Original Article

Scalp Cooling in Daily Clinical Practice for Breast Cancer Patients Undergoing Curative Chemotherapy: A Multicenter Interventional Study

Emilia Gianotti[1], Giorgia Razzini[1], Manuela Bini[1], Caterina Crivellaro[1], Angela Righi[1], Simona Darecchio[2], Stefania Lui[2], Maria Laura Basiricò[3], Silvia Cocconi[3], Katia Cagossi[1], Alessia Ferrari[1], Fabrizio Artioli[1]

[1]Unit of Medical Oncology, Carpi Civil Hospital, Carpi, Medicine Department, Local Health Unit, Modena, [2]Oncology Unit, Guastalla Civil Hospital, Guastalla, Medicine Department Local Healt Unit, Reggio Emilia, [3]Oncology Unit, Parma Hospital, University of Parma, Parma, Italy

Corresponding author: Dr. Giorgia Razzini, PhD

Unit of Medical Oncology, Carpi Civil Hospital, Carpi, Italy

Tel: +39059659981; Fax: +390593963761

E-mail: g.razzini-ext@ausl.mo.it

Received: October 01, 2018, Accepted: November 29, 2018

ABSTRACT

Objective: Chemotherapy-induced alopecia is a common and distressful side effect, especially among breast cancer patients. Scalp cooling (SC) can reduce hair loss during anthracycline- and taxane-based chemotherapy. This study assessed the effectiveness of SC in daily clinical practice in three Italian oncology units. **Methods:** From 2014 to 2016, we prospectively included 220 female early-stage breast cancer patients undergoing curative chemotherapy in combination with SC using the Paxman device. Effectiveness was defined as the severity of hair loss according to the Common Terminology Criteria for Adverse Events Version 4.0 as follows: Grade 0, no hair loss; Grade 1, <50% hair loss not requiring a wig; and Grade 2, ≥50% hair loss at each cycle and at completion of chemotherapy. The tolerability and safety were also evaluated. **Results:** The overall success rate of SC (hair loss Grade 0–1) was 68%. Severe hair loss was avoided in 89% of women receiving taxane-based chemotherapy and in 78% of women receiving both anthracyclines and taxanes. Among women undergoing anthracycline-based chemotherapy, 47% experienced hair preservation. SC was well tolerated, as only 20 patients discontinued SC for reasons other than hair loss. **Conclusions:** Our study confirmed that SC provides a

Access this article online

Quick Response Code:

Website: www.apjon.org

DOI: 10.4103/apjon.apjon_4_19

Cite this article as: Gianotti E, Razzini G, Bini M, Crivellaro C, Righi A, Darecchio S, *et al.* Scalp Cooling in Daily Clinical Practice for Breast Cancer Patients Undergoing Curative Chemotherapy: A Multicenter Interventional Study. Asia Pac J Oncol Nurs 2019;6:277-82.

reliable chance for breast cancer patients to keep their hair during taxane- and/or anthracycline-based chemotherapy.

Key words: Breast cancer, daily routine, effectiveness, scalp cooling

Introduction

One of the most unpleasant adverse events caused by anticancer therapy is alopecia, with an incidence of 70%.[1] Chemotherapy induces a rapid breakdown of mitotic activity, which interrupts the normal anagen growth of hair follicles and can lead to partial or complete scalp hair loss about 2 weeks after the beginning of treatment.[2] Chemotherapy-induced alopecia (CIA) is often temporary as hair usually starts to regrow within 3–4 weeks after the last treatment; however, changes in hair characteristics are often reported.[3]

The amount of hair loss is dependent on the type of cytotoxic drugs and secondarily on the cytotoxic sensitivity of each patient.[4] Higher dosages of chemotherapy lead to more severe alopecia, as well as combination chemotherapy with several agents.[5] Severe hair loss is associated with standard chemotherapy regimens containing doxorubicin, paclitaxel, docetaxel, cyclophosphamide, and/or epirubicin.[6,7]

