Technical Innovations & Patient Support in Radiation Oncology 32 (2024) 100261

Contents lists available at ScienceDirect

Technical Innovations & Patient Support in Radiation Oncology

journal homepage: www.sciencedirect.com/journal/technical-innovations-and-patient-support-in-radiation-oncology

Catheter removal after interstitial brachytherapy for breast cancer: Feasibility study for task delegation

M. Pignier, L. Rene, J. Carenco, M. Dubosc, M. Moreau, Y. Rizzi, M. Gauthier, S. Secchi-Cippoloni, J.M. Hannoun-Levi *

Department of Radiotherapy, Antoine Lacassagne Cancer Center, University of Cote d'Azur, Nice, France

ARTICLE INFO

Keywords:
Breast cancer
Brachytherapy
Task delegation
Radiation therapist
Device removal
Complications

ABSTRACT

Purpose: This study aims to assess the impact of delegating brachytherapy device removal to radiation therapists (RTTs) in the treatment of breast cancer, in terms of safety and efficacy of treatment.
Material and Methods: A retrospective, observational study was conducted to analyze breast cancer brachytherapy patients. Standardized protocols were drawn up and the RTTs were gradually trained to remove brachytherapy devices under medical supervision.
Results: 423 patients were included in the study over a period of 15 years. The move to involve RTTs in device removal did not lead to a significant increase in complications. Efficient management of complications was observed, with a stable rate of complications whatever the indication for treatment.
Conclusion: Delegating removal of brachytherapy devices to RTTs is a move towards the optimization of breast cancer care. This inter-professional approach guarantees diligent, safe care for patients while offering RTTs new opportunities for career development.

Introduction

In 2020, with 2.26 million new cases, breast cancer was the most frequently diagnosed cancer and the leading cause of death from cancer among women (684 996) [1]. It is forecast that there will be 3.19 million new cases of cancer by 2040 (30 % increase) and 1.04 million cancer-related deaths (34 % increase) [2].

Breast cancer treatment comprises different medical approaches, including surgery for tumor removal (lumpectomy/mastectomy), post-operative radiotherapy designed to eradicate the residual subclinical disease and systemic treatments like hormone therapy, chemotherapy and targeted treatments to prevent systemic spreading of the breast cancer.

In the event of breast-conserving surgery, adjuvant radiation is a therapeutic standard to improve both local control and overall survival [3]. Adjuvant radiation is based on 2 main techniques: external radiotherapy and brachytherapy. The choice between these 2 techniques, which offer specific advantages, is made on the basis of indication and individual patient characteristics. Brachytherapy is suitable for administration of a large dose (increase in efficacy) in a small volume (reduction in toxicity) over a short time. Brachytherapy can be proposed in addition to radiation after external radiotherapy for tumors with a high risk of local relapse [4], as sole treatment for accelerated partial radiation treatment of the breast in the case of tumors with a good prognosis [5], or as a second breast-conserving treatment in patients with local relapse in a previously treated breast [6].

Breast cancer brachytherapy entails implanting the vector (in the operating theatre), 3D image-based planning, treatment and removal of the device. Radiation therapists (RTTs) play an important part in the brachytherapy, and intervene in each of the stages described above. In terms of device removal, usually performed by the Brachytherapist, the possibility of delegating this task to the RTTs is a valid question. Such a move may be advantageous for the patient in addition to the medical and *para*-medical teams.

Material and Methods

In this retrospective, observational study, we collected the data of patients treated with multi-catheter interstitial brachytherapy for breast cancer. Patient consent was obtained before making the analysis, after

* Corresponding author at: Department of Radiation Oncology, Antoine Lacassagne Cancer Center – University Cote d'Azur, 33 Avenue Valombrose, 06107 Nice Cedex, France.
E-mail address: jean-michel.hannoun-levi@nice.unicancer.fr (J.M. Hannoun-Levi).

https://doi.org/10.1016/j.tipsro.2024.100261
Received 31 May 2024; Received in revised form 9 July 2024; Accepted 9 July 2024
Available online 10 July 2024

