Carnoy's in Aggressive Lesions: Our Experience

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Abstract Carnoy's solution is used in the treatment of various aggressive cysts and tumors in the maxillofacial region as a chemical cauterizing agent. Its use has been extensively studied in case of odontogenic keratocysts. It is used in the management of unicystic ameloblastomas and ossifying fibromas. In our institution from 2006 to 2010 we have treated 14 cases of maxillofacial lesions using Carnoy's solution. Among these cases 7 were of odontogenic keratocyst, 4 cases were of ameloblastoma and one case was of juvenile ossifying fibroma. So here we share our experience of treating these lesions with the Carnoy's solution.

Keywords Carnoy's solution · Ameloblastoma · Odontogenic keratocyst · Juvenile · Ossifying fibroma

Introduction

Carnoy's solution was described in 1933 by Cutler and Zollinger as a sclerosing agent in the treatment of cysts and fistulae. Carnoy's Solution is composed of 1 g of ferric chloride (FeCl_3) dissolved in 6 mL of absolute alcohol, 3 mL of chloroform, 1 mL of glacial acetic acid [1, 2]. It has been used in the treatment of various cysts and tumors in the maxillofacial region for the chemical cauterization procedure following enucleation of the lesion. Its use in the treatment of odontogenic keratocyst is thoroughly studied

[3]. Its use in the treatment of unicystic ameloblastoma and in ossifying fibroma is also reported in the literature. It is likely that the use of Carnoy's solution does contribute towards the favourable result in terms of morbidity and recurrence rate of the lesion. So we want to share our experience with the Carnoy's solution in treating various cysts and tumors in the maxillofacial region.

Materials and Methods

In our institution from 2006 to 2010 we have treated 12 cases of maxillofacial lesions using Carnoy's solution as a chemical cauterizing agent after enucleation or curettage. Among these cases 7 were of odontogenic keratocyst, 4 cases were of ameloblastoma and one case was of juvenile ossifying fibroma (Table 1).

In patients with odontogenic keratocyst, the age of the patients ranged from 17 to 65 years with the mean age of 41 years. Among these 5 were males and 2 females and the site of the lesion was posterior mandible in 5 cases, anterior mandible in one case and anterior maxilla in another case. All lesions were treated by enucleation and application of Carnoy's solution (Figs. 1, 2, 3). In 4 cases of ameloblastoma the age of the patients ranged from 14 to 65 years with the mean age of 39.5 years. Among these 3 were males and 1 was female. The lesions were present in the posterior mandible in 3 cases and in the anterior mandible in one case. All the cases were treated by enucleation of the lesion and application of Carnoy's solution. Among these, one case was of plexiform type, one was of acanthomatous type and two were of unicystic ameloblastoma, among unicystic one case showed plexiform type proliferation of the epithelium (Figs. 4, 5, 6). Juvenile ossifying fibroma was reported in a 9 year old boy. It was of trabeculated

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Table 1 Tabular representation of all cases

Sl. no.	Diagnosis after final biopsy	Age/sex	Area of the lesion	Follow up	Recurrences
Case 1	OKC	15 years/male	Right side of body of the mandible	1 year	No recurrence
Case 2	OKC	17 years/female	Right side of anterior maxilla	1 year	No recurrence
Case 3	OKC	17 years/male	Right side of body of the mandible	6 months	Lost to follow up
Case 4	OKC	42 years/male	Left side of posterior mandible	One and half year	No recurrence
Case 5	OKC	46 years/male	Anterior mandible crossing the midline	1 year	No recurrence
Case 6	OKC	51 years/male	Left ramus of the mandible	1 year	No recurrence
Case 7	OKC	65 years/female	Right posterior mandible	1 year	No recurrence
Case 8	Unicystic ameloblastoma	14 years/female	Left posterior mandible	1 year	No recurrence
Case 9	Acanthomatous ameloblastoma	30 years/male	Anterior mandible crossing the midline	6 months	Lost to follow up
Case 10	Plexiform ameloblastoma	60 years/male	Left side of posterior mandible extending into ramus	3 years	No recurrence
Case 11	Unicystic ameloblastoma	65 years/male	Left posterior mandible	6 months	Lost to follow up
Case 12	Juvenile ossifying fibroma	9 years/male	Left angle of the mandible	2 years	No recurrence

Fig. 1 Preoperative radiograph of case of keratocystic odontogenic tumor

variant involving the left angle region of mandible. It was curetted and Carnoy's solution was used as a cauterizing agent (Figs. 7, 8, 9). In all these cases we applied the Carnoy's solution for 3 min and then the defect was irrigated with normal saline [3]. Whenever the inferior alveolar nerve was encountered it was protected during the application of Carnoy's solution. The composition of Carnoy's solution used in our unit is 60 cm³ of absolute ethanol, 30 cm³ of chloroform and 10 cm³ of glacial acetic acid. It is devoid of ferric chloride because of its carcinogenic effect [4]. The follow up period of these cases ranged from 6 months to 3 years with the mean follow up period of one and half year. The radiographs are taken at every 6 months interval. In our cases we have not encountered any recurrences till now. Out of 12 patients 3 are lost to follow up and rest of the patients are still under follow up.

