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SIALORROHEA MANAGEMENT CHALLENGE TO THE DIAGNOSTICIAN: AN OVERVIEW

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ABSTRACT

Treatment of sialorrhea is best managed by a clinical team that includes primary health care providers, speech pathologists, occupational therapists, dentists, orthodontists, neurologists, and otolaryngologists. Treatment options range from conservative (i.e., observation, postural changes, and biofeedback) to more aggressive measures such as medication, radiation, and surgical therapy. Anticholinergic medications, such as glycopyrrolate and scopolamine, are effective in reducing drooling, but their use may be limited by side effects. The injection of botulinum toxin type A into the parotid and submandibular glands is safe and effective in controlling drooling, but the effects fade in several months, and repeat injections are necessary. Surgical intervention, including salivary gland excision, salivary duct ligation, and duct rerouting, provides the most effective and permanent treatment of significant sialorrhea and can greatly improve the quality of life of patients and their families or caregivers.

Key Words: Sialorrohea, Pharmocologic Management, Surgical Management etc.

INTRODUCTION

Saliva is the watery and usually frothy substance produced in and secreted from the three paired major salivary (parotid, submandibular and sublingual) glands and several hundred minor salivary glands, composed mostly of water, but also includes electrolytes, mucus, antibacterial compounds and various enzymes. Healthy persons are estimated to produce 0.75 to 1.5 litres of saliva per day. At least 90% of the daily salivary production comes from the major salivary glands while the minor salivary glands produce about 10%. On stimulation (olfactory, tactile or gustatory), salivary flow increases fivefold, with the parotid glands providing the preponderance of saliva [1]. Saliva is secreted by the six major salivary glands (two parotid, two submandibular and two sublingual) and several hundred minor salivary glands. The major salivary glands produce 90 percent of the approximately 1.5 L of saliva that are secreted per day. In the unstimulated (basal) state, 70 percent of saliva is secreted by the submandibular and sublingual glands. When stimulated, salivary flow increases by five times, with the parotid glands providing the preponderance of the saliva. The parasympathetic nervous system innervates the parotid, submandibular, and sublingual glands with fibers that originate in the pons and medulla, and synapse in the otic and submandibular ganglia. Postganglionic fibers from the otic ganglion provide secretory function to the parotid gland, and fibers from the submandibular ganglion supply secretory function to the submandibular and sublingual glands. The flow of saliva is enhanced by sympathetic innervation, which promotes contraction of muscle fibers around the salivary ducts [2].

Saliva is a major protector of the tissues and organs of the mouth. In its absence both the hard and soft tissues of the oral cavity may be severely damaged, with an increase in ulceration, infections, such as candidiasis, and dental decay. Saliva is composed of serous part (alpha amylase) and a mucus component, which acts as a lubricant. It is saturated with calcium and phosphate and is necessary for maintaining healthy teeth. The bicarbonate

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content of saliva enables it to buffer and produce the condition necessary for the digestion of plaque which holds acids in contact with the teeth. Moreover, saliva helps with bolus formation and lubricates the throat for the easy passage of food [3].

The organic and inorganic components of salivary secretion have got a protective potential. They act as barrier to irritants and a means of removing cellular and bacterial debris. Saliva contains various components involved in defense against bacterial and viral invasion, including mucins, lipids, secretory immunoglobulins, lysozymes, lactoferrin, salivary peroxidise, and myeloperoxidase. Salivary pH is about 6-7, favouring digestive action of salivary enzyme, alpha amylase, devoted to starch digestion. The various functions of saliva include mechanical cleansing of the mouth, contributing to oral homeostasis, and helping to regulate oral pH. Saliva also has bacteriostatic and bacteriocidal properties that contribute to dental health and decrease oral odor. It is important in the lubrication of food boluses, and the amylase in saliva begins the digestion of starches [4].

Sialorrhea (drooling or excessive salivation) is a common problem in neurologically impaired children (i.e., those with mental retardation or cerebral palsy) and in adults who have Parkinson's disease or have had a stroke. It is most commonly caused by poor oral and facial muscle control. Drooling (also known as driveling, ptyalism, sialorrhea, or slobbering) is when saliva flows outside the mouth, defined as "saliva beyond the margin of the lip". This condition is normal in infants but usually stops by 15 to 18 months of age. Sialorrhea after four years of age generally is considered to be pathologic. The prevalence of drooling of saliva in the chronic neurological patients is high, with impairment of social integration and difficulties to perform oral motor activities during eating and speech, with repercussion in quality of life.