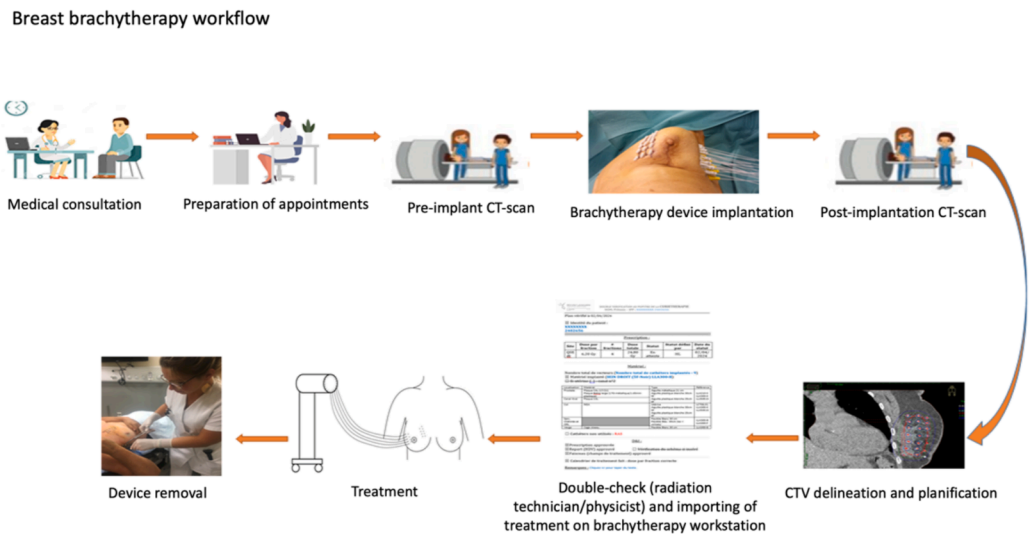

Fig. 1. Breast brachytherapy workflow.

providing clear, fair information on the use of these data. In accordance with the legislation in force, data collection was registered with the National Health Data Hub under N° F20210402112942.

Patient features

We collated the data of patients diagnosed with breast cancer for whom brachytherapy was indicated and performed. The two main indications for breast brachytherapy were accelerated partial breast radiation therapy (IPAS) **[7;8]** and second breast-conserving treatment [9].

Treatment characteristics (Fig. 1).

The RTT plays a key part in organizational planning by managing appointments (consultation with the anesthetist, follow-up, imaging, etc …) and coordinating the various players involved (hospitalization, physicists, doctors) [10].

Brachytherapy involves several stages defined as follows:

Step 1: Pre-implant scan

Two to three days before the implant, a scan is performed so the physicist and doctor can precisely locate the catheter entry and exit points. Over and above the technical side, the RTT takes the time to explain the subsequent stages to the patient, giving her information about the appointments planned and providing the requisite explications for optimal treatment and a trust-based patient relationship throughout the course of treatment.

Step 2: Implantation of the brachytherapy device

On the day of implantation, in the operating theatre, disinfection is performed and surgical drapes are put in place. The Brachytherapist implants the vector, usually plastic tubes but occasionally rigid metal needles, according to the geometric data obtained during pre-implant planning, based on the dosimetric principles of the Paris System. [11]. During this stage, the RTT helps the patient prepare for the intervention, providing psychological support, explaining the procedure and using relaxation techniques like sophrology.

Step 3: Post-implant scan

After implanting the device, a post-implant scan is performed. The assistant positions phantoms to enable the doctor and physicist to optimise dose distribution.

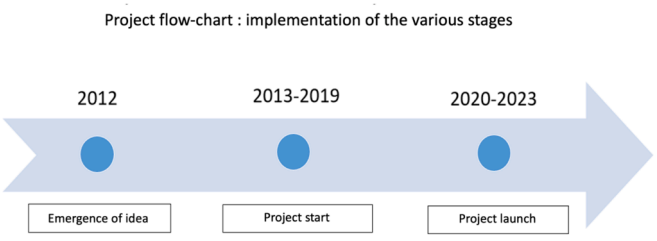

Fig. 2. Time-frame for the organization and planning of Breast Brachytherapy Task Transfer.

