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Case report

Herbalism

Management of basal cell carcinoma of the skin using frankincense (*Boswellia sacra*) essential oil: a case report

KM Fung[1,2,3], MM Suhail[4], B McClendon[2], CL Woolley[5], DG Young[5], HK Lin[2]*

Abstract

Introduction

Basal-cell carcinoma (BCC) is the most common form of skin cancer. Incidence of BCC is rising rapidly worldwide associated with a significant increase in health care costs. Various treatment options are available for patients diagnosed with BCC ranging from surgery, electrodessication, radiation, photodynamic therapy to non-invasive therapeutic approaches. Traditionally being used for aromatherapy, based on the abundance of highly volatile, aromatic compounds, frankincense essential oil prepared by hydrodistillation of *Boswellia sacra* gum resins, also possesses anti-cancer activity that can potentially provide non-surgical and non-invasive treatment option for BCC by topical application. This case report discusses the management of BCC of the skin using frankincense (*Boswellia sacra*) essential oil.

Case report

We present a case of a male patient, with two foci (arm and chest) of BCC, treated with local and topical application of frankincense essential oil several times a day, for a period of 20 weeks. Biopsies were performed before and after frankincense essential oil treatment. Pathological study demonstrated total resolution of the BCC on the arm and substantial resolution in the BCC of the chest after treatment. Significant increase in apoptotic cells was observed in the residual carcinoma in the chest. Topical application of frankincense essential oil did not cause redness, swelling, erosion, crusts, vesicles, squamae, itching, tingling, or any other local or systemic side effects in this patient.

Conclusion

Local application of frankincense essential oil may provide a non-surgical treatment alternative, with no or minimal side effect for carcinoma *in situ*, minimally invasive carcinoma and pre-cancerous conditions such as actinic keratosis. A study with larger number of patients with both squamous-cell carcinoma and BCC is required to confirm our current findings.

* Corresponding author
Email: hk-lin@ouhsc.edu

[1] Department of Pathology, University of Oklahoma Health Sciences Center, Oklahoma City, OK 73104, USA
[2] Department of Urology, University of Oklahoma Health Sciences Center, Oklahoma City, OK, 73104, USA
[3] Oklahoma City Veterans Medical Center, Oklahoma City, OK 73104, USA
[4] AYUB S42 Research, New Salalah, Dhofar State 211, Sultanate of Oman
[5] Young Living Essential Oils, Lehi, Utah, UT 84043, USA

Introduction

Skin cancer is the most prevalent form of all cancers with basal-cell carcinoma (BCC) as the most common form. It is estimated that every year more than 2 million cases of BCC are diagnosed in the United States[1]. In addition, because of the growing incidence of BCC worldwide[2,3], it becomes an important health issue in health care costs[4]. Although the majority of BCC grows slowly and rarely spreads to other parts of the body[5], BCC can cause significant local destruction and disfigurement by invading surrounding tissues. Patients may also experience recurrent, locally advanced, or metastatic BCC[6,7]. Several treatment options, including surgical interventions and non-surgical alternatives, have been used to treat localised and advanced BCC[8-10].

Aromatic gum resins, obtained from trees of the genus *Boswellia* (family Burseraceae), also known as frankincense, have been used in ayurvedic and traditional Chinese medicine to treat a variety of health-related issues. Gum resins of *Boswellia* species contain active ingredients that have potent anti-cancer activity. Frankincense extracts have been shown to suppress tumour development and induce tumour apoptosis in animal models[11,12]. In a human clinical study, an extract prepared from *Boswellia serrata* reduces cerebral oedema with anti-cancer activity in patients irradiated for brain tumours[13]. Although frankincense essential oils, obtained from hydrodistillation of gum resins, have been classically used in aromatherapy, we have demonstrated that frankincense essential oil prepared from the chemical-free extraction method possesses anti-tumour activity in suppressing proliferation and inducing apoptosis of various human cancer cell lines in cultures and in an animal model[14-16].