Drooling occurs in about one in two patients affected with motor neuron disease and one in five needs continuous saliva elimination, its prevalence is about 70% in Parkinson disease, and between 10 to 80% in patients with cerebral palsy. Contributing factors may include hyper secretion of saliva, dental malocclusion, postural problems, and an inability to recognize salivary spill. Physical and psychosocial complications of sialorrhea range from mild and inconvenient symptoms to severe problems that can have a significant negative impact on quality of life. Physical complications include perioral chapping and maceration with secondary infection, dehydration and foul odor. The psychosocial complications include isolation, barriers to education (such as an inability to share books or computer keyboards), low self esteem and increased dependency and level of care. Caretakers and loved ones may find it more difficult to demonstrate affection with affected patients, contributing to a potentially devastating stigmatization [5].

Pathophysiology [6,7]

Pathophysiology of drooling is multi-factorial. It is generally caused by conditions resulting in excess production of saliva due to local or systemic causes like:

- **Physiological:** Pregnancy
- **Local causes:** Oral inflammation due to teething, Infection like in oral cavity infection, dental caries, tonsillitis, peritonsilar abscess etc.
- **Systemic**

Toxin Exposure: Pesticides, mercury, capsaicin, snake poisoning etc.
Medication: Tranquilizers, anticonvulsants, anticholinesterases, lithium etc.
Neuromuscular: Cerebral palsy, Parkinson's disease, motor neuron disease, bulbar/ pseudobulbar palsy, stroke etc.
Infection: Rabies etc.
Gastric: Gastroesophageal reflux etc.

Inability to Retain Saliva within the Mouth: Can be due to poor head control, constant open mouth, poor lip control, disorganized tongue mobility, decreased tactile sensation, macroglossia, dental malocclusion, nasal obstruction. Problems with swallowing- resulting in excess pooling of saliva in the anterior portion of the oral cavity e.g. lack of awareness of the build-up of saliva in the mouth, infrequent swallowing and inefficient swallowing. Drooling is mainly due to neurological disturbance and less frequently to hyper salivation. Under normal circumstances, persons are able to compensate for increased salivation by swallowing [8].

However, sensory dysfunction may decrease a person's ability to recognize drooling and anatomic or motor dysfunction of swallowing may impede the ability to manage increased secretion. Sialorrhea usually is caused by neuromuscular dysfunction, hyper secretion, sensory dysfunction, or anatomic (motor) dysfunction. The most common cause is neuromuscular dysfunction. In children, mental retardation and cerebral palsy are commonly implicated; in adults, Parkinson's disease is the most common etiology. Pseudobulbar palsy, bulbar palsy, and stroke are less common causes. Hypersecretion commonly is caused by inflammation, such as teething, dental caries and oral cavity infection. Other causes of hypersecretion include side effects from medications (i.e., tranquilizers, anticonvulsants), gastroesophageal reflux, toxin exposure (i.e., mercury vapor) and rabies. Under normal circumstances, persons are able to compensate for increased salivation by swallowing. However, sensory dysfunction may decrease a person's ability to recognize drooling, and anatomic or motor dysfunction may impede the ability to manage increased secretions. Anatomic abnormalities are usually not the sole cause of drooling but commonly exacerbate other causative conditions. Macroglossia and oral incompetence may predispose patients to salivary spill. Unfortunately, neither of these

conditions is easily remedied. Malocclusion and other orthodontic problems may compound oral incompetence; orthodontic correction can reduce sialorrhea [9].

Management

Treatment of sialorrhea is best accomplished by using a team approach. The primary care physician usually focuses on the complete history and physical examination of the patient, with special attention to the impact of drooling on quality of life and the potential for improvement. Speech pathologists and occupational therapists work with patients to improve their swallowing mechanics and to support their posture with devices such as the head-back wheelchair. Dentists and orthodontists assess and treat dental and oral diseases and malocclusion.