Step 4: Dose delivery

Before beginning treatment, the physicist and RTT double-check patient identity, prescribed dose, fractionation, Dose Volume Histogram… The dose delivered to the target volume and its fractionation vary according to indication: 7 to 8 fractions for accelerated partial breast irradiation (IPAS) [7] and 1 fraction under the SIFEBI protocol [8] or 8 to 10 fractions in the event of second breast-conserving treatment [9].

Step 5: Removal of the brachytherapy device

At the end of treatment, the device is removed carefully, without anesthesia, after local disinfection, and the absence of bleeding from the entry and exit points is checked. Finally, the patient receives the prescriptions required for local care, together with the follow-up appointments.

In terms of device removal, the RTTs have gradually been trained in this procedure by working alongside doctors. They have thus acquired experience with these technical procedures. For a period running from 2008 to 2019, they assisted the Brachytherapist during this intervention. As of 2020, the RTTs thus trained have removed the devices themselves under medical supervision (Fig. 2).

Patient follow-up

To validate the feasibility of delegating removal of the brachytherapy device to the RTT, we analyzed the acute complications likely to occur during or immediately after removal of the tubes. The acute complications of brachytherapy have been described in a phase 3 randomized study by GEC-ESTRO – Accelerated partial breast irradiation

Table 1
Patients and tumour features (n = 423).

Items	#	[min – max]/%
# pts	423	
Median age (years)	73	[28—92]
Number of vectors	12	[4—24]
Number of plans	3	[1 –5]
Breast side		
Right	197	44.6
Left	226	53.4
Indications		
APBI	126	29.8
VAPBI	62	14.7
2nd conservative treatment	235	55.6

pts = patients; APBI: accelerated partial breast irradiation; VAPBI: very accelerated partial breast irradiation (single fraction).

with interstitial multi-catheter brachytherapy versus external beam whole breast irradiation [12,13]. The Common Terminology Criteria for Adverse Events (CTCAE) Version 5.0 was used to measure the severity of the acute complications [14]. Acute toxicity up to 3 months after brachytherapy was not analyzed in this study as only toxicity linked to device removal made it possible to analyze the feasibility of transferring the task of device removal to the RTT. The 3 acute complications potentially linked to device removal are pain, infection and hemorrhage.

Results

From 2008 to 2023, 423 patients received breast brachytherapy at the Centre Antoine Lacassagne in Nice. Patient characteristics and details of the treatment given can be found in Table 1. The average age was 73 [28—92]. For 188 patients, brachytherapy consisted in one IPAS after tumor removal for primary cancer [7] (for 62 patients, in a single fraction [8]). 235 patients received a second breast-conserving treatment for local relapse [9]. The average number of catheters implanted per patient was 12 [4—24], with an average number of treatment plans of 3 [1–5].

Among the 423 patients treated, 13 complications were described (3.1 %): 2 infections (15.4 %), 11 hemorrhages (84.6 %). No complications in terms of pain were observed. The rate of Grade 1 and 2 complications was 92.3 % (11 patients) et 7.7 % (1 patient) respectively. No Grade 3 complication was observed.

During the period studied, 7 (53.85 %) complications were observed after APBI and 6 (46.15 %) after a 2nd breast-conserving treatment (Fig. 3**).** Between 2008 and 2019, 8 complications were observed during device removal by a doctor (8/361 patients = 2.2 %), with 2 infections and 7 hemorrhages. Between 2020 and 2023, when the RTT removed the device under Brachytherapist supervision, 5 complications were observed (5/62 patients = 8.1 %) – 5 hemorrhages.

The number of catheters implanted and the number of treatment plans and sessions did not significantly impact the risk of complications.

Discussion

Device removal was delegated to the RTTs for several reasons. This initiative was mainly designed to optimize the utilization of medical resources by focusing on efficient time use by doctors and RTTs. It also sought to broaden the skills of the latter, thus giving them an opportunity for professional development within the care-giving team.

In the long run, the goal was to enable the RTTs to perform this task alone, under the indirect supervision of the doctors, who could thus concentrate on more complex clinical and decision-making activities without undermining the quality and safety of patient care. [15].

These data were analyzed in order to assess the toxicity linked with catheter removal and to prove the feasibility of delegating this task to the RTT. The results of the study indicate a low rate of complications during removal (3.1 %). In the event of complications, their management remained fairly simple as compression usually sufficed.

