ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 5, Issue – 2, March - 2022, Page No. : 394 - 405

Management of mucocele in children - A review

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Citation of this Article: Dr. S.K Srinath, Dr. Sahana Srinath, Dr. Pushpalatha. S, Dr. Aarcha S Kumar, "Management of mucocele in children - A review", IJDSIR- March - 2022, Vol. – 5, Issue - 2, P. No. 394 – 405.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Oral mucocele is one of the most common pathologies found in the pediatric population. Since mucoceles have a high recurrence rate and rarely resolve on their own, proper diagnosis and treatment planning dictates the outcome of successful management. Therefore, surgical removal is the common treatment option. There are several disadvantages of surgical management like pain, trauma, damage to adjacent vital tooth structures, scarring, lip disfigurement, and bleeding. Pediatric behavior management is another perspective that has to be considered during the management of mucocele, especially in children. Therefore, the aim of the review is to outline different treatment options for the management of mucocele.

Keywords: Children, Extravasation, Mucocele, Management, Retention.

Introduction

Mucoceles (also called sialocele and ptyalocele) are mucus-filled cavities of benign, exophytic, soft tissue lesions of the oral cavity that develop following the extravasation or retention of the mucous material from the major or minor salivary glands.[1] They represent the 17th most common lesion of the oral cavity. Mucocele is believed to arise equally in both the sexes[2] and affect patients of all ages, with the highest percentage (70%) occurring in those ranging from 3-20 years old.[3] However, the incidence of mucocele in infants less than 1 year is low (2.7%).[4]

Congenital mucocele, mostly caused by congenital atresia of the salivary duct by trauma to the oral tissues because of intrauterine finger sucking, trauma, trauma while passage through the birth canal, forceps delivery or newborn manipulation by the medical personnel are reported in the literature.[5]

Mucoceles can appear at any site of oral mucosa where salivary glands are present.[4] In young patients, mucous extravasation cyst most commonly arises on the lower lip lateral to the midline[5] as it is more prone to trauma, especially at the premolar level.[6] Similarly, retention mucoceles are usually located in the cheek or palate of older patients.[4] Other common sites for mucocele development involve the soft palate, retromolar region, and dorsum of the tongue.[2] Mucoceles located on the floor of the mouth are termed a 'ranula'. They always originate in the body of the sublingual gland and, less commonly, in the ducts of the rivinus (sublingual gland) or in the warthon's duct (submandibular duct).

Clinical features

Oral mucoceles are relatively rapid in onset, single or multiple, painless, translucent, fluctuant nodule which is usually asymptomatic. Clinically the lesion lies deep in the tissue (classical mucocele) or can be exceptionally superficial (superficial mucocele). The superficial lesion appears as raised, vesicular, well-circumscribed vesicles several mm to cm or more in diameter with a bluish translucent cast. The deeper lesion is manifested also as a swelling but because of the thickness of the overlying tissue, the color and surface appearance is nodular and firm and imitates normal mucosa. Patients usually presents with dome-shaped swelling with a blueish hue due to extravasated mucin. The size of the lesion varies from mm to several cm depending on the location. Smaller lesions appear as a blister. [7,8]

The blueish hue results due to tissue cyanosis, vascular congestion associated with stretching of overlying tissue, and the translucency of the accumulated fluid beneath. The variation in colour depends on the size of the lesion, its proximity to the mucosal surface, and the elasticity of the overlying tissue. Most of the mucoceles are soft while palpating while chronic lesions are firm on palpation due to fibrosis.[9]

The retention phenomena in accessory salivary glands occur frequently on the lower lip but may also occur on the palate, cheek, tongue, and floor of the mouth. Depending upon the location clinical appearance varies. The lesion is common in adults and old age. It occurs both in the minor and major salivary glands but unlike extravasation, involvement of major salivary is common. The parotid gland is most commonly involved where it presents as slowly growing, fluctuant and painless swelling. Those arising from minor glands affect the floor of the mouth, buccal mucosa, and lip.