In this case report, we present a case of local application of frankincense essential oil, prepared from *Boswellia sacra* obtained by an optimised hydrodistillation condition on two separate BCCs in one patient, leading to total resolution of one tumour and substantial reduction in tumour size in another lesion, with no detectable side effects. We suggest that frankincense essential oil can be an effective non-surgical treatment option for BCC.

Case report

A 56-year-old man presented to his doctor, with a skin lesion on

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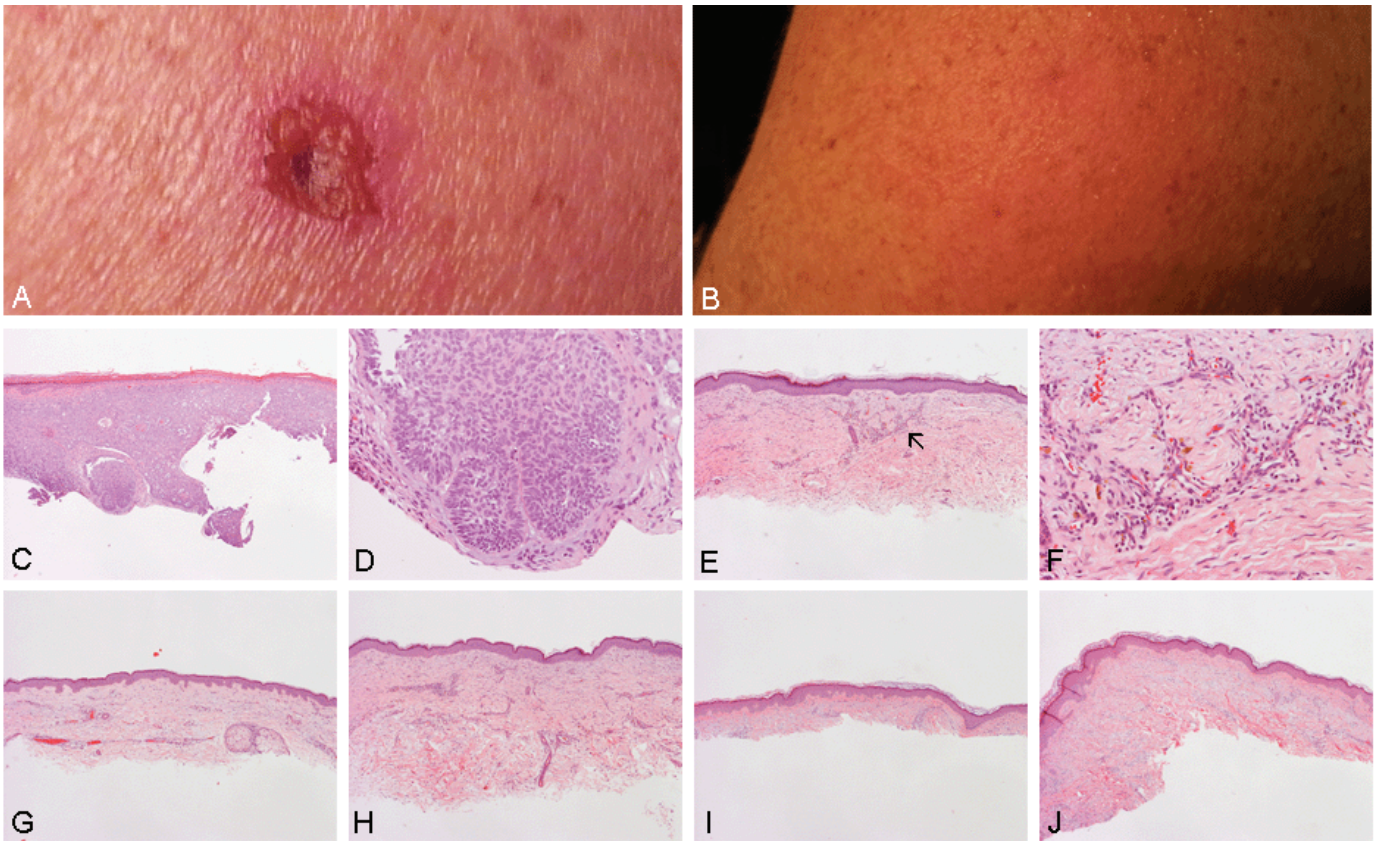

