

# Radiotherapy

## Key observations

- Morocco has one linear accelerator machine per 1250 patients, which is lower than the number recommended by the International Atomic Energy Agency (IAEA) as ideal (one per 450 patients) but substantially higher than that reported from most LMICs.
- At CM-VI, postoperative radiotherapy was received by 52.6% of patients with stage I disease, 67.1% with stage II, 65.7% with stage III, and 56.2% with stage IV. At INO, postoperative radiotherapy was received by 81.4% of patients with stage I disease, 92.3% with stage II, 96.8% with stage III, and 89.7% with stage IV.
- Although 74.9% of the patients at INO who underwent BCS received radiotherapy, the proportion was much lower at CM-VI (39.2%). The apparently low number of patients receiving radiotherapy at CM-VI could be partly due to poor maintenance of records.
- The median interval between the date of surgery and initiation of radiotherapy was 7–9 months; ideally, this should not exceed 6 weeks.
- The Houses of Life (*Maisons de Vie*) established in recent years have made a substantial impact in reducing the bed occupancy at the oncology centres for those undergoing radiotherapy.

### 9.1 Principles of radiotherapy for breast cancer

Radiotherapy is an essential component of multimodal therapy for breast cancer. Whole-breast irradiation (with or without nodal irradiation) after BCS with an additional booster dose to the tumour bed (by either EBRT or brachytherapy), if indicated, reduces the risk of recurrence and improves survival. A meta-analysis of several RCTs observed a

15% reduction in recurrence (locoregional or distant) at 10 years after BCS and a 3% reduction in mortality at 15-year follow-up with adjuvant radiotherapy; the benefit was observed in both node-negative and node-positive disease (Darby et al., 2011). Postmastectomy radiotherapy to the chest wall and regional lymph nodes substantially reduces the locoregional failure rate. It also contributes to the increase in DFS (Rutqvist et al., 2003). Radiotherapy is recom-

mended in all patients with breast cancer who undergo radical surgery, except in patients with T1/T2 tumour without any nodal metastasis and with negative surgical margins. Hypofractionated radiotherapy to deliver 39–42.9 Gy (15–16 fractions; each fraction 2.6–3.3 Gy) compared with the earlier standard dose of 50 Gy achieves similar tumour control and better cosmesis (Smith et al., 2018). Hypofractionation substantially reduces the total treatment time to

just more than 3 weeks, which in turn reduces the load on the radiotherapy services.

## 9.2 Patients with breast cancer treated with radiotherapy in Morocco and radiotherapy details

At CM-VI, of the 785 patients with breast cancer who received some form of cancer-directed treatment, 36.2% ( $n = 284$ ) received radiotherapy. The proportion of patients who received radiotherapy was lower in 2013–2017 (23.4%) than in 2008–2012 (53.1%).

At INO, of the 1157 patients who received some form of cancer-directed treatment, 65.0% ( $n = 752$ ) received radiotherapy. The proportion was higher in 2008–2012 (73.8%) than in 2013–2017 (58.4%).

Most of the patients were treated with EBRT alone. Using hypofractionated radiotherapy, EBRT could be completed in 3–4 weeks in 55.1% of patients receiving radiotherapy at CM-VI and 66.2% of patients at INO.

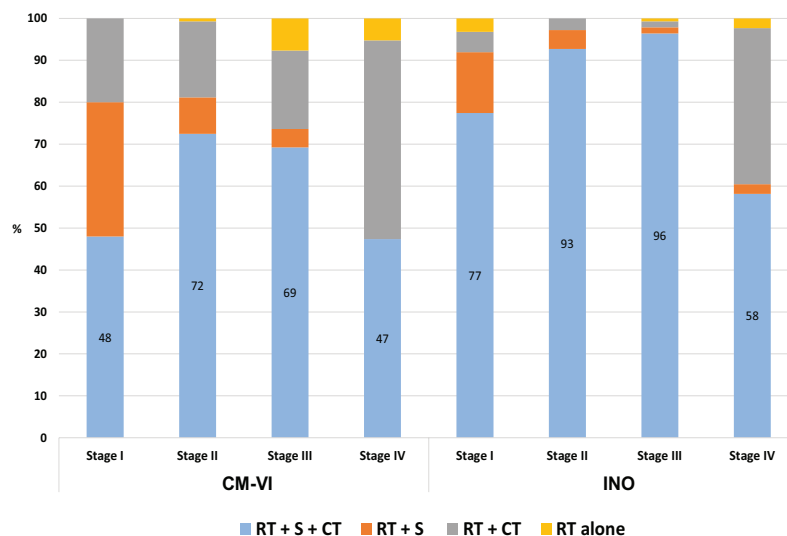
Brachytherapy (either HDR or low-dose-rate [LDR]) is usually recommended to boost the tumour bed after surgery and was administered to 17 patients at CM-VI and 15 patients at INO. Most of the brachytherapy applications at both centres were during 2008–2012.