Mucous retention phenomena are almost always restricted to the lower lip rarely on the upper lip. The mucous retention phenomenon often arises within a few days, reaches a certain size, and persists as such for months unless treated. If contents of the cyst are thick and mucinous.

Ranula is rare compared to usual mucocele develops as slowly enlarging painless mass on one side of the floor of the mouth. The tongue is elevated and when it's large it hides the salivary gland. The lesion is usually deep-seated, and the overlying mucosa is normal in appearance. If superficial, it has a translucent bluish color. A rare plunging supra hyoid type that has herniated through the mylohyoid is also seen.[7]

Etiology

Mucous retention cysts which are common in the major salivary gland are due to ductal obstruction due to

stricture, sialolith, or mucous plug, secondary to periductal scarring or fibrosis and tumour.

Mucus extravasation cyst common in minor salivary gland is caused by traumatic damage to mucosa such as lip biting, lip chewing, mechanical trauma to an excretory duct of salivary gland causing ductal rupture and spillage of mucus into surrounding connective tissue area.[6,10]

Pathogenesis

Extravasation mucoceles are caused by a leaking of salivary secretions from surrounding tissue ducts or acini into surrounding connective tissue causing inflammation. Trauma to the lip stimulates mucosal keratinocytes which in turn secretes pro-inflammatory cytokines like IL-1, IL-6, TNF-alpha inducing neutrophil recruitment and subsequent inflammation. extravasated mucin also activates dermal macrophages which in turn secretes TNF, causing fibroblast proliferation and synthesis of MMP2 and MMP 9 thus causing dermal remodeling.[11]

According to Bagan et al[12] extravasation, mucoceles undergo three evolutionary phases

1. First phase: mucous spills diffusely from the excretory duct into surrounding tissues where some leucocytes and histiocytes are found.
2. Second phase (resorption phase): Foreign body reaction results in granulomas due to histiocytes, macrophages, and giant multinucleated cells
3. Third phase: Connective cells form a pseudo capsule without epithelium around the mucosa.

Diagnosis

Diagnosis is mainly clinical. Pathognomonic appearance, lesion location, history of trauma, rapid appearance, variations in size, bluish color, and the consistency of mucocele aids in diagnosis. Depending on how much tissue is present over the lesion mucoceles can be mobile lesions with soft and elastic consistency. Chronic mucocele shows less fluctuation as they are fibrosed.

Although not commonly used, imaging techniques like USG, CT, and MRI helps to better visualize the form, diameter, position, and determination of the lesion origin, exclude the differential diagnosis, determine the extent of the lesion, and aid in the surgical procedure.[8]

Ultrasonography- high-resolution ultrasonography can detect calculi, abscesses, and cysts, and can even correctly assess up to 90% of benign versus malignant tumours.

CT MRI- in cases of large plunging or cervical ranula that has breached through a defect in the mylohyoid muscle CT and MRI aids in determining the extent of the swelling, for surgical planning.

Fine-needle aspiration biopsy (FNAB)- of mucocele reveals abundant mucosa without epithelial components, and many inflammatory cells, especially histiocytes. chemical analysis shows an increase in amylase and protein content.[12]