Figure 1: Carcinoma on the arm. (A) Original lesion before treatment. (B) Image taken at three months and one week of local application of frankincense essential oil and the lesion has completely disappeared. (C) and (D) A biopsy performed before treatment, which shows BCC with nodular growth pattern. (E–J) Serial sections of the biopsy performed after treatment shows extensive scar formation, but no residual BCC. A small amount of inflammatory cells (arrow in E) is present and is illustrated in higher magnification in (F).

his left upper arm (Figure 1A) and right chest (Figure 2A). He claimed that the lesions were present from several months. These lesions were neither itchy nor painful. The patient had a history of squamous-cell carcinoma three years ago with surgical treatment. There was no family history of skin cancer or melanoma. Shaved biopsy was performed on both lesions. The lesion on the arm was diagnosed as nodular BCC (Figures 1C and 1D), and the lesion on the chest was diagnosed as BCC with superficial, nodular and infiltrative growth pattern (Figures 2D and 2E). Both specimens showed incomplete excision with residual BCC remaining in the patient. The pathology slides were reviewed by a separate board-certified anatomic pathologist (Dr. KM Fung), who confirmed the diagnosis.

Management and outcome

Topical application of frankincense essential oil hydrodistillate was applied several times a day to both lesions over a period of four months. At the end of the treatment, BCC on the arm had completely resolved (Figure 1B) and smooth healing of skin was observed. Biopsy material obtained from this area demonstrated only focal and mild, chronic inflammatory cell infiltration (Figures 1E and 1F) and scar formation, with no detectable residual BCC (Figures 1E–1J).

The lesion on the chest showed progressive shrinkage on gross examination during the course of treatment (Figures 2B and 2C). By the end of the treatment, the original lesion had shrunken to about 20% of the original size (Figure 2C). Histological examination demonstrated extensive scar formation. A residual focus of BCC (Figures 2F and 2G) that measured 1.3 mm in greatest dimension on glass slides was identified. This focus was estimated to comprise approximately 10% of the volume of the biopsy material on histological slides. A substantial amount of pyknotic/apoptotic cells were observed in this post-treatment lesion (arrow and inset in Figure 2G) in comparison to the original biopsy (Figure 2E), where only scant pyknotic/apoptotic cells were seen. Although an infiltrative component was present in the original biopsy, the post-treatment biopsy was largely composed of nodular BCC.