None of the patients at CM-VI and less than 5% of the patients at INO required hospitalization to receive radiotherapy.

### 9.2.1 Indications for radiotherapy

At both CM-VI and INO, the most common indication for radiotherapy was postoperative adjuvant therapy (with or without chemotherapy) (Fig. 9.1). The proportions of patients who received postoperative radiotherapy at CM-VI were 52.6% for

**Fig. 9.1.** The combination of treatment methods according to stage and oncology centre in patients treated with radiotherapy. CM-VI, Centre Mohammed VI pour le traitement des cancers; CT, chemotherapy; INO, Institut National d’Oncologie Sidi Mohamed Ben Abdellah; RT, radiotherapy; S, surgery.



patients with stage I disease, 67.1% with stage II, 65.7% with stage III, and 56.2% with stage IV. The proportions of patients who received adjuvant radiotherapy (with or without chemotherapy) at INO were 81.4% for patients with stage I disease, 92.3% with stage II, 96.8% with stage III, and 89.7% with stage IV.

Postoperative radiotherapy is recommended after BCS in almost all cases to get rid of the microscopic tumour foci. Although 74.9% of patients who underwent BCS were treated with adjuvant radiotherapy at INO, only 39.2% of the BCS patients received radiotherapy at CM-VI. The proportion of patients who received radiotherapy after mastectomy was also substantially higher at INO (70.2%) than at CM-VI (40.0%). The proportion of patients who received radiotherapy after lumpectomy and mastectomy according to stage at the two oncology centres is shown in Fig. 9.2.

The proportion of patients receiving radiotherapy at CM-VI has been

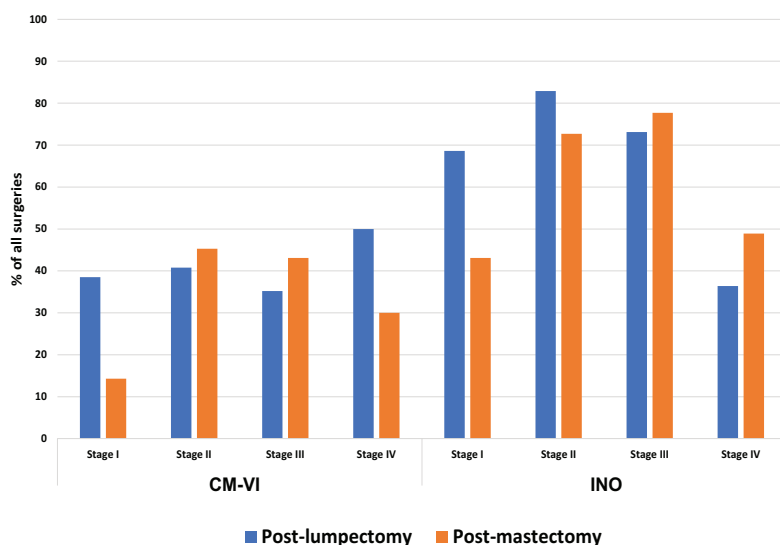
underreported, especially in recent years. The radiotherapy-related information is maintained in a dedicated database in the radiotherapy department and is not transferred to the case files on a regular basis.

### 9.2.2 Time between surgery and initiation of radiotherapy

EBRT should be initiated within 3–6 weeks after surgery unless systemic chemotherapy is given in between.