Entrusting this responsibility to RTTs must be predicated on several

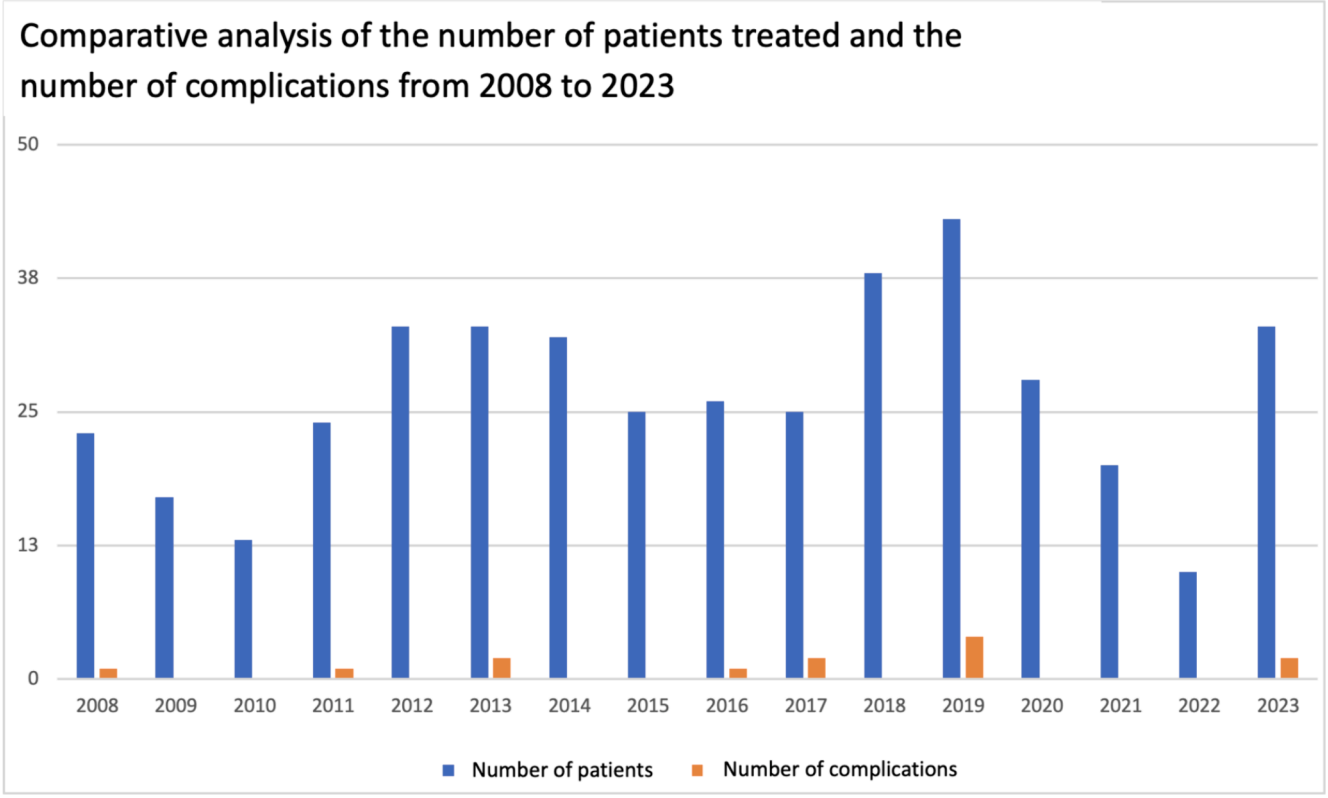

Fig. 3. Comparative analysis of the number of patients treated and the number of complications between 2008 and 2023.

fundamental conditions designed to guarantee the safety and quality of the care given. First, the RTT must acquire theoretical and practical knowledge of breast cancer brachytherapy in order to understand and effectively manage any possible risks and complications linked to the overall procedure, and more specifically the removal of brachytherapy devices. Also, specific in-house training in how the brachytherapy department functions is necessary. Device removal must be carried out in accordance with the procedure drafted together with the medical team, good clinical practices and medical guide-lines. Finally, a regular evaluation of practices and skills is required to maintain and constantly improve safety and quality standards. This evaluation can be made in different ways, such as case reviews and feedback, in order to analyze in depth, the efficiency and safety of delegating removal to the RTTs. This process also seeks to identify possible gaps in knowledge or points for improvement in the performance of this task. All in all, entrusting responsibility for brachytherapy device removal to RTTs is an important decision that calls for adequate preparation, specialized training and supervision to guarantee safe, high-quality patient care.

