Hair loss (alopecia) from chemotherapy is one of the most feared side effects of many patients, particularly women. Many patients and their healthcare providers believe that cryotherapy can help prevent or mitigate these changes. Scalp cooling has been used for more than 30 years to prevent alopecia caused by chemotherapy, particularly taxanes and anthracyclines. This article presents an overview of the evidence for this strategy, as well as its impact on nursing care provision.

**AT A GLANCE**
- Alopecia is a distressing side effect of chemotherapy that affects men and women.
- The U.S. Food and Drug Administration approved one device (the Dignicap® system) to reduce the incidence of hair loss related to chemotherapy.
- The use of scalp cooling devices requires additional chair time that may affect patient flow in chemotherapy units.

**Scalp Cooling**

The prevention of chemotherapy-induced alopecia

Anne Katz, PhD, RN, FAAN

Susan, a patient who will undergo chemotherapy for treatment of ovarian cancer, requests a meeting with the unit manager to discuss her wish to use a scalp cooling device to prevent hair loss from chemotherapy. The manager of the unit is unsure whether her request can be accommodated. She does not know how useful it will be in preventing hair loss and has concerns about the impact it might have on patient flow through the unit, as well as on nursing resources.

Hair loss is one of the sentinel side effects of chemotherapy that is feared by many individuals with cancer (Lemieux, Maunsell, & Provencher, 2008). Many patients and their healthcare providers believe that cryotherapy can help prevent these changes. Scalp cooling has been used for years to prevent chemotherapy-induced alopecia, but what evidence supports its use?

Women who are distressed by hair loss also tend to be depressed and have lower emotional, role, and social functioning (Choi et al., 2014). Although it is often assumed that alopecia affects women worse than men, men report distress with hair loss, particularly body hair, compared to women, who report distress with loss of hair on the head, as well as the eyebrows and eyelashes (Hilton, Hunt, Emslie, Salinas, & Ziebland, 2008).

The degree of alopecia is, in part, dependent on medication dose, as well as whether it is used with other chemotherapeutic agents (Breed, 2004). One scalp cooling device, the Dignicap® system, was approved by the U.S. Food and Drug Administration in December 2015. The system has sensors that measure the scalp temperature, as well as two independent cooling systems that allow the coolant to flow through the front and back separately (see Figure 1). The caps are attached to a unit, and users do not need to change caps during treatments, as is required for other devices, such as Penguin Cold Caps. Hair loss is most frequently graded using either the World Health Organization Toxicity scale grading system or the Dean scale (see Table 1); some studies measure the success or failure of cryotherapy by whether a wig or head covering is deemed necessary by the patient.

**Review of the Literature**

A PubMed search was conducted using the keywords scalp cooling, alopecia, and prevention of chemotherapy-induced alopecia, and three studies using the Dignicap system were reviewed. In addition, four reviews of the effectiveness of scalp cooling have been published. The earliest (Grevelman & Breed, 2005) concluded that, although scalp cooling appears effective, particularly for patients receiving taxanes or anthracyclines, the 53 studies reviewed were small and poorly designed. The authors noted that great variation exists in scalp cooling success rates, which may be related to different cooling times and temperatures, as well as different chemotherapy regimens. A more recent review (Komen, Smorenburg, van den Hurk, & Nortier, 2013) of 32 studies revealed the same conclusions. Kadakia, Rozell, Butala, and Loprinzi (2014) included eight studies...
on scalp cooling in their review of cryo-therapy and concluded that additional research is needed, as well as more user-friendly methods for scalp cooling. Shin, Jo, Kim, Kwon, and Myung (2014) conducted a systematic review and meta-analysis of eight randomized trials and nine controlled clinical trials with a total of 1,098 participants (616 receiving the intervention and 482 controls). They found that scalp cooling significantly reduced the risk for alopecia (relative risk = 0.38, 95% confidence interval [0.32, 0.45]).

One study reported 100% protection from alopecia in all 74 patients (Ridderheim, Bjurberg, & Gustavsson, 2003). Another study reported more than 50% alopecia in 49% of the participants (Ekwall, Nygren, Gustafsson, & Sorbe, 2013), and, similarly, in another study of the Dignicap system (Friedrichs & Carstensen, 2014), 52.6% of participants experienced less than 50% hair loss.

Temperature of Scalp Cooling Device
A modeling study of optimal temperature to reduce alopecia (Pliskow, Mitra, & Kaya, 2016) suggested that the thermal resistance of the hair/air layer has a significant effect on the eventual temperature of the skin and tissue of the head. The hair follicle needs to be cooled to 22°C to reduce the risk for hair loss, so the cooling power of any device needs to be greater than this to reduce loss of cooling during use.