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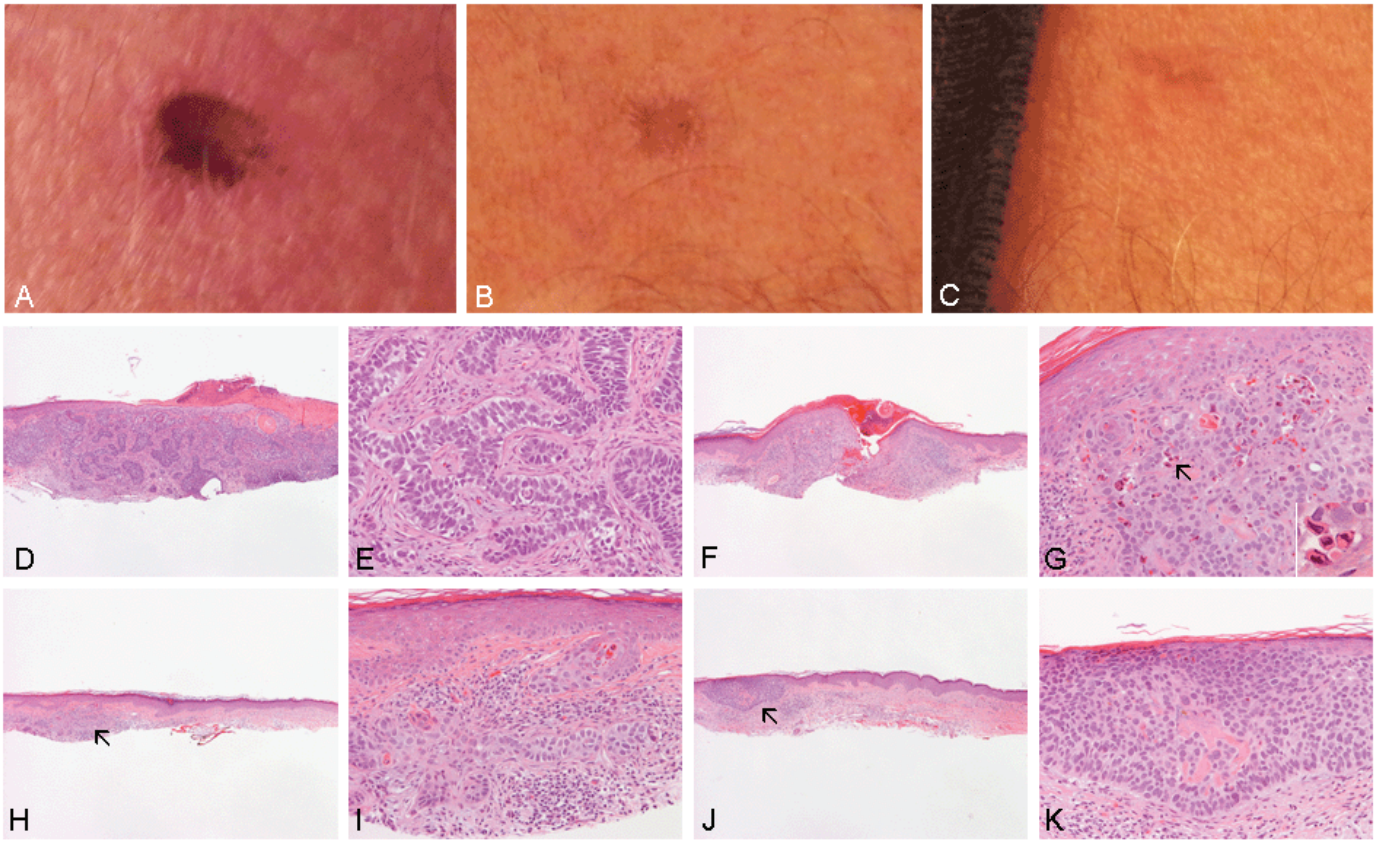

Figure 2: Carcinoma on the chest. (A) Original lesion before treatment. (B) and (C) Images of lesion taken at three and four months after treatment, respectively, show progressively regression. (C) and (D) A biopsy taken before treatment shows BCC with an infiltrative growth pattern. (F–K) Serial sections are performed in the post-treatment lesion. Many pyknotic/apoptotic cells (arrow and inset in G) are present. Note that the residual BCC (arrows in (H) and (J) are located adjacent to areas with extensive scarring.

Discussion

Superficial BCC is commonly treated with topical non-surgical therapies. Conservative treatments, including photodynamic therapy and topical medications, are available for patients diagnosed with BCC. Two topical medications have been approved by the Food and Drug Administration (FDA) for treating BCC, imiquimod and fluorouracil. The 5% imiquimod cream is applied topically for six weeks or longer, with response rates between 80% and 90%; and the 5% fluorouracil cream is applied twice a day for 3–6 weeks, with response rates greater than 80%[9]. All treatment characteristics are significant determinants of treatment choice, and there is significant variability in the population preferences for either of these treatments[17]. In addition to chance of clearance and cost associated with these treatment options, patients are often concerned about cosmetic outcomes and side effects they might experience.

