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Management of locally aggressive mandibular tumours using a gas combination cryosurgery

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ABSTRACT

This study evaluated the results of curettage followed by cryosurgery using a combination of propane, butane, and isobutane gas for several benign but locally aggressive bone tumours on the mandible. Twenty-nine patients (16 men and 13 women) participated in the study. Patient ages ranged from 6 to 87 years (mean, 23.72 years). Before enucleation and cryosurgery, some patients received prior treatment consisting of marsupialisation to decrease tumour size. Twenty-seven of the 29 patients (93.10%) showed no evidence of clinical or radiographic recurrence after treatment through enucleation and cryosurgery. Wound dehiscence, which was observed in all cases, healed by second intention. The average follow-up period was 70.55 months (range, 53–120 months). These results suggest that enucleation followed by cryosurgery is an effective therapy for managing locally aggressive mandible tumours. In addition, this treatment is a less expensive intervention than more radical procedures.

1. Introduction

Ameloblastoma, myxoma, keratocystic odontogenic tumour, central giant cell lesions, and fibro-osseous lesions are benign yet aggressive and locally recurrent lesions that affect the maxillofacial region (Salmassy and Pogrel, 1995).

Because conservative treatment may lead to an unacceptable rate of recurrence and radical treatment may compromise function and aesthetics, management of these lesions remains controversial (Salmassy and Pogrel, 1995).

Cryosurgery is an alternative treatment modality for locally aggressive instead of invasive lesions (Emmings et al., 1966; Bradley and Fisher, 1975; Curi et al., 1997; Veth et al., 2005; Gage and Baust, 2007). This method uses freezing to induce tissue necrosis (Veth et al., 2005).

Veth et al. (2005) provided an excellent review based on their considerable experience in treating 302 patients with diverse bone and soft tissue tumours. Cryosurgically treated patients included 43 with giant cell tumours, 15 with chondroblastoma, 73 with borderline chondrosarcoma, and 44 with grade I chondrosarcoma. In a 2-year follow-up study, 96–100% of patients were disease free, although some patients required repeated treatments.

Several studies have reported successful management of ameloblastomas (Pogrel, 1993; Salmassy and Pogrel, 1995; Curi et al., 1997; Fregnani et al., 2010), myxomas (Pogrel, 1993; Salmassy and Pogrel, 1995; Rocha et al., 2009), keratocystic odontogenic tumours (Jensen et al., 1988; Bradley and Fisher, 1975; Pogrel, 1993; Salmassy and Pogrel, 1995; Schmidt and Pogrel, 2001), and central giant cell lesions (Webb and Brockbank, 1986; Pogrel, 1993) with cryosurgery using liquid nitrogen application.

Central giant cell lesions are benign tumours of the jaws. Therapeutic options have varied greatly over the years (Tosco et al., 2009). The traditional treatment for this lesion is curettage and resection (Shirani et al., 2011), but alternative therapies such as injection of corticosteroids in the lesion or subcutaneous administration of calcitonin or interferon alpha are described in several case reports, with variable success (de Lange et al., 2007). Furthermore, Webb and Brockbank (1986) reported successful treatment of an aggressive giant cell lesion of the mandible with curettage and cryotherapy.

Schmidt and Pogrel (2001) retrospectively evaluated 26 keratocystic odontogenic tumours treated with a combination of enucleation and liquid nitrogen cryotherapy. During the follow-up

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period (average, 3.5 years; range, 2–10 years), 23 of 26 (88.5%) patients showed no evidence of clinical or radiographic recurrence.

Rocha et al. (2009) described a case of a recurrent mandibular myxoma treated with excision and curettage following liquid nitrogen cryotherapy. After 10 years of postoperative follow-up, the patient showed no clinical or radiographic signs of lesion recurrence.

Curi et al. (1997) evaluated 36 solid ameloblastomas of the jaw treated with curettage followed by liquid nitrogen cryosurgery. Local recurrence was observed in 11 (30.6%) patients. Postoperative complications were wound dehiscence (5.5%), paraesthesia (5.5%), infection (5.5%), and pathologic fracture (11.1%). Despite complications in some cases, the authors suggested that curettage followed by cryosurgery decreases rate of local recurrences and reduces the initial indication of resection with continuity defects.

Data suggest that additional treatment with liquid nitrogen helps to decrease rates of recurrences in comparison to treatment with curettage alone, especially for lesions with histories of recurrence (Schmidt and Pogrel, 2001). Other indications for liquid nitrogen treatment include large and complex mandibular lesions, in which enucleation of the cyst lining might be difficult, and lesions in which conventional management might involve vital structures, such as the inferior alveolar nerve (Schmidt, 2003).

The aim of this treatment modality is to destroy cells associated with the lesion (Schmidt, 2003). During cryosurgery, cell and tissue death results from intracellular and extracellular ice crystal formation, osmotic and electrolyte disturbances, denaturing of lipid–protein complexes, and vascular stasis (Farrant, 1965; Whittaker, 1984; Schmidt, 2003).