CIA significantly affects the quality of life of many cancer patients regardless of gender or age.[8,9] The suffering associated with CIA is, however, mostly described among women with breast cancer.[10] To avoid this traumatic event, patients may decide to refuse chemotherapy or choose a less effective treatment.[11]

Since 1970, scalp cooling (SC) or cryotherapy has proved to be the most effective and widely used method to prevent CIA.[12-14] SC works by lowering the scalp skin temperature, which reduces the exposure and metabolism of cytotoxic agents to the hair follicle.[15] Although a scalp skin temperature below 18°C seems to produce better results, there is currently no indication for a cutoff point under which alopecia can be completely prevented.[16] Therefore, it is crucial to optimize the reduction of the scalp skin temperature by ensuring a tight contact between the cold cap and the skin of the scalp.[17] The efficacy of SC has been increasingly demonstrated over the past 20 years, with average success rates varying from 50% to 70%.[18-20] The best results in terms of hair preservation have been reported for taxane-based chemotherapy;[21,22] the results for taxane-based chemotherapy are better than those for anthracycline-based chemotherapy.[23,24] However, two separate meta-analyses have confirmed that there is a clinical evidence to recommend SC to CIA prevention in breast cancer patients using doxorubicin, epirubicin, or taxane-containing chemotherapy regimens.[25,26] Patient baseline characteristics that could affect the efficacy of SC efficacy have not been extensively investigated.[27,28]

Recently, two SC devices have been approved by the US Food and Drug Administration based on the positive results of prospective studies.[29,30] Among these, the Paxman cooling device[31] was evaluated in the unblinded Scalp Cooling Alopecia Prevention Randomized Controlled Phase 3 trial including 142 women with Stage I and II breast cancer undergoing chemotherapy. Analysis showed that 50.5% of patients in the SC group had hair preservation, compared to no patients in the control group. Hair preservation was greater among patients who received taxane-based chemotherapy compared to those who received an anthracycline-based regimen (59% vs. 16%). SC is considered a reasonable, supportive care option as it is well tolerated by cancer patients.[32] Moderate headaches, coldness, and/or uncomfortable sensations are the most frequent side events related to SC.[33] Scalp metastases are not associated with SC during chemotherapy, but caution is recommended for its broad-scale application.[34] Despite evidence of its efficacy and safety, there are several practical concerns to make SC available for routine use, including the device cost and the impact on patient flow and hospital logistics.[35] Hence, we report a multicenter observational study aiming to evaluate the Paxman scalp cooler in preventing CIA among women with breast cancer in daily oncological practice.

Methods

We conducted a prospective observational study in three oncology centers located in Northern Italy with the current experience (at least 30 patients treated within 12 months) in using the Orbis Paxman Hair Loss Prevention System. The study protocol was approved by the Ethical Committee at each site, and all patients provided signed informed consent. The devices were obtained owing to philanthropic funding. We included women with early breast cancer undergoing SC during anthracycline- and/or taxane-based chemotherapy with curative intent from January 2014 to December 2016. The following chemotherapeutic regimens were administered: doxorubicin (60 mg/mq) in combination with cyclophosphamide (600 mg/mq) (AC); AC followed by paclitaxel (80 mg/mq); epirubicin (90 mg/mq) in combination with cyclophosphamide (600 mg/mq) (EC); 5-fluorouracil (500 mg/mq); epirubicin (75–90–100 mg/mq); cyclophosphamide (600 mg/mq) (FEC); FEC followed by docetaxel (100 mg/mq); paclitaxel (80 mg/mq) alone; and docetaxel alone (100 mg/mq). The chemotherapy schedules were based on the National Comprehensive Cancer Network