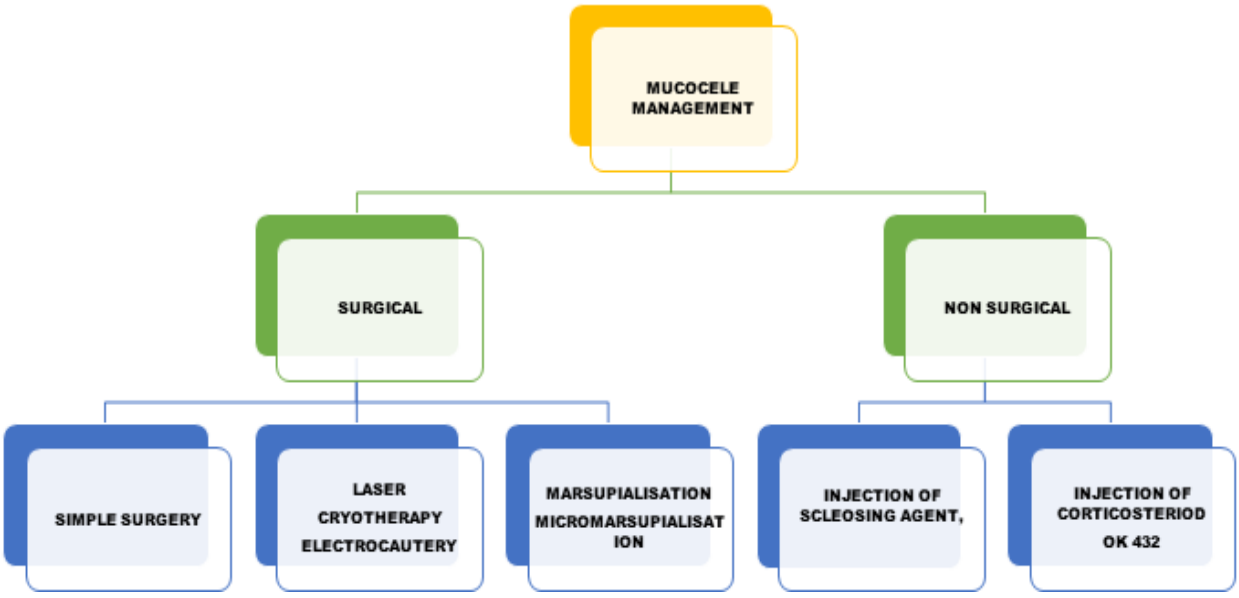
Histopathological features

Histopathologic study is vital to confirm the diagnosis and also to ensure that the glandular tissue is completely removed. Retention cysts are true cysts covered by the epithelium wall covered by flat or cuboidal cells produced from the excretory duct of salivary glands without any inflammation whereas extravasation cysts are pseudocyst without defined walls. The extravasated mucous is surrounded by a layer of inflammatory cells and well encapsulated by a reactive granulation tissue made up of fibroblasts caused by an immune reaction. [13]

Management of oral mucocele

Various treatment modalities are available in the literature for the management of oral mucoceles which range from non-surgical to surgical. [I]

Flow chart: various treatment modalities for the management of mucocele.



Surgical management

The conventional method of surgical excision using a scalpel blade is the treatment of choice in pediatric patients for small and moderate-sized mucoceles. Small lesions can be excised with or without the salivary gland but it is always better to excise with the salivary gland in order to prevent a recurrence. Small lesions are completely excised along with associated salivary gland tissue and any marginal glands before primary closure.[14] Moderate-sized lesions with thin fibrous walls, cannot be surgically excised as it often leads to surgical recurrence. Moderate-sized lesions with thick connective tissue wall can be complete surgical excision of mucocele along with the associated mucus glands and marginal glands before primary closure. Ranula are treated with surgical excision of mucocele with sublingual gland removal to prevent recurrence and formation of plunging ranula.[15] Surgical excision of large mucocele and ranula in the floor of the mouth especially in the paediatric age group may be associated with haemorrhage, injury to lingual nerve, lingual vessels, Wharton's duct, reduced mobility of the tongue. These lesions are were thus treated with simple marsupialization procedures.

Standard technique

A circular incision is made around the lesion, the dissection is continued in the plane adjacent to the capsule down to the muscle layer of lip, and the cyst is removed all minor salivary glands in the field done to the muscle should be excised to prevent recurrence. wound edges are undermined and closed with sutures. Any damage to other glands or ducts during the excision procedure should be avoided to prevent recurrence [15]

