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Management of Radiotherapy-induced-local Surgical Complications after surgery for Breast Cancer; A Single Institute Experience

Rabie Ramadan[1,*], Ahmed Shaaban[1], Heba G. El-Sheredy[2]

[1]Department of Surgery, Medical Research Institute, Alexandria University
[2]Cancer Management and Research Department, Medical Research Institute, Alexandria University
*Corresponding author: rr_mri.surg@yahoo.com

Abstract **Background:** Radiation therapy (RT) is an integral component of the management of breast cancer. During RT delivery most of breast cancer patients experience adverse reactions; Most of these reactions are usually not severe enough to cause disabilities that affect their usual daily activities. Irradiation of the chest wall or reconstructed breast may result in changes in the treated soft tissues and skin that may compromise the cosmetic outcome. This study aimed to describe the management of Radiotherapy-induced-local surgical complications after surgery for breast cancer at our institution. **Patients and Methods:** This study included patients with breast cancer who developed radiotherapy-induced local surgical complications for which these patients were admitted to the department of Surgery, Alexandria Medical Research Institute hospital during the period between January 2015 and June 2016. The complications were classified as minor or major. The minor complications included complications which were managed conservatively or by minor surgical procedure while the major complications were those which needed reoperation for management. **Results:** This study included 49 patients of whom 22 patients (45%) had SSM with immediate breast reconstruction with implant, 12 patients (24.4%) had NSM with immediate breast reconstruction with implant, 10 patients (20.4%) had MRM and 5 patients (10.2%) had CBS. Thirty two patients (65.3%) developed minor complications which included capsular contracture (Baker1-2), seroma, minor skin infection and minor wound dehiscence; They were managed conservatively or by minor surgical procedures as analgesics, supporting bra, seroma aspiration, antibiotics after culture and sensitivity testing or debridement and secondary suturing. Seventeen patients (34.7%) had major complications which included capsular contracture (Baker 3-4), Severe infection, major wound dehiscence and radiation burn and/or Ulcer; they needed reoperation for management which varied between excision of all radiated skin without reconstruction and excision of all radiated skin and correction by TRAM. **Conclusions:** Radiotherapy-induced local surgical complications after surgery for breast cancer are not uncommon, can cause major adverse events and can occur after any type of surgery for breast cancer. Luckily; most of them are minor and can be managed conservatively or by minor surgical procedure. The oncoplastic breast surgeon should be ready to deal with these complications with different options to decrease morbidity and to regain better cosmetic outcome.

Keywords: *breast cancer, breast surgery, adjuvant radiotherapy, capsular contracture, complications*

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1. Introduction

Breast cancer is an important health challenge that women face and affects their safety and productivity. It is the most frequently diagnosed cancer in females, and the second leading cause of cancer-related deaths [1]. According to global cancer statistics, breast cancer accounts for 23% of all new cases of cancer in females worldwide. [2,3] In Egypt, data from the National Cancer Institute showed that breast cancer is the commonest cancer among Egyptian women, representing 37% of all female cancers. Also, it was responsible for nearly 15% of all cancer-related deaths. [4] The multi-disciplinary approach including surgery, chemotherapy, endocrine therapy and radiation therapy, has become the standard treatment for primary breast cancer patients. [5] Surgery plays an essential role in breast cancer treatment. The choice of surgical technique either mastectomy or breast conserving surgery (BCS) depends on tumour location, size and/or shape of the patient's breast; or