Guidelines.[36] The exclusion criteria were as follows: age <18 years, metastatic disease, blood disorders including but not limited to cryoglobulinemia, and cold agglutinin disease. SC to prevent hair loss was offered as supportive care to all eligible breast cancer patients by an oncologist during the initial consultation about chemotherapy. The nursing team informed patients who decided to use SC about the procedure, the anticipated effect, and the potential adverse events. Patients declining SC did so from their own choice, and the incidence of CIA in this group was not documented. The cool cap was applied during each chemotherapy cycle by a nurse according to the device manual. The device cools the skin on the patient's scalp to approximately 18°C by circulating coolant throughout a cap at –4°C. SC began 30 min before chemotherapy infusion; the postinfusion cooling time after the last drug was 60 min for all regimens except for 150 min for the AC regimen. The patient's hair was dampened before putting the cap in place to minimize isolation of the air layer between the cap and the scalp skin. To prevent patients from suffering coldness, the forehead was protected with a thin cotton layer and a blanket was provided. Mild headaches were treated with paracetamol, if requested by the patient. Hair loss was rated according to the Common Terminology Criteria for Adverse Event Version 4.0 as follows: Grade 0 (G0), no hair loss; Grade 1 (G1), <50% hair loss not requiring a wig or head cover; and Grade 2 (G2), ≥50% hair loss. Success was defined as G0–G1 hair loss. Patients who agreed to receive SC were assessed for hair loss at baseline and before each cycle of chemotherapy by a nurse who also considered the patient's opinion.[37] Patients with hair loss of G2 after the second cycle of chemotherapy did not continue SC. The reasons for SC discontinuation and the related side effects were also documented. Nurses also recorded baseline patient characteristics and the chemotherapy regimen in the electronic study database. The data were then analyzed by descriptive statistics using Microsoft Excel.

Results

A total of 220 women with breast cancer were included in the study. The baseline patient characteristics and clinical information are summarized in Table 1. The median age was 49 years; almost all patients had a South European ethnicity and none had alopecia at the baseline. In total, 44% ($n = 98$) of the participants received anthracycline-based chemotherapy, 30% ($n = 64$) were administered anthracycline followed by taxane chemotherapy, and 26% ($n = 58$) received taxane-based chemotherapy. A median of eight sessions was performed with the Paxman scalp cooler.

Two hundred patients were available for success rate evaluation. Twenty patients interrupted SC immediately during the first cycle of chemotherapy for reasons other

Table 1: Demographic information and baseline characteristics

Parameter	Participants ($n=220$) No. (%)
Age (years)	
Median (range)	49 (34-66)
Ethnic background	
West and South European	215 (98)
African	2 (1)
Asian	3 (1)
CTCAE® V4.0 Alopecia Grade 0 at baseline	212 (96)
CTCAE® V4.0 Alopecia Grade 1 at baseline	8 (4)
Study site	
1	150 (68)
2	40 (18)
3	30 (14)
Planned chemotherapy regimen	
AC: doxorubicin, 60 mg/mq and cyclophosphamide, 600 mg/mq (4 cycles every 3 weeks)	59 (27)
AC followed by paclitaxel, 80 mg/mq weekly for 4 cycles	22 (10)
EC: epirubicin, 90 mg/mq and cyclophosphamide, 600 mg/mq (4 cycles every 3 weeks)	20 (9)
EC followed by paclitaxel, 80 mg/mq weekly for 4 cycles	11 (6)
FEC: 5-fluorouracil, 500 mg/mq, epirubicin, 75-90-100 mg/mq and cyclophosphamide, 500 mg/mq (4 cycles every 3 weeks)	19 (8)
FEC 3-4 cycles followed by docetaxel, 100 mg/mq (3 cycles every 3 weeks)	31 (14)
DC: docetaxel, 75 mg/mq with cyclophosphamide, 600 mg/mq (4-6 cycles every 3 weeks)	21 (9)
Paclitaxel, 80 mg/mq weekly for 4 cycles	28 (13)
Docetaxel, 100 mg/mq weekly for 3 cycles	9 (4)
Scalp cooling sessions	
Median (range)	8 (1-16)

*CTCAE: Common Terminology Criteria for Adverse Events

than CIA and were recorded as discontinued [Table 2]. Four patients felt that too much time was required and 16 patients interrupted SC for moderate-to-severe cooling-related adverse events, including migraine ($n = 8$), coldness ($n = 4$), dizziness ($n = 2$), and vomiting ($n = 2$).