To ensure proper follow-up and a quick reaction in the event of complications, it is absolutely necessary for the RTT performing the intervention to be accompanied by another RTT who participated in the initial treatment, or a qualified auxiliary nurse. The presence of an additional person not only provides for closer surveillance during the removal of the brachytherapy device, but also immediate support in the event of unforeseen situations or complications. In this manner, the medical team guarantees diligent, safe patient care throughout the procedure. Efficient task-sharing takes account of the scope of responsibility of the various players involved. The continuous presence of a Brachytherapist in the department also guarantees optimal patient care. Such progress in the division of labor optimizes the use of doctors' time and reduces waiting time for patients.

As the tasks performed by RTTs become increasingly automated, the intellectually stimulating part of their work may diminish. It thus becomes essential to rekindle interest by entrusting RTTs with more responsibilities and offering them opportunities for professional development. This will make the profession more attractive [16]. This trend is also observed in radiology, where the insertion of veinous catheters has already been delegated (PICC LINE) [17], together with ultrasound examinations [18] and the inclusion of Advanced Practice Nurses (IPA) [19]. Our study is thus in phase with the concept of Advanced Practice Radiation Therapist (APRT) created in 2004 in Canada [20].

Conclusion

Delegating brachytherapy device removal to RTTs in breast cancer treatment is mainly designed to optimize the use of medical resources. It also gives RTTs the opportunity to broaden their professional skills and advance their career. With proper training, ongoing supervision and regular evaluation, this approach could be extended to other fields of medicine, thereby contributing to a new approach to patient care that optimizes efficiency while maintaining and enhancing quality for the patient. This approach follows a general trend observed in various medical fields, where tasks are progressively delegated to RTTs after specialized training.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021;71:209–49.

[2] World Health Organization. International agency for research on cancer. Estimated number of new cases and deaths from 2020 to 2040, Females, age [0-85+] Breast https://gco.iarc.fr/tomorrow/en/dataviz/isotype?sexes=2&single_unit=500000&cancers=20. Access on line 08/22/22.

[3] Early Breast Cancer Trialists' Collaborative Group (EBCTCG); Darby S, McGale P, Correa C, Taylor C, Arriagada R, Clarke M, Cutter D, et al. Effect of radiotherapy after breast-conserving surgery on 10-year recurrence and 15-year breast cancer death: meta-analysis of individual patient data for 10,801 women in 17 randomised trials. Lancet 2011;378(9804):1707-16.

[4] Polo A, Polgár C, Hannoun-Levi JM, Guinot JL, Gutierrez C, Galalae R, et al. Risk factors and state-of-the-art indications for boost irradiation in invasive breast carcinoma. Brachytherapy 2017;16(3):552–64.

[5] Hannoun-Levi JM, Gimeno Morales M, Gal J, Anchuelo J, Guinot JL, Gastanaga M, et al. Very accelerated partial breast irradiation in 1 or 2 days: Late toxicity and early oncological outcome of the GEC-ESTRO VAPBI cohort. Radiother Oncol 2024;8(194):110217. https://doi.org/10.1016/j.radonc.2024.110217. Epub ahead of print. PMID: 38460552.

[6] Hannoun-Levi JM, Gal J, Polgar C, Strnad V, Loessl K, Polat B, et al. Second conservative treatment for local recurrence breast cancer: a GEC-ESTRO oncological outcome and prognostic factor analysis. Int J Radiat Oncol Biol Phys 2023;117(5):1200–10.

[7] Sumodhee S, Levy J, Chamorey E, Lam Cham Kee D, Chand ME, Gautier M, et al. Accelerated partial breast irradiation for elderly women with early breast cancer: A compromise betweenwhole breast irradiation and omission of radiotherapy. Brachytherapy. 2017 Sep-Oct;16(5):929-934.

