 6. Complications in the TRAM group with BMI > 30 kg/m^2.

	OR	CI	P value
Total complications	1.8	1.76 - 1.91	<0.001
Surgical site infection.	1.23	1.16 - 1.45	<0.001
Surgical wound dehiscence	1.1	0.99 - 1.4	0.1
Flap/implant failure	1.025	1.02 - 1.21	<0.001

OR: Odds Ratio; CI: confidence interval.

Table 7. Complications in the Expander group with BMI> 30 kg/m^2.

	OR	CI	P value
Total complications	1.29	1.17 - 1.31	<0.001
Surgical site infection.	1.12	1.05 - 1.3	<0.001
Surgical wound dehiscence	1.07	1.03 - 1.1	<0.001
Flap/implant failure	1.16	1.08 - 1.27	<0.001

OR: Odds Ratio; CI: confidence interval.

Table 8. Complications in the direct implant group with BMI > 30 kg/m^2.

	OR	CI	P value
Total complications	1.12	1.09 - 1.21	<0.001
Surgical site infection.	1.03	1.01 - 1.09	<0.001
Surgical wound dehiscence	1.45	1.32 - 1.51	<0.001
Flap/implant failure	1.51	1.41 - 1.59	<0.001

OR: Odds Ratio; CI: confidence interval.

Table 9. Complications in the population according to risk factors.

COMPLICATION	DM			HBP			SMOKING		
	OR	CI	P	OR	CI	P	OR	CI	P
TOTAL	1.78	1.73 - 1.81	<0.001	1.12	1.09 - 1.15	<0.001	1.31	1.28 - 1.33	<0.001
SURGICAL SITE INFECTION	1.92	1.90 - 2.2	<0.001	1.21	1.18 - 1.27	<0.001	1.46	1.44 - 1.51	<0.001
WOUND DEHISCENCE	1.58	1.54 - 1.601	<0.001	1.04	1.01 - 1.1	<0.001	1.58	1.55 - 1.61	<0.001
FLAP/IMPLANT FAILURE	1.32	1.27 - 1.304	<0.001	1.05	0.99 - 1.09	0.1	1.01	0.95 - 1.12	0.1

OR: Odds Ratio; CI: Confidence Interval; P: P-value; DM: Diabetes Mellitus; HBP: High Blood Pressure.

Table 10. Probability of complications according to the radiation risk factor.

	OR	CI	P
TOTAL	1.89	1.75 - 1.92	<0.001
SURGICAL SITE INFECTION	1.019	1.012 - 1.12	<0.001
SURGICAL WOUND DEHISCENCE	1.77	1.72 - 1.88	<0.001
FAILURE OF THE PROSTHESIS FLAP	1.78	1.75 - 1.81	<0.001

OR: Odds Ratio; CI: Confidence Interval; P: P-value.

5. Discussion

The increase in incidence and survival of more than 87% in breast cancer due to advances in diagnosis and treatment, make it necessary to offer a reconstruction process after mastectomy, capable of reducing risks and minimizing complications in order to improve the patient quality of life [7] [8].

Breast reconstruction is a complex, staged and diverse process that is largely influenced by the characteristics of the patient and their risk factors, as well as the characteristics and resources of the center where the procedures is carried out and the preferences and training of the surgeon [9]. These reasons explain the diversity of reconstruction protocols in the world, which over time have been modified based on their own experience and the experience of other centers. However, no reconstruction process is the same as another.

The average ages of the patients studied in our series are similar to those observed in other series. The region of the country with the highest number of cases was the central region followed by the southern region. When studying the time that passes from the mastectomy to the beginning of the reconstruction, we observed a mean of 20.8 months in general, being less in those reconstructed with an expander (5.2 months); and this in general depended on the clinical characteristics of the patient, the histology of the tumor and surgeon's prefe-

rence. The variance of time that the reconstruction lasted, until the symmetrization and reconstruction of the areola-nipple complex, was influenced by factors such as lack of material supplies, late referral of the patient to the department of plastic surgery, doubts of the patient, among others. However, a percentage of patients complied with early referral and were able to undergo surgery for their first reconstructive stage at the time of their mastectomy.

Over the years and the safety evidence of alloplastics, the use of breast implant and breast tissue expander for reconstruction has increased, reaching up to 65.4% of all the reconstructions performed in the United States in 2017 [10]. The use of alloplastics has been associated with a shorter hospital stay, shorter surgical and recovery time, with a slight superiority in the final aesthetic results [11] [12]. These data matches with the one obtained in our series where more than half of the reconstructions were performed with alloplastics. Schmauss *et al* in 2016 described that despite the promise of alloplastics, it was observed that at least 70% of the patients reconstructed with these materials, required reoperation in a period of 10 years due to complications related to the implants. However, the risk factors present in the patients that could contribute to the need for reintervention have not been clearly elucidated [13] [14].