Adverse Events
Risk for injury to the scalp does exist with these devices, particularly if they are used improperly. In Belum et al.'s (2016) case study of four patients who developed thermal injury from scalp cooling, three of the patients used the Penguin Cold Caps and one used the Elasto-Gel hypothermia cap. The injuries were rated grade 1 or 2 in severity and resolved with the cessation of scalp cooling and topical treatment of the injury. Some of these patients improvised alternatives to wearing a moleskin, which is usually used under the Penguin Cold Caps.

Scalp Metastases
Concerns about the risk for scalp metastases have also been raised. Lemieux, Amireault, Provencher, and Maunsell (2009) conducted a retrospective study of women with breast cancer and found the incidence of scalp metastases to be 1.1% (6 of 535 cases) in women who used scalp cooling compared to 1.2% of women who did not (1 of 87). Median follow-up was 5.8 years in this study. In a case study of two patients who developed scalp metastases after scalp cooling (Lemieux, Desbiens, & Hogue, 2011), one woman was diagnosed with a primary scalp metastasis nine years after treatment and the other was diagnosed seven years after treatment; the latter used scalp cooling during just one chemotherapy cycle. In a review of the incidence of scalp metastases in women with breast cancer by van den Hurk et al. (2013), the conclusion was drawn that the incidence is so low in women with breast cancer that scalp cooling can be provided without the risk of this rare occurrence. The most common side effects of scalp cooling are headache, intolerance, and, rarely, tissue damage.

Impact on Oncology Nursing Resources
Any of these systems require significant “chair time” before and particularly after administration of chemotherapy, depending on the chemotherapy agent administered. On average, this amounts to 30 minutes before the treatment begins and 45 minutes to 3 hours after completion of chemotherapy infusion.

Preparation of the patient’s hair is necessary before using these devices. No specific evidence-based protocol exists for scalp cooling preparation; the instructions appear to come from anecdotal patient experience. Wetting the hair is thought to improve the conduction of cooling to the scalp. No rationale for using conditioner on the hair is documented; however, some instructions for patients suggest combing

### TABLE 1. ALOPECIA GRADING SCALES

<table>
<thead>
<tr>
<th>GRADE</th>
<th>WHO TOXICITY</th>
<th>DEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No change</td>
<td>0%–25%</td>
</tr>
<tr>
<td>1</td>
<td>Minimal loss</td>
<td>25%–50%</td>
</tr>
<tr>
<td>2</td>
<td>Moderate, patchy</td>
<td>50%–75%</td>
</tr>
<tr>
<td>3</td>
<td>Complete, reversible</td>
<td>75%–100%</td>
</tr>
<tr>
<td>4</td>
<td>Complete, reversible</td>
<td></td>
</tr>
</tbody>
</table>

WHO—World Health Organization
Note. Percentages indicate degree of hair loss.
Note. Based on information from Dean et al., 1979; Miller et al., 1981.

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FIGURE 1.
DIGNICAP® SCALP COOLING SYSTEM

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"No specific evidence-based protocol exists for scalp cooling preparation; the instructions appear to come from anecdotal patient experience."

a small amount of conditioner through the hair before using the device.

Postcooling instructions include taking special care of the hair. Patients should avoid warming or rubbing the scalp for one to three days after treatment, as well as being in warm or hot baths, saunas, and swimming pools. They should not wash their hair for two to three days after treatment, avoid using a hair dryer, use a gentle shampoo and conditioner, and avoid vigorous brushing of hair. Patients need to be educated about this before starting the scalp cooling treatment and potentially reminded after each treatment.

**Conclusion**

Despite the lack of large-scale studies in the United States and strong evidence to support its use, scalp cooling is often requested by patients or recommended by oncology care providers to prevent alopecia. However, using this procedure appears to afford some protection against hair loss, albeit with increased nursing resources and chair time. Perhaps what this procedure offers with greater certainty is hope that hair loss can be prevented and, along with it, less distress and alterations in body image and quality of life for survivors.

**Anne Katz, PhD, RN, FAAN,** is a clinical nurse specialist at the Manitoba Prostate Centre and a sexuality counselor for the Department of Psychosocial Oncology at CancerCare Manitoba, both in Winnipeg, Manitoba, Canada. Katz can be reached at drnnekatz@gmail.com, with copy to CJONEditor@ons.org.

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**REFERENCES**


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