[8] Hannoun-Lévi JM, Lam Cham Kee D, Gal J, Schiappa R, Hannoun A, Fouche Y, et al. Accelerated partial breast irradiation in the elderly: 5-Year results of the single fraction elderly breast irradiation (SiFEBI) phase I/II trial. Brachytherapy 2020;Jan-Feb;19(1):90–96.

[9] Montagne L, Hannoun A, Hannoun-Levi JM. Second conservative treatment for second ipsilateral breast tumor event: A systematic review of the different re-irradiation techniques. Breast 2020;49:274–80.

[10] Hannoun-Levi JM, Gautier M, Rizzi Y, Razzouk K. Workflow optimization of brachytherapy-based very accelerated partial breast irradiation. Brachytherapy 2023;22(4):491–5.

[11] Common Terminology Criteria for Adverse Events (CTCAE) Version 5.0 Published: November 27, 2017. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ctep.cancer.gov/protocoldevelopment/electronic_applications/docs/ctcae_v5_quick_reference_5x7.pdf.

[12] Strnad V, Ott OJ, Hildebrandt G, Kauer-Dorner D, Knauerhase H, Major T, et al. 5-year results of accelerated partial breast irradiation using sole interstitial multicatheter brachytherapy versus whole-breast irradiation with boost after breast-conserving surgery for low-risk invasive and in-situ carcinoma of the female breast: a randomised, phase 3, non-inferiority trial. Lancet. 2016;387(10015):229-38.

[13] Ott OJ, Strnad V, Hildebrandt G, Kauer-Dorner D, Knauerhase H, Major T, et al. Groupe Européen de Curiethérapie of European Society for Radiotherapy and Oncology (GEC-ESTRO). GEC-ESTRO multicenter phase 3-trial: Accelerated partial breast irradiation with interstitial multicatheter brachytherapy versus external beam whole breast irradiation: Early toxicity and patient compliance. Radiother Oncol 2016;120(1):119–23.

[14] Polgár C, Ott OJ, Hildebrandt G, Kauer-Dorner D, Knauerhase H, Major T, et al. Late side-effects and cosmetic results of accelerated partial breast irradiation with interstitial brachytherapy versus whole-breast irradiation after breastconserving surgery for low-risk invasive and in-situ carcinoma of the female breast: 5-year results of a randomised, controlled, phase 3 trial. Lancet Oncol 2017;18(2):259-268.

[15] Boisbouvier S, Bayart É, Chamois J, Clavère P, Corbin S, De Oliveira A, et al. Survey by SFRO, SNRO and AFPPE about the evolution of the radiation therapist profession in France]. Cancer Radiother 2023;27(8):712–7. French. doi: 10.1016/j.canrad.2023.07.013. Epub 2023 Oct 25. PMID: 37891038.

[16] Skubish S, Starrs C, McDonagh D. Exploring opportunities & pathways for advanced practice radiation therapy roles in the United States. Tech Innovat Patient Supp Radiat Oncol 2021;17:59–62.

[17] Takematsu Y, Shibasaki S, Tanaka T, Hiro J, Takahara T, Matsuoka H, et al. The safe implementation of peripherally inserted central catheters by nurse practitioners for patients with gastroenterological diseases in Japan: a single-center retrospective study. Surg Today 2024;54(5):487–95.

[18] Bullington PW, Reed JR, Owens DL, Rothers JL, Peek GJ, Herring C. Improving healthcare professionals' ultrasound-guided peripheral vascular access ability utilizing self-assembled ultrasound phantoms: a prospective, observational quality improvement project. J Vasc Access 2024;27. https://doi.org/10.1177/11297298241254633. Epub ahead of print. PMID: 38800992.

[19] Schramm J, Uranga T, Birkle A, Thorp R, Taylor L. Improving holistic care skills for advanced practice registered nurses: integration of a complementary and alternative medicine course into a doctor of nursing practice curriculum. J Dr Nurs Pract. 2021 May 11:JDNP-D-20-00077. doi: 10.1891/JDNP-D-20-00077. Epub ahead of print. PMID: 33975904.

[20] Rozanec N, Lavergne C, Harnett N. A Canadian experience of palliative advanced practice radiation therapy TIPS: Training, implementation, practice and sustainability. Tech Innovat Patient Support Radiat Oncol 2021;17:89–96.