As shown in Table 3, at the end of their planned chemotherapy regimens, 136 patients reported hair loss of G0–G1. Thus, the overall success rate was 68%. The remaining 64 (32%) patients experienced G2 hair loss within the first two cycles of chemotherapy, and the treatment was considered to have failed in these patients. Hair preservation according to the type of cytotoxic agent is shown in Table 4. The best results were reported for 49 (89%) of 55 patients receiving taxane-based chemotherapy. Prevention of hair loss was achieved in 47 (78%) of 60 patients undergoing treatment with both anthracyclines (mainly epirubicin based) and taxanes in a sequential scheme. Finally, 88 patients received an anthracycline-based chemotherapy regimen, of whom 40 (47%) were able to preserve their hair. After a median follow-up of 24 months (range: 16–34 months) following the last treatment with SC, none of the patients had developed scalp skin metastases and nine patients had breast cancer recurrence.

Discussion

Our results confirm that SC applied in routine clinical practice can avoid CIA among women with breast cancer undergoing curative chemotherapy with taxane and/or anthracycline cytostatic agents. In our study, the Paxman device had been implemented for at least 1 year; therefore, the nursing team had sufficient experience with the SC procedure. This could partially explain the high overall success rate of 68%, which is comparable to those in similar recent studies.[29,38]

We conducted a multicenter prospective study enrolling 220 early-stage breast cancer patients treated with specific chemotherapy regimens to standardize the study results.

Taxane-induced severe alopecia occurs in 70%–80% of patients at the commonly used dosages.[7] Our observation of an 89% success rate in the group of patients receiving taxane-based therapy clearly shows the added value of SC.

We also add evidence to the role of SC in patients receiving both anthracycline- and taxane-based chemotherapy (78% success) as was also reported by Friedrichs and Carstensen.[23]

For anthracycline-based treatment, generally inferior results are reported.[26] In our study, patients receiving FEC or EC achieved better results in terms of hair preservation compared to those receiving AC regimen. Although subgroup analysis was not conducted due to the limited number of patients, women receiving epirubicin at lower dose experienced less hair loss (data not shown), concordant with the findings of another report.[39]

In our experience, the duration of SC did not seem to affect its success rate.[27] Only 47% of the patients receiving AC did not show alopecia, although the postinfusion cooling time was longest for AC regimen compared to those for the other chemotherapy regimens. SC was confirmed to be a safe procedure for breast cancer patients as no scalp metastases were detected throughout the entire study period, and the percentage of disease recurrence in 2 years of follow-up was in line with current evidence.[40] Finally, we found no indication that breast cancer patients undergoing chemotherapy with SC with no alopecia were less sensitive to chemotherapy and, therefore, at risk of a worse outcome prognosis, as suggested elsewhere;[41] however, long-term follow-up is still ongoing. The present study had several limitations. First, we used a cohort study design without randomization; to standardize the study results, we investigated specific chemotherapy regimens known to cause alopecia in women with early-stage breast cancer.