At CM-VI, the median interval between surgery and initiation of radiotherapy for the patients who did not receive chemotherapy in between was 8.9 months (IQR, 5.0–11.0 months). The interval increased over time (7.0 months in 2008–2012 and 9.7 months in 2013–2017). The patients who underwent surgery at CM-VI had lower median waiting periods (4.0 months; IQR, 2.6–8.1 months) than those who had had surgery elsewhere (8.9 months; IQR, 6.5–11.5 months).

**Fig. 9.2.** Proportion of patients receiving radiotherapy after lumpectomy and mastectomy at the Centre Mohammed VI pour le traitement des cancers (CM-VI) and the Institut National d'Oncologie Sidi Mohamed Ben Abdellah (INO) by stage of breast cancer.



At INO, the median interval between surgery and initiation of radiotherapy for the patients who did not receive chemotherapy in between was 6.9 months (IQR, 4.9–9.1 months). No substantial difference was observed between the time periods (7.1 months in 2008–2012 and 6.5 months in 2013–2017) or by whether the surgery was performed at INO (median interval 6.1 months) or elsewhere (median 7.0 months).

### 9.3 Radiotherapy for breast cancer in Morocco compared with other settings

Radiotherapy is an integral part of multimodal management of breast cancer, especially when a conservative approach is followed in surgical interventions. Morocco has made substantial progress in improving radiotherapy facilities, which is evident from the fact that there are eight EBRT machines per 10 000 cancer patients (one per 1250 patients) in the country. All telecobalt machines have been replaced by linear accel-

erator (linac) facilities. Linacs with multileaf collimator, three-dimensional conformal radiotherapy, intensity-modulated radiotherapy, and image-guided radiotherapy facilities are available at CM-VI and INO. Individualized computed tomography scan-based treatment planning and intensity-modulated radiotherapy, which ensure greater target dose homogeneity and sparing of normal tissues, are used at the oncology centres in Morocco.

The EUSOMA guidelines with regard to quality of adjuvant radiotherapy for breast cancer are that: (i) at least 90% of patients should receive radiotherapy after BCS and (ii) at least 90% of patients should receive radiotherapy after radical mastectomy if more than three axillary lymph nodes are involved (Biganzoli et al., 2017). Less than a quarter of the patients at INO who underwent BCS did not receive radiotherapy, whereas at CM-VI nearly 60% did not receive radiotherapy. The proportion of patients who received radiotherapy after mastectomy was also less than

expected at CM-VI. As mentioned earlier, the lower frequency reported at CM-VI could be because of incomplete records.

Following international guidelines, the oncology centres in Morocco use hypofractionated radiotherapy, which has substantially reduced the total duration of radiotherapy. However, we observed that in a substantial number of patients the total duration of radiotherapy was either too short (< 2 weeks) or too long (> 10 weeks), especially at CM-VI. Some of these patients may have been noncompliant. There was a delay in the initiation of radiotherapy after initial surgery at both centres.

Morocco has established several Houses of Life (*Maisons de Vie*) to accommodate cancer patients and their families while the patients undergo chemotherapy or radiotherapy at the oncology centres. These unique facilities have substantially reduced the need for hospitalization while the patients are undergoing radiotherapy.

The European guidelines and the IAEA recommend four linac machines per 1 million population (or one per 450 patients) (IAEA, 2011; Rosenblatt et al., 2013). There is an acute shortage of radiotherapy machines in most LMICs, and as a result limited numbers of patients with breast cancer are treated with adjuvant radiotherapy. It has been estimated that approximately 45–55% of the patients with breast cancer in the Islamic Republic of Iran receive radiotherapy, a proportion comparable to that in Morocco (Jönsson et al., 2019). African countries have, on average, one radiotherapy machine per 3.8 million population. This covers just 22–28% of the need, and 28 of the 51 LMICs on the continent have no radiotherapy machines at all (Zubizarreta et al., 2015). A radiotherapy facility requires radiation oncologists, medical physicists,

radiotherapists, and dosimetry technicians, and lack of trained staff is a major barrier to the establishment of radiotherapy facilities in many African countries. There are facilities for

training radiotherapy professionals in just 10 African countries.

From this perspective, Morocco has made great progress in ensuring access to good-quality radiotherapy.

There is scope for further improvement in reducing delays in initiation of radiotherapy after surgery and ensuring that more patients with high-risk disease are offered radiotherapy.

## References

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