Frankincense gum resins have been used as a component in anti-cancer drugs in traditional Chinese medicine. We have optimised hydro-distillation conditions to prepare frankincense essential oil from *Boswellia sacra* gum resins with potent anti-cancer activity. We observed that frankincense essential oil can possess potent growth suppression activity and apoptosis induction, specifically in cultured human bladder, breast, colon and pancreatic cancer cells versus their normal counterparts[15,16]. Frankincense essential oil-modulated anti-tumour activity is also observed in a heterotopic xenograft human pancreatic cancer mouse model[14]. Our observation of the current case study using topical application of frankincense essential oil for treating BCC is in agreement with a previous news report that frankincense essential oil distilled from *Boswellia carterii* gum resins is effective in treatment of malignant melanoma in horses[18]. More importantly, topical application of frankincense essential oil did not cause side effects during the entire course of the treatment, as described in cases treated with other topical applications, such as imiquimod, fluorouracil and photodynamic therapy with redness, swelling, erosion, crusts, vesicles, squamae,

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itching and tingling[9]. The low adverse effects of frankincense essential oil is consistent with a previous report that chemical extraction of *Boswellia serrata* gum resins has no detectable severe adverse effects after being administered to patients irradiated for brain tumours[13].

The anti-cancer activity of frankincense essential oil may result from a combination of anti-proliferative and pro-apoptotic activities. Frankincense essential oil-induced growth inhibition may be due to suppressed phosphatidylinositol-3-kinase/protein kinase B (PI3K/Akt) activation and cell cycle progression with simultaneous elevated expression of growth arrest genes[16]. Frankincense essential oil-induced apoptosis is caspase-dependent based on the cleavages and activation of caspase-3, -8, -9 and poly (ADP-ribose) polymerase (PARP) in various human cancer cell lines[14,15]. BCC response to topical frankincense essential oil administration with elevated apoptosis is consistent with our observations in various experimental models.

Anti-cancer potency of frankincense essential oil depends upon methods of distillation and chemical compositions of final products. In an ongoing phase II clinical trial, a chemical extract of *Boswellia* species gum resins is studied as an adjuvant agent in patients with high-grade gliomas with emphasis on boswellic acids[13]. Although boswellic acids have been considered as a major component in the gum resins of *Boswellia* species, responsible for frankincense extracts-mediated anti-tumour activity[19-26], we reported that compounds other than boswellic acids might be equally or more important in frankincense essential oil-modulated anti-cancer activity. With a complex chemical constituent in frankincense essential oil, many components may work synergistically to provide a potent anti-cancer activity. Although it might not be easy to isolate a group of compounds working synergistically, it is important to identify a signature compound(s) that assures consistent biological and anti-cancer activities in the future.

Vismodegib, the first oral treatment for BCC, was recently approved for the treatment of patients with locally advanced or metastatic BCC, whose cancer was refractory to standard treatments or who were not candidates for surgery or radiation. The most common adverse effects of vismodegib include mild-to-moderate hair loss, muscle cramps, taste disturbance and weight loss. The estimated cost of one month of treatment with vismodegib is 7,500 USD[10]. Our preliminary results showed that the abundance of high-molecular-weight compounds is positively correlated with frankincense essential oil-induced cytotoxicity in cultured human cancer cell lines (data not shown). More importantly, this formula has significantly reduced adverse effects, including light-headedness, gastrointestinal irritation, or diarrhoea after oral administration (data not shown). The formula that contains more abundant high-molecular-weight compounds might be useful for treating advanced or metastasised BCC through oral administration.

Conclusion

Frankincense essential oil obtained from hydrodistillation of *Boswellia* species gum resins possesses anti-cancer properties by modulating multiple signalling pathways and activating caspase-dependent apoptosis in cancer cells. With more understanding of biological compounds and mechanistic actions, frankincense essential oil can be a safe and effective alternative therapeutic agent for treating BCC through topical administration.

Abbreviation list

BCC, basal-cell carcinoma.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

CW and GY are affiliated with Young Living Essential Oils. The rest of the authors declared that they have no competing interests.

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