Aluko technique

conventional technique involves slit before placement of suture resulting in loss of cyst contents leading to recurrence, making incision edge handling difficult. In order to overcome this disadvantage, a novel method called "Stitch and Stab method" involves placement of suture before cutting the slit on the lesion thereby allowing the maintenance of the patency of the slit. This ensures the decompression of mucocele and continuous drainage until a continuity is established between epithelium of interior and exterior of the mucocele. It is done under topical anaesthesia and is executed by placing 4 successive strokes of the needle with the attached polygalactin 910 suture material in alternatingly

opposing direction such that there will be a total of 8 points at which suture material pierce the roof of the cyst. Therefore, the mucous material will escape through the cut slit and knotted suture is left in place until suture gets absorbed. This technique has shown 100% success rate. It can be easily performed with lower surgical skills, brief time and only needs one suture. There is uneventful healing and also reduces complications of using tissue cutting forceps. In this novel technique direct handling of incision edge is not involved, epithelialisation occurs across the cut slits within few days and continuity of epithelial cover is established between interior and exterior of cyst as the suture holds incised edge apart. [16]

Shira technique

Prior to lesion excision in order to support the fibrous wall of mucocele intralesional injection of hydrocolloid impression material technique was described by Shira in 1962, highlighting its practical advantages. It is easier to remove the cyst wall in its entirety, preserving the integrity of the surrounding tissues in this technique. Gianluca Botticelli reported a case with Shira's technique and recall after 12 months showed no relapse and healing with minimum scarring. [17]

Marsupialisation-alternate modality

Marsupialisation- it is an alternative to conventional surgical modality. Large mucoceles and ranula greater than 1.5 cm are best treated with this technique. Before marsupialisation, ranula should be allowed to mature for several months. During this time period a distinct fibrous lining develops. Roof of the cyst is excised; cavity is drained the mature lining is identified and suture to raw edge of the mucosa. With time circular wound edge contracts and mature mucosa lined pathway forms. During the procedure, submandibular duct is identified and cannulated to prevent traumatic injury and obstruction of submandibular duct.[15]

As this treatment does not eliminate the source of leakage of the mucus into the surrounding tissue, recurrence rate associated with technique is 61 % to 89%. In order to reduce recurrence Baur mash et al suggested insertion of positive pressure gauze into cavity while unroofing. With this, recurrence rate was reduced to 10-12%.

Micro marsupialisation

The technique was first described by Morton and Bartley for the management of ranula. It has a 14% recurrence rate in paediatric population.

It is carried out to drain the accumulated saliva by passing a suture thread along the largest diameter of the lesion. The suture permits formation of an epithelial tract to form in between the surface and the underlying salivary glandular tissues. A study conducted by Girradi et al concluded that micro marsupialisation technique was equally efficacious as surgical excision for treatment of mucocele.[18]

Modified micro marsupialisation

Technique described by Sandrini et al in which multiple sutures are passed through lesion superficially such that the distance between the entry and exit of needle during suture is minimal.[19]

Laser

It is an effective treatment for mucocele excision in pediatric patients as it provides a bloodless, suture less, and well-accepted treatment. Various types of lasers have been used to treat and remove mucoceles such as carbon dioxide (CO_2), erbium, and diode laser. Carbon dioxide laser is effective in the management of pediatric ranulas with limited side effects but recurrent ranulas are best treated with surgical removal along with the salivary gland. Diode laser produces more thermal

damage than co_2 laser. CO_2 laser has a high-water absorption rate and is well absorbed by all soft tissues making it the perfect surgical treatment of oral soft tissues. Several studies have diode laser as it has the advantage of small size and low cost and is proven to be effective. It is carried out in a circular pattern similar to the standard technique and the remaining salivary glands are vapourised. Hemostasis is achieved by defocusing the beam and the char is formed at the base of the wound. It works by transmitting photo-thermal energy to cells it contacts that causes an increase in temperature, protein denaturation, vaporization, and carbonization. [15,20]