Cryosurgery produces cellular necrosis in bone while maintaining the inorganic osseous framework (Emmings et al., 1966; Bradley and Fisher, 1975). However, this method weakens the bone and increases the risk of pathologic fracture, a phenomenon observed both clinically and experimentally (Fisher et al., 1977; Pogrel, 1993).

Tissues freeze at approximately −2.2 °C (Schmidt, 2003). Temperatures below −20 °C are believed to cause cell death (Smith and Fraser, 1974; Gage et al., 2009). Liquid nitrogen boils at −196 °C (Salmassy and Pogrel, 1995). The mixture of propane, butane, and isobutane gas, which is used to perform endodontic tests, reaches −50 °C. The aim of this study was to evaluate the effectiveness of this gas combination in patients with locally aggressive mandibular bone tumours.

2. Materials and methods

This retrospective review was approved by the ethical committee of the University Hospital João de Barros Barreto, Federal University of Pará. Consent was obtained through a written document explaining in detail the procedures to be performed and was signed by each patient who participated in the study.

Twenty-nine patients (16 men and 13 women) participated in the study. The average patient age was 23.72 years (range, 6–87 years). Diagnoses included ameloblastoma ($n = 10$), keratocystic odontogenic tumour ($n = 9$), myxoma ($n = 5$), central giant cell lesion ($n = 2$), neurofibroma ($n = 2$), and tumour of Pindborg ($n = 1$).

Most tumours were located on the mandible: 9 involved the body (right side, 5; left side, 4), 12 involved the ramus (right side, 8; left side, 4), and 4 involved both the body and ramus (right side, 1; left side, 3). Two tumours were observed on the chin (Table 1).

Each patient was treated by the same surgeon using a standardized technique. Before enucleation and cryosurgery, cystic lesions were marsupialised to decrease the tumour size. This

Table 1
Site distribution, subtype, sex, age, follow-up, recurrence, pathological fracture, infection and wound dehiscence in locally aggressive mandibular tumours treated with cryosurgery using combination propane, butane, and isobutane gas.

Lesion	Site	Sex	Age (years)	Follow-up (months)	Recurrence	Pathological fracture	Infection	Wound dehiscence
Ameloblastoma solid	Right body and ramus	F	20	72	No	No	No	Yes
Ameloblastoma cystic	Left body and ramus	F	18	60	No	No	No	Yes
Ameloblastoma cystic	Right ramus	M	24	60	No	No	No	Yes
Ameloblastoma cystic	Left ramus	M	07	120	No	No	No	Yes
Ameloblastoma solid	Left body and ramus	M	45	67	No	No	No	Yes
Ameloblastoma solid	Chin	F	16	86	No	No	No	Yes
Ameloblastoma solid	Left ramus	M	26	60	No	No	No	Yes
Ameloblastoma cystic	Right ramus	F	21	60	No	No	No	Yes
Ameloblastoma cystic	Left ramus	M	46	66	No	No	No	Yes
Ameloblastoma solid	Right ramus	F	87	74	No	No	No	Yes
Keratocystic odontogenic tumour	Left ramus	M	15	54	No	No	No	Yes
Keratocystic odontogenic tumour	Left ramus	F	32	54	No	No	No	Yes
Keratocystic odontogenic tumour	Right ramus	F	13	55	No	No	No	Yes
Keratocystic odontogenic tumour	Left body	M	32	108	No	No	No	Yes
Keratocystic odontogenic tumour	Multiple	F	12	120	Yes	No	No	Yes
Keratocystic odontogenic tumour	Multiple	F	13	54	No	No	No	Yes
Keratocystic odontogenic tumour	Right ramus	M	35	54	No	No	No	Yes
Keratocystic odontogenic tumour	Right ramus	F	33	54	Yes	No	No	Yes
Keratocystic odontogenic tumour	Right ramus	M	16	66	No	No	No	Yes
Myxoma	Left body and ramus	M	26	54	No	No	No	Yes
Myxoma	Chin	F	23	93	No	No	No	Yes
Myxoma	Right body	M	27	58	No	No	No	Yes
Myxoma	Right body	M	08	62	No	No	No	Yes
Myxoma	Left body	M	06	54	No	No	No	Yes
Central giant cell lesion	Left body	F	15	54	No	No	No	Yes
Central giant cell lesion	Right body	M	11	53	No	No	No	Yes
Neurofibroma	Right ramus	M	26	99	No	No	No	Yes
Neurofibroma	Right ramus	M	12	86	No	No	No	Yes
Pindborg	Left body	F	23	89	No	No	No	Yes
Total	–	–	**Mean**	**Mean**	–	–	–	–
29			**23.72**	**70.55**				