There are several risk factors that must be considered when choosing the reconstructive protocol since there is increasing global evidence that certain conditions (obesity, smoking, Diabetes Mellitus, preoperative radiation and hypertension) exponentially increase postoperative complications in those patients undergoing reconstruction.

Obesity is a risk factor that plays a crucial role in the results of patients undergoing reconstruction. Hanwright *et al.* [15] published a series in 2013 where 35.2% of their population were obese and showed an increase in complications such as: surgical site infection and reconstruction failure higher than that observed in non-obese patients. A fact that is not different from that obtained in our series, where 34.09% were obese and related with a greater probability of postoperative complications in all breast reconstruction groups, from which surgical site infection stands out followed by wound dehiscence. When analyzing by groups, it was observed that obese women who underwent reconstruction with autologous tissue had a higher probability of general complications compared to the group with reconstruction with alloplastics. Ilonzo *et al.* [16] published those overweight patients had a higher risk of complications (OR: 1.38), while obese patients (OR: 2.1) and morbidly obese patients had an even higher risk than the previous ones (OR: 3.84).

The study shows an increased probability of complications in diabetic, hypertensive and smoking patients. However, it has been possible to reduce these complications when the disease is controlled (SAH, DM) and when the previous smoking habit is abandoned before surgery.

Preoperative radiotherapy is a non-modifiable risk factor since oncological safety is above the reconstructive process [17]. Nelson *et al.* [18] observed that those patients who underwent preoperative radiotherapy were not ideal candi-

dates for immediate reconstruction since radiation has deleterious effects on soft tissues, losing elasticity and resistance due to the subcutaneous fibrosis it causes. Previously, Lee and Mun in 2015 conducted a review of 20 studies where they observed a significant increase in early complications on radiated patients (OR: 2.58) and observed greater capsular contracture as a late complication (OR: 3.32), compared to non-radiated ones [19]. One year later, Chen *et al.* [20] demonstrated that patients who received preoperative radiotherapy had up to 50% failure of the reconstruction (implant exposure or flap necrosis) and Kearney *et al.* [21] reported that there was a high conversion rate in patients radiated from reconstruction with alloplastics to autologous tissue. Reish *et al.* [22] published that preradiated patients presented a higher percentage of secondary procedures and conversions, and reported that the percentage of reconstruction failure in autologous vs alloplastic in radiated reconstruction was 6.9% and 33.7%, respectively.

In our study, we analyzed the complications globally and individually in surgical site infection, surgical wound dehiscence and reconstruction failure. It was observed that the probability in radiated patients of global complications was higher than in non-radiated patients (OR: 1.89) and the most likely complication was reconstruction failure (1.78), data that matches with those described in other series.

Lam in 2013 reported that complications, especially reconstruction failure, were noticeably higher in preoperative radiated patients with 18.6% vs 3.1% non-radiated patients. He also observed that in breast tissue expander, the preoperative radiation failure was 29.7% and the incidence of capsular contracture in this group was high compared to the non-radiated one (8.9% vs 0.5%) [23]. In our study, the percentage of patients radiated was 22.7%, observing a low percentage of these patients in those reconstructed with alloplastics, this percentage is due to the growing evidence of complications observed in the experience of other centers and to the exhaustive analysis of our center experience.

6. Conclusions

Breast reconstruction is a complex and staged surgical process in which the clinical and biological characteristics of the patient, the resources and availability of the hospital center, and the surgical training and preferences of the plastic surgeon play an important role. Therefore, each case must be individualized taking into account the risk factors and the specific treatment for breast cancer.

Obesity is a risk factor demonstrated in studies around the world and matches with what was obtained in our series, so the risk should be reduced through weight control and nutritional surveillance in order to optimize results, and opting in this group risk for alloplastics that show a lower percentage of complications.

Preoperative radiotherapy is a non-modifiable risk factor. It has been shown that if alloplastics are used in this risk group, complications increase exponen-

tially as well as costs, morbidity and negative experience of reconstruction, even causing patients to abandon the reconstructive process. Therefore, in addition to other risk factors and characteristics of the patients, the radiated ones should always be reconstructed with autologous tissue, which has shown a lower rate of immediate and late complications.

Despite these studies, more solid evidence is needed to allow us make decisions and plan reconstructive protocols based on it in the future, seeing that no group is superior to another but that each type of reconstruction has an indication.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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