the patient's preference. [6] The meta-analyses of the Early Breast Cancer Trialists'Collaborative Group (EBCTCG) had confirmed that BCS have similar rates of disease control and survival to those of mastectomy. [7] In recent years; Breast reconstruction can be safely provided to most women with disease requiring mastectomy because this surgical management leads to asymmetry and deformities that are intensified after adjuvant treatment. [8] Immediate breast reconstruction (IBR) is becoming more popular for breast cancer patients who are not good candidates for breast-conserving therapy. [9] During the last years; Reconstruction principles have been defined and numerous surgical techniques with volume displacement and volume replacement have been published with different indications, incision lines and suggested rotation techniques. [10] Since the introduction of oncoplastic techniques, the management of breast cancer has improved regarding the cosmetic results and the technical alternatives available to general surgeons specialized in breast cancer. [11] Radiation therapy (RT) is an integral component of the management of early-stage breast cancer. The primary aim of radiation therapy is the eradication of microscopic residual disease adjacent to the original site of the tumor as well as elimination of any evidence of multicentric disease. External beam radiation is the usual type of radiation therapy that is administered for the treatment of breast cancer. [12] In patients with early-stage breast cancer; adjuvant whole breast irradiation (WBI) following breast-conserving surgery lowers the relative risk of ipsilateral breast tumor recurrence by approximately 70% at 5 years and produces a5% absolute improvement in 15-year overall survival. [13,14] Following mastectomy, radiotherapy is indicated to lower the rates of local recurrence in breast cancer patients. Node positive patients are most likely to require radiotherapy. [15] Significant progress and various technical improvements have been achieved in RT. The earlier research focused on improving the locoregional disease-control by combining surgery with RT. [16] During RT delivery most of breast cancer patients experience adverse reactions. These reactions are usually not severe enough to cause disabilities that affect their usual daily activities. Acute reactions are generally more common, self-limiting, and resolve within 4–6weeks after the treatment. The reactions like fatigue, Itching, skin dryness and erythema with or without desquamation, are the most common symptoms observed after radiotherapy. [17] Late toxicities are uncommon but can have significant health consequences. These include the appearance of the breast as persistent breast edema, hyperpigmentation, capsular contracture, ulceration, burn and fibrosis or those that occur as a result of permanent injury to other organs such as Lymphedema, brachial plexopathy, radiation pneumonitis, cardiac morbidity, or secondary malignancy. [18] This study aimed to describe the management of Radiotherapy-induced-local surgical complications after surgery for breast cancer at our institution.

2. Patients and Methods

This study included patients with breast cancer who were treated with surgery followed by radiotherapy and developed radiotherapy-induced local surgical complications for which these patients were admitted to the department of Surgery, Alexandria Medical Research Institute hospital during the period between January 2015 and June 2016. We considered the complications occurred after completion of radiotherapy at the site of previous surgery to be radiotherapy-induced local surgical complications. All patients included in this study were subjected to complete history taking including age, timing of appearance of complications and thtype of submitted primary surgical procedure. The obtained data were confirmed with the patients' medical records including operative data of the submitted primary surgical proedure. For simplification of studying these complications; they were classified as minor or major. The minor complications included complications which were managed conservatively or by minor surgical procedure while the major complications were those which needed reoperation for management. The procedure used to manage every complication was discussed with patients, and their approval was documented and approved by the ethical committee of the Medical Research Institute.

3. Results

This study included 49 patients; of whom 22 patients (45%) were submitted to skin sparing mastectomy (SSM) with immediate breast reconstruction with implant as a primary surgical procedure, 12 patients (24.4%) had nipple spring mastectomy (NSM) with immediate breast reconstruction with implant, 10 patients (20.4%) had modified radical mastectomy (MRM) and 5 patients (10.2%) had conservative breast surgery (CBS). The mean age of patients was 48 years (Range: 29-67 years). Thirty two patients (65.3%) out of the forty nine developed minor complications while 17 patients (34.7%) had major complications. Complications occurred with a median time of 14 months following radiotherapy completion (Range: 4-24 months). the minor complications (32 patients) included capsular contracture (Baker1-2), seroma, minor skin infection and minor wound dehiscence; They were managed conservatively or by minor surgical procedures as analgesics, supporting bra, seroma aspiration, antibiotics after culture and sensitivity testing or debridement and secondary suturing. The major complications (17 patients) included capsular contracture (Baker 3-4), Severe infection, major wound dehiscence and radiation burn and/or Ulcer; they needed reoperation for management which varied between excision of all radiated skin without reconstruction and excision of all radiated skin and correction by TRAM. Post-radiation complications regarding types and management were collected in Table 1. Figure 1 - Figure 4 showed examples of complications that have occurred to studied patients and how they have been managed.