Alopecia assessment was performed by the nurse together with the patient using a rating scale for better objectively; however, hair preservation by SC is considered relevant if evaluated by patients themselves.[37]

Finally, our results were obtained from comparable cancer sites in terms of workload and logistical organization, and this could explain the high success rate, including but not

Table 2: Patient disposition

	Participants No. (%)
Included in the study	220 (100)
Analyzed for effectiveness	200 (91)
Discontinued for other reasons than alopecia	20 (9)
Low tolerability	4
Side effects	16

Table 3: Scalp cooling success rate

Parameter	Participants No. (%)
Success	136 (68)
Failure	64 (32)
Total	200 (100)

Table 4: Scalp cooling success rate according to chemotherapy regimen

Parameter	Participants No. (%)		
	Anthracycline*	Taxane**	Anthracycline-Taxane***
Success	40 (47)	49 (89)	47 (78)
Failure	45 (53)	6 (11)	13 (22)
Total	85 (100)	55 (100)	60 (100)

*AC, EC , FEC, DC. **Paclitaxel, docetaxel. ***AC followed paclitaxel, FEC followed docetaxel, EF followed by docetaxel

limited to the prevalence of taxane-based chemotherapy regimen. Despite these limitations, our results indicate that SC should be offered as a part of supportive care to cancer patients.[42] As reported by Shaw *et al.*, nursing and medical staff commitment are fundamental to the implementation of SC in the daily practice of oncology units.[43]

In our study, only 10% of the participants prematurely dropped out for reasons other than CIA. The key factors to keep patients on the intervention included good management of the device by the nursing team as well as a dedicated nurse during the first session of SC to provide support and motivation to bear the mild-related adverse events and discomfort. The present study did not perform a cost evaluation, which might be included in a future study.

Conclusion

Our study confirmed that SC provides a reliable chance for breast cancer patients to keep their hair during taxane- and/or anthracycline-based chemotherapy, especially when epirubicin and taxanes are administered.

Since 2017, we are routinely offering SC to newly diagnosed breast cancer patients undergoing chemotherapy.

The use of SC device requires extra time and effort on the part of the nursing team; therefore, it would be important to investigate patient- and treatment-related variables that might influence the efficacy of SC.