Discussion

Carnoy's solution is a boon in the treatment of various aggressive cysts and tumors in the maxillofacial region. Odontogenic keratocyst which was described by Philipsen in 1956 accounts for 3–10.5 % of all jaw cysts [5–7]. It is now designated by the world health organisation as a keratocystic odontogenic tumor (KCOT). Various treatment modalities for this lesion range from conservative methods like enucleation, curettage and marsupialisation to aggressive modalities like enucleation with adjunctive procedures like peripheral ostectomy, liquid nitrogen cryotherapy or application of Carnoy's solution and resection with or without loss of jaw continuity [5, 8–10]. The reason for these treatment modalities is its high recurrence rate. The recurrence rate of these lesions can range from 25 to 60 %. It is influenced by

Fig. 2 Immediate post operative radiograph of same case as in Fig. 1

Fig. 3 One and half year post operative radiograph of same case as in Fig. 1 showing the formation of bone in between the teeth and periphery of the cavity

Fig. 4 Pre operative radiograph of a case of unicystic ameloblastoma in a 15 year old female

Fig. 5 Immediate post operative photograph of same case as in Fig. 4

Fig. 6 Six months post operative radiograph of the same case as in Fig. 5 showing the bone formation and regaining of the contour of the lower border

many factors including the type of treatment [10]. Though it is accepted fact that the resection of the jaws results in the lowest recurrence rate, this procedure has also got highest morbidity. Even the enucleation with the application of Carnoy's solution can result in a recurrence rate comparable to that of resection without unnecessary aggressive treatment [6–8]. So unless resection is deemed necessary the most appropriate treatment would be enucleation of keratocyst and chemical cauterization with the Carnoy's solution.

Ameloblastomas are categorized broadly into three variants: unicystic, solid and peripheral. Unicystic ameloblastoma has become established as a distinct clinico-pathological entity on the general basis of its unicystic radiographic appearance, histologic findings, association with an unerupted tooth, occurrence in the mandible of younger patients, and a recurrence rate after conservative surgical treatment lower than that of its conventional

counterpart. It is a rare type of ameloblastoma accounting for about 6 % of ameloblastomas [4, 11, 12]. In the literature, recurrence after conservative (non-resection) treatment of conventional ameloblastoma ranges from 50 to 90 %. Recurrence after conservative treatment of unicystic ameloblastoma is reported to be between 10 and 25 % [4, 13]. The use of Carnoy's solution to reduce the morbidity and recurrence rate in relation to unicystic ameloblastoma was initially suggested by Stoelinga and Bronkhorst in 1987 [3]. In our cases two were of unicystic variety and other two were of solid variety. Though the unicystic variant is commonly seen in younger patients, in one of our cases it was seen in 65 year old male patient. The management of unicystic ameloblastoma remains controversial. Though they represent a less aggressive type of ameloblastoma they may be too destructive and infiltrative in their behaviour to respond predictably to local enucleation

Fig. 7 Pre operative radiograph of a case of juvenile ossifying fibroma

Fig. 8 Immediate post operative radiograph of same case as in Fig. 7

Fig. 9 One year post operative radiograph of the same case as in Fig. 8 showing almost complete bone formation in the defect

or curettage. So it will be prudent to treat them by somewhat more aggressive means than enucleation or curettage [12]. So along with enucleation or curettage the application of Carnoy's solution would be a better option. We have used Carnoy's solution even to treat two cases of solid ameloblastomas. In one case of solid ameloblastoma the age of the patient was 60 years. So taking the age into consideration we went for more conservative approach. In another case the lesion was present in the anterior mandible crossing the midline of a 30 year old male patient. Considering again the age and difficulties with the reconstruction of the anterior mandible we went for conservative options. We have used Carnoy's solution even to treat a case of juvenile ossifying fibroma in a 9 year old boy. Juvenile ossifying fibroma is a unique benign fibro-osseous neoplasm. There are two variants of this neoplasm, trabecular and psammomatoid. The average age at diagnosis of psammomatoid seems to be later in life than trabecular variety. Ninety percentage of trabecular type involve the jaw bones whereas only 25 % of psammomatoid type involve jaw bones, 75 % of psammomatoid are seen in orbit, paranasal sinuses and calvaria. Though these lesions behave aggressively and recurrences are seen in 30–50 % of the cases conservative surgical excision is the treatment of choice. The extent of surgical resection should be dictated by the age of the patient, site of the lesion and involvement of surrounding vital structures [14–17]. So we treated our case with curettage and applied Carnoy's solution and till 2 years we have not observed any recurrence. Still the patient is on follow up.

Carnoy's solution has been thoroughly studied in relation to keratocysts and was shown in an animal model to penetrate cancellous bone to a depth of 1.54 mm. So it is likely to penetrate cancellous bone and thus devitalize and fix the remaining tumor cells. Ferich et al. suggested that the application of Carnoy's solution should not exceed 3 min. They showed that the critical time to nerve impairment of the rabbit inferior alveolar nerve was 3 min and it should not be directly applied over the nerve. Though there remains a need for human studies, the use of Carnoy's solution to reduce the recurrence rate should be balanced against the risk of nerve morbidity [5, 13].

Carnoy's solution has made its significance in the treatment of odontogenic keratocysts and type 1 and 2 unicystic ameloblastomas. But its application can even be considered in the treatment of selected solid ameloblastomas and juvenile ossifying fibromas. Here we would like to emphasize the importance of application of Carnoy's solution is to preserve and save the unaffected bone so as to

maintain the normal contour and architecture. We would like to conclude that Carnoy's solution could be considered as a definitive and conservative management procedure in the treatment of these benign but aggressive lesions.

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