Table 1. Post-radiation Complications (Types and Management)

Type of complication/No.	Type of primary surgery /NO.	Management
Minor: 32 (65.3%)		
• Capsular Contracture (Baker1-2) (12)	SSM (7) NSM (5)	Analgesics, Supporting bra
• Seroma (8)	SSM (2) NSM (1) MRM (3) CBS (2)	Seroma aspiration
• Minor Skin infection (5)	SSM (1) NSM (1) MRM (2) CBS (1)	Antibiotics after culture and sensitivity testing
• Minor Wound dehiscence (7)	SSM (2) NSM (1) MRM (3) CBS (1)	Debridement and secondary suturing
Major : 17 (34.7%)		
• Capsular contracture (Baker 3-4) (6)	SSM (4) NSM (2)	- Excision of all radiated skin and correction by TRAM. (2) - Capsulectomy with replacement of implant by de-epithelialized TRAM. (1) - Capsulectomy with removal of the implant with implant exchange.(1) - Excision of all radiated skin without reconstruction. (2)
• Severe infection (4)	SSM (2) NSM (1) MRM (1)	- Removal of implant and replacement by de-epithelialized TRAM. (1) - Excision of all radiated skin without reconstruction.(2) - Culture and sensitivity and debridement followed by daily dressing then delayed closure. (1)
• Major wound dehiscence (4)	- SSM (2) - NSM (1) - MRM (1)	- Excision of all radiated skin with LD flap and lipofilling for reconstruction . (1) - Excision of all radiated skin without reconstruction.(2) - Debridement followed by daily dressing then delayed closure. (1)
• Radiation burn and/or Ulcer (3)	MRM (2) CBS (1)	- Wide local excision followed by TRAM. (1) - Wide local excision of all radiated burnt skin including the ulcer with by LD flap with tattooing for new areola. (1) - The patient had extensive dermatitis and burn associated with local recurrence treated with mastectomy with excision of all affected skin with direct closure. (1)
Total	**49(100%)**	

SSM: Skin Spring Mastectomy, **NSM**: Nipple Spring Mastectomy, **CBS**: Conservative Breast Surgery, **MRM**: Modified Radical Mastectomy, **TRAM:** Transverse Rectus Abdominis Myocutneous flap, **LD:** Latissmus Dorsi Myocutaneous Flap.

Figure 1. 49 years old female patient with post-radiation burn after RT MRM with LT breast cancer treated by LT MRM and excision of all radiated burnt skin at the RT side with TRAM

Figure 2. 38 years old female patient with post-radiation burn and Ulcer after LT MRM; treated by wide local excision of all radiated burnt skin including the ulcer with LD flap with tattooing for new areola

Figure 3. 46 years old female patients, Smoker, with left cancer breast treated by CBS, after adjuvant radiotherapy, the patient had extensive dermatitis and burn associated with local recurrence treated with mastectomy with excision of all affected skin with direct closure

Figure 4. 42 years old female patient with left Breast cancer treated by nipple sparing mastectomy and implant reconstruction; after adjuvant radiotherapy she developed capsular contraction (Baker 3) with infection and major wound dehiscence , treated with excision of skin with reconstruction by LD and lipofilling