Cryotherapy

Cryosurgery is the procedure where there is a deliberate destruction of tissue by freezing it using liquid nitrogen. Nowadays, liquid nitrogen is the most popular cryogen agent and is used in different specialties avidly. Temperatures ranging from -25°C to -50°C (-13°F to -58°F) can be easily achieved within 30 seconds if a sufficient amount of liquid nitrogen is applied via spray or probe. The basic procedure of cryotherapy is rapid cooling, slow thawing, and repetition of the freezing process thus maximizing tissue destruction. The two methods recognized are a closed system with the use of probes and nitrous oxide, or an open system with the use of a liquid nitrogen spray or a cotton tip. Nitrous oxide gas when released from high pressure to low pressure, aids in temperature fall resulting in freezing of tissues. Hence cell death occurs, as the temperature falls below −20°C. During the freeze cycle, the drop in temperature results in the crystallization of extracellular water and cell shrinkage due to membrane lipid hardening. The electrolyte concentration and intracellular water start moving out of the cell to balance the electrolyte gradient. This water also crystallizes and gets trapped within the cellular membrane causing toxic concentration of intracellular electrolytes. During the thaw cycle, cells at the lesion's periphery take up excess electrolytes to equalize this gradient difference, leading to swelling and cell lysis. This treatment is well received by the patients as it displayed less postoperative discomfort and more favorable clinical healing compared to surgical excision in patients whose surgery is contraindicated due to age or medical history. [21,22]

Non-surgical treatment

Surgical procedures have several disadvantages such as trauma, pain, lip disfigurement, damage to adjacent vital structures, and ducts leading to development of satellite lesions, behaviour management problems in pediatric patients and can also be expensive to the patient. Hence non-surgical treatments are considered. (III)

Table 1: Surgical methods – Advantages and Disadvantages.

Surgical method	Advantage	Disadvantage	Recurrence rate
Conventional surgical method	Simple procedure, complete excision of mucocele	Haemorrhage, Pain, damage to vital tissues, scar, long recovery period Ductal damage, satellite lesions	61-89% as cyst is not removed completely
Stitch and stab method	No recurrence, low surgical skills required, one suture required, no		No recurrence

	tissue damage, brief time, uneventful healing		
Shira's technique (injection of impression material before excision)	Minimally invasive, no scarring, preserves the healthy surrounding tissue, complete removal of cyst wall	Accidental extension of material into deep tissue plane	No recurrence after follow up of 12 months
Marsupialisation	Prevents damage to vital structures around mucocele, no scar, no inadvertent healing	Mucocele is not completely excised. High relapse	High recurrence rate 61-86%chance
Micro marsupialisation	Rapid, simple, Least traumatic, no local anesthesia, reduced healing period, less invasive	High relapse, if incomplete epithelization of suture tracts	a study by giraddi et al showed 10% recurrence rate after follow up of 9 months
Laser	Quick no intraoperative bleeding, no scar formation, less contraction, better wound healing, minimum post operative discomfort and pain	Damage to eye by laser, so protective eyewear is must, Cutting slower than electrocautery, odour if flesh burns	Low recurrence
Cryotherapy	local anaesthesia-not required, no bleeding, less post operative discomfort, favorable wound healing, minimum surgical defect, no suture	Unpredictable degree of swelling, lack of precision of depth in area of freezing, slight necrosis, sloughing	No recurrence follow up of 5 months

Table 2: non-surgical methods -Advantages and Disadvantages

Non-surgical method	Advantage	Disadvantage	Recurrence
Corticosteroid injection	Safe, convenient, easy, cost effective,	Size of lesion did not regress completely regress completely in few cases	No recurrence after follow up 6 months
Absolute ethanol	Simple, minimally invasive, economic, no post-operative complication	Severe pain and soft tissue edema	No recurrence after 2 year follow up
Sodium tetradecyl sulphate	Safe, cost effective, minimally invasive simple,	Nil	Nil

	complete resolution of lesion		
Bleomycin sclerotherapy	Complete lavage of cyst contents	Poor resolution of mucocele, technique sensitive	High recurrence
OK 432	No hemorrhage, minimal complications, LA is not required, no deformity, no secondary infection, no scar formation	Allergy to streptococcal preparation, extra cystic injection causes odynophagia, effect diminishes if it leaks out of mucocele, cannot be injected to smaller lesions	Low recurrence
Polidocanol	Simple, produces anaesthetic effect, less post-operative complications, complete regression of lesion	Inflammatory response produces mild bleeding and swelling post operatively	No recurrence following 3 months period
Gamma linolenic acid	Effective in multiple mucoceles	Allergies, interactions with other medications	Recurrence after discontinuation of therapy
Hematological drug	High success rate in large lesions	Post-operative increased volume and tension in swelling Asthenia	No recurrence