Acknowledgments

We are very grateful to the philanthropic donors for providing the scalp cooling device at each center and to all nurse team for their helpful support.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Trüeb RM. Chemotherapy-induced alopecia. Curr Opin Support Palliat Care 2010;4:281-4.
2. Karakunnel J, Berger AM. Hair loss. In: Cancer: Principles & Practice of Oncology. 8th ed. PA, USA: Lippincot Williams & Wilkins; 2008. p. 2688-91.
3. Batchelor D. Hair and cancer chemotherapy: Consequences and nursing care – A literature study. Eur J Cancer Care (Engl) 2001;10:147-63.
4. Durden FM, Mirmirani P. Alopecia and cutaneous complications of chemotherapy. In: Chang AE, editor. Oncology Evidence-based Approach. NY: Springer; 2006. p. 1363-71.
5. Breed W, Van den Hurk CJ, Peerbooms M. Presentation, impact and prevention of chemotherapy induced hair loss: Scalp cooling potentials and limitations. Dermatology 2011;6:109-25.
6. Cersosimo RJ, Hong WK. Epirubicin: A review of the pharmacology, clinical activity, and adverse effects of an Adriamycin analogue. J Clin Oncol 1986;4:425-39.
7. Prevezas C, Matard B, Pinquier L, Reygagne P. Irreversible and severe alopecia following docetaxel or paclitaxel cytotoxic therapy for breast cancer. Br J Dermatol 2009;160:883-5.
8. Lemieux J, Maunsell E, Provencher L. Chemotherapy-induced alopecia and effects on quality of life among women with breast cancer: A literature review. Psychooncology 2008;17:317-28.
9. Baxley KO, Erdman LK, Henry EB, Roof BJ. Alopecia: Effect on cancer patients' body image. Cancer Nurs 1984;7:499-503.
10. Tierney AJ, Taylor J, Closs SJ. Knowledge, expectations and experiences of patients receiving chemotherapy for breast cancer. Scand J Caring Sci 1992;6:75-80.
11. Hesketh PJ, Batchelor D, Golant M, Lyman GH, Rhodes N, Yardley D, *et al.* Chemotherapy-induced alopecia: Psychosocial impact and therapeutic approaches. Support Care Cancer 2004;12:543-9.
12. Edelstyn GA, MacDonald M, MacRae KD. Doxorubicin-induced hair loss and possible modification by scalp cooling. Lancet 1977;2:253-4.
13. Dougherty L. Scalp cooling to prevent hair loss in chemotherapy. Prof Nurse 1996;11:507-9.
14. Katsimbri P, Bamias A, Pavlidis N. Prevention of chemotherapy-induced alopecia using an effective scalp cooling system. Eur J Cancer 2000;36:766-71.
15. Bülow J, Friberg L, Gaardsting O, Hansen M. Frontal subcutaneous blood flow, and epi- and subcutaneous temperatures during scalp cooling in normal man. Scand J Clin Lab Invest 1985;45:505-8.
16. Komen MM, Smorenburg CH, Nortier JW, van der Ploeg T, van den Hurk CJ, van der Hoeven JJ, *et al.* Results of scalp cooling during anthracycline containing chemotherapy depend on scalp skin temperature. Breast 2016;30:105-10.
17. Janssen FE, Van Leeuwen GM, Van Steenhoven AA. Modelling of temperature and perfusion during scalp cooling. Phys Med Biol 2005;50:4065-73.
18. Protière C, Evans K, Camerlo J, d'Ingrado MP, Macquart-Moulin G, Viens P, *et al.* Efficacy and tolerance of a scalp-cooling system for prevention of hair loss and the experience of breast cancer patients treated by adjuvant chemotherapy. Support Care Cancer 2002;10:529-37.
19. Massey CS. A multicentre study to determine the efficacy and patient acceptability of the paxman scalp cooler to prevent hair loss in patients receiving chemotherapy. Eur J Oncol Nurs 2004;8:121-30.
20. van den Hurk CJ, Peerbooms M, van de Poll-Franse LV, Nortier JW, Coebergh JW, Breed WP, *et al.* Scalp cooling for hair preservation and associated characteristics in 1411 chemotherapy patients – Results of the Dutch scalp cooling registry. Acta Oncol 2012;51:497-504.
21. Betticher DC, Delmore G, Breitenstein U, Anchisi S, Zimmerli-Schwab B, Müller A, *et al.* Efficacy and tolerability of two scalp cooling systems for the prevention of alopecia associated with docetaxel treatment. Support Care Cancer 2013;21:2565-73.
22. Cigler T, Isseroff D, Fiederlein B, Schneider S, Chuang E, Vahdat L, *et al.* Efficacy of scalp cooling in preventing chemotherapy-induced alopecia in breast cancer patients receiving adjuvant docetaxel and cyclophosphamide chemotherapy. Clin Breast Cancer 2015;15:332-4.
23. Friedrichs K, Carstensen MH. Successful reduction of