4. Discussion

Radiotherapy either after lumpectomy or mastectomy is generally well tolerated by most patients and doesn't significantly hinder their daily activities. Acute side effects of treatment are common, self-limiting, and resolve within 4–6weeks after the treatment is completed. [20] Skin reactions and fatigue dominate the acute toxicities. In some cases, radiodermatitis leads to temporary interruption of treatment delivery. [21] Late post-radiation reactions occur several months after the treatment. [22] Irradiation of the chest wall or reconstructed breast may result in changes in the treated soft tissues and skin that may compromise the cosmetic outcome. Changes in the aesthetic appearance of the breast result from volume loss, fibrosis, or retraction at the tumor bed. [22] Surgical factors like the extent of surgical resection, the resected volume and the scar orientation have an important impact on the appearance of the breast and the cosmetic outcome. [23] The main factors correlated with the intensity of post radiation reactions are total radiation dose, energy, fractionation, radiotherapy technique, and irradiated volume. [24] The introduction of modern radiotherapy into breast cancer treatment has helped in a significant reduction in the incidence of radiodermatitis, as demonstrated in several randomized studies. [25] According to our results; 65.3% of complications were minor and managed conservatively and 34.7% of complications were major and needed reoperation. Capsular contracture (Baker 1 up to 4) was the most common adverse event; most of them were Baker 1 and 2 and managed conservatively by analgesics and supporting bra. In another study delivered by Cordeiro PG et al, [26] the most common complication in patients treated with radiation was seroma. The study conducted by Hughes K et al.; [23] concluded that none of the patients were observed to have any greater than Baker grade II capsular contracture, and the majority were classified as grade I; this is different from our results which concluded that 18 cases had capsular contracture (12 cases (66.7%) had grade 1 and 2 while 6 cases (33.3%) had grade 3 and 4); this difference may be related to radiotherapy administration techniques. On univariate analysis, RT was the only variable related to capsule formation ($p < 0.001$).

[27] Several studies had shown that there was a major complication rate of approximately 20% in patients who undergo immediate implants following SSM and NSM and adjuvant radiotherapy. [28-33]; In the current study; twelve patients (70.6%) out of the 17 who developed major complications had SSM or NSM with immediate reconstruction with implant as a primary surgical procedure. Spear SL and Onyewu C concluded that the infection rate was also higher at 4% in the irradiated group and 0% in the control group. [34] In the current study; 9 patients developed post-radiation infection (5 patients with minor Skin infection and 4 patients with severe infection) which accounts for 18.4% of the total complications; really we cannot judge whether the radiation is totally accused as risk factor as we had not control non irradiated group. Cordeiro PG et al, [26] concluded that 72 % of patients with complications chose the same surgical option used as a primary procedure to mange the complication but in our study; only one patient (5.9%) with Baker 3 capsular contracture chose capsulectomy with removal of the implant with implant exchange while 6 patients (35.3%) (2 patients with Capsular contracture, 2 patients with severe infection and 2 patients with major wound dehiscence) chose excision of all radiated skin without reconstruction but really we were not controlled only by the patient desire in choosing the procedure by which the complication was managed but also by the type and the degree of complication, the extension of skin affection and the need for coverage, the oncologic state and the type of submitted primary surgical procedure. The multiplicity of these parameters put to determine the procedure used in management of major complications may be due to that we dealt with complications which occurred after different types of surgical procedures used for management of breast cancer (SSM, NSM, MRM, CBS) but Cordeiro PG et al [26] dealt only with patients who developed radiotherapy-induced-local surgical complications after SSM or NSM with immediate reconstruction with implant as a primary surgical procedure.

5. Conclusions & Recommendations

- Radiation is a critical component of multimodality treatment for breast cancer improving locoregional control and survival.
- Radiotherapy-induced local surgical complications after surgery for breast cancer are not uncommon and can cause major adverse events including increased morbidity, psychological trauma, additional cost and bad cosmetic outcomes.
- Radiotherapy-induced local surgical complications can occur after any type of surgery for breast cancer but luckily most of them are minor and can be managed conservatively or by minor surgical procedure.
- The oncoplastic breast surgeon should be ready to deal with these complications with different options to decrease morbidity and to regain better cosmetic outcome.
- Improvement in the targeting of radiotherapy, surgical techniques and quality of implants can reduce these complications and consequently reducing the related morbidity and these maneuvers should be the area of active ongoing research.

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All authors have contributed significantly to this work.

Conflicts of Interest

The authors declare that there's no conflict of interest

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