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Intralesional injection of corticosteroid

Corticosteroids

Act as the most potent anti-inflammatory agent inhibiting the expression of multiple inflammatory genes and may also increase the transcription of genes coding for anti-inflammatory proteins including lipocortin-1, interleukin-1, and interleukin-10 receptor antagonist reducing pathogenesis of mucocele. It also acts as sclerosing agent that resulted in shrinkage of dilated ducts. High-potency corticosteroids like clobetasol propionate in a mucosal adhesive base is very helpful in controlling painful and recurrent mucoceles. A study conducted by Rupam Sinha evaluated the outcome of intralesional injection of corticosteroid in 20 cases, 18 of them showed complete regression of the lesion whereas the remaining 2 cases showed a decrease in size except for mild discomfort. Following injection, there were no other complications.[23,24]

Gamma linolenic acid

The seed oil of the evening primrose (Oenothera biennis) contains 9% gamma-linolenic acid, an intermediate in prostaglandin E synthesis. In clinical use, the administration of gamma

linolenic acid aims to restore to normal n-6 essential fatty acid (EFA) metabolism. The clinical result of alteration of n-6 EFA metabolism are decreased inflammation as it has anti-inflammatory effects and effects on cell membranes. The effects on cell membrane produce changes in membrane fluidity and cell functions. GLA is a predecessor of prostaglandin E which works by reducing inflammation through competitive inhibition of prostaglandins and leukotrienes. This is a probable mechanism for the anti-

inflammatory, antiatherogenic, antithrombotic and antiproliferative effects of GLA. It is useful for multiple mucoceles if a nonsurgical approach is considered, but there are possible side effects and interactions with other medications and allergies to consider.[25]

Intralesional injection of sclerosing agent

Absolute ethanol as a sclerosant has been proved to be safe and effective, has been applied in treatment of renal tumours, cysts, and vascular malformations. According to the mucous ingredients and the histological characterization a torn end of a main duct of a minor salivary gland is found to communicate with the mucus pool surrounded by connective tissue. Absolute ethanol includes denaturing of the ingredients to deposit and make the epithelial cells near the gap of a mucous tubule dehydrate and necrose, that leads to an inflammatory reaction followed by the formation of scars that can close the gap to prevent the mucus from over brimming. A clinical study conducted by Zhang et al enrolled 14 patients with mucoceles of glands of Blandin and Nuhn (common in patients less than 20 years). these patients were treated with injection of absolute ethanol into the mucous cavity of lesion showed extirpation of lesion in all patients after one to three injections.[26]

Sodium tetradecyl sulphate

The sclerosant, sodium tetradecyl sulphate (STS) in a various concentration of 1.5% and 3%, injected intralesional Ly into the mucocele using an insulin syringe. It is commonly used in treatment of varicose veins of legs and venous and lymphatic malformations. The sclerosant was injected slowly, and care was taken to prevent through-and-through puncturing of the cyst. STS (Sodium tetradecyl sulphate) is an anionic detergent that solubilizes the phospholipid component of cell walls resulting in cell lysis. This can be alternative modality when compared to conventional methods with success and less chances of recurrence.[27]