alopecia induced by anthracycline and taxane containing adjuvant chemotherapy in breast cancer – Clinical evaluation of sensor-controlled scalp cooling. Springerplus 2014;3:500.
24. Rice BA, Ver Hoeve ES, DeLuca AN, Esserman LJ, Rugo HS, Melisko ME, *et al.* Registry study to assess hair loss prevention with the penguin cold cap in breast cancer patients receiving chemotherapy. Breast Cancer Res Treat 2018;167:117-22.
25. Shin H, Jo SJ, Kim DH, Kwon O, Myung SK. Efficacy of interventions for prevention of chemotherapy-induced alopecia: A systematic review and meta-analysis. Int J Cancer 2015;136:E442-54.
26. Rugo HS, Voigt J. Scalp hypothermia for preventing alopecia during chemotherapy. A Systematic review and meta-analysis of randomized controlled trials. Clin Breast Cancer 2018;18:19-28.
27. Schaffrin-Nabe D, Schmitz I, Josten-Nabe A, von Hehn U, Voigtmann R. The influence of various parameters on the success of sensor-controlled scalp cooling in preventing chemotherapy-induced alopecia. Oncol Res Treat 2015;38:489-95.
28. Komen MM, Smorenburg CH, van den Hurk CJ, Nortier JW. Factors influencing the effectiveness of scalp cooling in the prevention of chemotherapy-induced alopecia. Oncologist 2013;18:885-91.
29. Rugo HS, Klein P, Melin SA, Hurvitz SA, Melisko ME, Moore A, *et al.* Association between use of a scalp cooling device and alopecia after chemotherapy for breast cancer. JAMA 2017;317:606-14.
30. Nangia J, Wang T, Osborne C, Niravath P, Otte K, Papish S, *et al.* Effect of a scalp cooling device on alopecia in women undergoing chemotherapy for breast cancer: The SCALP randomized clinical trial. JAMA 2017;317:596-605.
31. Paxman System and Clinical Brochure. Available from: https://www.paxmanscalpcooling.com/the-system. [Last accessed on 2018 Feb 03].
32. Roe H. Scalp cooling: Management option for chemotherapy-induced alopecia. Br J Nurs 2014;23:S4, S6, S8.
33. Ridderheim M, Bjurberg M, Gustavsson A. Scalp hypothermia to prevent chemotherapy-induced alopecia is effective and safe: A pilot study of a new digitized scalp-cooling system used in 74 patients. Support Care Cancer 2003;11:371-7.
34. Rugo HS, Melin SA, Voigt J. Scalp cooling with adjuvant/neoadjuvant chemotherapy for breast cancer and the risk of scalp metastases: Systematic review and meta-analysis. Breast Cancer Res Treat 2017;163:199-205.
35. Mols F, van den Hurk CJ, Vingerhoets AJ, Breed WP. Scalp cooling to prevent chemotherapy-induced hair loss: Practical and clinical considerations. Support Care Cancer 2009;17:181-9.
36. National Comprehensive Cancer Network Guidelines. Available from: http://www.nccn.org/professionals/physician_gls/pdf/breast.pdf. [Last accessed on 2016 Dec 17].
37. Komen MM, van den Hurk CJ, Nortier JW, van der Ploeg T, Smorenburg CH, van der Hoeven JJM, *et al.* Patient-reported outcome assessment and objective evaluation of chemotherapy-induced alopecia. Eur J Oncol Nurs 2018;33:49-55.
38. Vasconcelos I, Wiesske A, Schoenegg W. Scalp cooling successfully prevents alopecia in breast cancer patients undergoing anthracycline/taxane-based chemotherapy. Breast 2018;40:1-3.
39. Peck HJ, Mitchell H, Stewart AL. Evaluating the efficacy of scalp cooling using the penguin cold cap system to reduce alopecia in patients undergoing chemotherapy for breast cancer. Eur J Oncol Nurs 2000;4:246-8.
40. Lemieux J, Provencher L, Perron L, Brisson J, Amireault C, Blanchette C, *et al.* No effect of scalp cooling on survival among women with breast cancer. Breast Cancer Res Treat 2015;149:263-8.
41. Sehouli J, Fotopoulou C, Erol E, Richter R, Reuss A, Mahner S, *et al.* Alopecia as surrogate marker for chemotherapy response in patients with primary epithelial ovarian cancer: A metaanalysis of four prospective randomised phase III trials with 5114 patients. Eur J Cancer 2015;51:825-32.
42. Nangia J. Quality of life matters: It is time to integrate scalp cooling in routine clinical practice. J Oncol Pract 2018;14:157-8.
43. Shaw JM, O'Brien J, Chua S, De Boer R, Dear R, Murray N, *et al.* Barriers and enablers to implementing scalp cooling in Australia: A qualitative study of health professionals' attitudes to and experience with scalp cooling. Support Care Cancer 2018;26:305-12.