Bleomycin sclerotherapy followed by doxycycline lavage

Bleomycin and doxycycline have been reported as good sclerosants when used in lymphatic and venous malformation treatments of head and necks. Yueh catheter needle and syringe setup is used. Ranula puncture is done using Yueh needle under ultrasound guidance. Real time image guided access into the dominant cystic space and cystic fluid aspirate to estimate the total volume of ranula. Then, supplementary access to cyst using an identical catheter needle at second puncture then doxycycline contrast mixture was lavaged between two syringes in ranula lumen in 6-10 cycles to clear mucinous components of the lesion, Upto 5ml of bleomycin 3mg/ml was drawn into syringe to replace entire cyst volume. Aspiration and lavage of contents of ranula followed by using a sclerosing agent to fill up volume of ranula is a better method when compared to using intra cystic sclerosing agents only. A clinical study conducted by Sayan Manna et al concluded that bleomycin sclerotherapy following doxycycline lavage achieved poor rate of complete resolution when compared to ok 432 and ethanol but the technique of lavage yielded superior results when compared to simply injecting any sclerosing agents. [28]

Polidocanol sclerotherapy

It consists of 95% hydroxy polyethoxy dodecane and 5% ethyl alcohol. Its detergent action encourages a rapid over-hydration of endothelial cells, that leads to vascular injury.

It is an anionic surfactant that is cytotoxic for endothelial cells (lyse erythrocytes, leukocytes and platelets). Polidocanol sclerotherapy has been widely used in treating venous malformations, digital mucous cysts,

placenta accreta and lymphatic malformations. It can activate intracellular signalling pathways that regulate intracellular calcium release and nitric oxide production which further induces cellular injury or death. A dose of 3% polidocanol preferred is approximately 2 ml per injection to a maximum of 4 ml, repeated every 1 week to a maximum of 3–4 injections

A clinical study conducted by Liu et al in 122 cases showed that 102 cases were cured, 8 cases showed remarkable remission, and 2 cases had partial remission. No recurrence was found during the follow-up period, and none of the cases showed an invalid effect, resulting in a total cure rate of 91.07%. This effect of polidocanol on mucocele of the minor salivary gland may be associated with its cytotoxicity and anti-angiogenesis characteristics as well.[29,30]

Picibanil

Picibanil (ok-432) is a lyophilized biological preparation containing cells of streptococcus pyogenes su-strain treated with benzylpenicillin.[20] It is safe, inexpensive, high effective substitute for surgery, antineoplastic and does not require special equipment. A clinical study conducted by Nobou Ohta et al injected ok 432 to lower lip mucocele observed the disappearance and marked reduction of mucocele after treatment.[21] A strong local inflammatory reaction at the injection site is caused by activation of neutrophils and monocytes, leading to cytokine production (tumor necrosis factor) which increases the permeability of endothelial cells and promotes mucus excretion.[21] Another clinical study revealed of ok 432 sclerotherapy of plunging ranula in 21 patients showed 33.3% showed that total shrinkage and resolution 19% showed near total shrinkage (more than 90% of volume) 19% patients revealed marked shrinkage>75% of volume) 14.3% recurrence after total shrinkage of 1 month. over all recurrence rate was 47% but 14% only after the last sclerotherapy.[31,32]

Homotoxicological drug

another noninvasive technique which integrates the principle of homeopathy with conventional medicine. Nickel gluconate-Mercurius heel-potentised swine organ preparation. these drugs accelerate pseudocyst resorption, glandular and physiological function. larger lesions had higher success rate because of increased vascularity.[33]

Sonography guided sclerotherapy

Ultrasound/sonogram is used to guide the injection of sclerosing into the cystic lesion or aspiration of contents of cyst. Advantage of method is that amount of secretion of ranula can be aspirated by adjusting the needle tip within the cyst rather than just blind aspiration, also prevents extra cystic injection of sclerosing agent as one can see the injection solution within the cyst when it is injected and the collapsed cyst re enlarging to the original size. a small cyst which is not palpable can be effectively aspirated under sonography guidance.[34]

Conclusion

Owing to the high recurrence rate, discomfort associated with mucocele, with the available surgical and non-surgical techniques best suited technique in the paediatric population has to be selected and employed following proper diagnosis in order to alleviate discomfort associated.

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