Otolaryngologists identify and correct causes of aerodigestive obstruction like macroglossia and adenotonsillar hypertrophy that contribute to drooling. Neurologists, otolaryngologists, and primary care physicians can assess the patient for significant cranial neuropathies .After a thorough assessment, a consensus on appropriate treatment options should be developed by the treatment team, the patient and the patient's family. Treatments can be offered in a stepwise fashion, from least invasive, nonsurgical therapies to most invasive. For minimal problems, in children under four years of age, or in adults with unstable neurologic function, observation is frequently the best option. Minimal problems also can be treated with a feeding program aimed at improving oromotor control, although this effort is rarely successful [10].

Any situational factors should be corrected, and dental malocclusion and caries should be treated. Adenotonsillectomy should be performed, when indicated, and patients should be fitted with appropriate wheelchairs and braces, if necessary. Several orthodontic appliances may be used for the treatment of sialorrhea. Customized plates formed to fit the palate can aid in better lip closure. Movable beads can be placed on the upper plate; they stimulate tongue movement, thus helping to deflect saliva toward the pharynx. The use of these beads in combination with swallowing therapy has been successful in patients with moderate sialorrhea [11]. Biofeedback and automatic cueing techniques have successfully treated patients with mild neurologic dysfunction and drooling. One study showed that biofeedback was successful in patients older than eight years who had mild to moderate problems [12]. Patients are trained to associate behaviour with a cue; for example, swallowing or wiping the face is associated with an electronic beep.

These devices can be used for several hours a day. The drawback to these devices is that patients become habituated to the stimulus, and the devices become less effective after repetitive use. Positioning prior to implementation of any therapy, it is essential to look at the position of the patient. When seated, a person should be fully supported and comfortable. Good posture with proper trunk and head control provides the basis for improving oral control of drooling and swallowing. Eating and drinking skills-drooling can be exacerbated by poor eating skills. Special attention and developing better techniques in lip closure, tongue movement and swallowing may lead to improvements of some extent. Acidic fruits and alcohol stimulate further saliva production, so avoiding them will help to control drooling [13].

Oral Facial Facilitation

This technique will help to improve oral motor control, sensory awareness and frequency of swallowing. Scott and staios et al noted improvement in drooling in patients with both hyper and hypo tonic muscles using this technique. This includes different techniques normally undertaken by speech therapist, which improves muscle tone and saliva control. This technique can be practiced easily, with no side effects and can be ceased if no benefits noted.

a) Icing: Effect usually last up to 5-30 minutes, improves tone, swallow reflex.

b) Brushing: As effect can be seen up to 20- 30 minutes, suggested to undertake before meals.

c) Vibration: Improves tone in high tone muscles

d) Manipulation: Like tapping, stroking, patting, firm pressure directly to muscles using fingertips known to improve oral awareness.

e) Oral motor sensory exercise: Includes lip and tongue exercises [14].

Speech Therapy

Speech therapy should be started early to obtain good results. The goal is to improve jaw stability and closure, to increase tongue mobility, strength and positioning, to improve lip closure (especially during swallowing) and to decrease nasal regurgitation during swallowing [15].

Behaviour Therapy

This uses a combination of cueing, overcorrection, and positive and negative reinforcement to help drooling. Suggested behaviours, like swallowing and mouth wiping are encouraged, whereas open mouth and thumb sucking are discouraged. Behaviour modification is useful to achieve (1) increased awareness of the mouth and its functions, (2) increased frequency of swallowing, (3) increased swallowing skills. This can be done by family members and friends. Although there is no randomized controlled trial done, over 17 articles published in last 25 years showing promising results and improved quality of life. No reported side effects make behavioural interventions an initial option compared to surgery, botulinum toxin or pharmaceutical management. Behaviour interventions are useful prior and after medical management such as botulinum toxin or surgery [16].

Oral Prosthetic Device

Variety of prosthetic devices can be beneficial, e.g. chin cup and dental appliances, to achieve mandibular stability, better lip closure, tongue position and swallowing. Cooperation and comfort of the patient is essential for better results. Positive and negative reinforcement has been described as an adjunct in the management of sialorrhea in patients with moderate neurologic disease. Caretakers praise patients for not drooling or require them to wipe their faces when they forget to swallow. In a small, prospective study, acupuncture improved sialorrhea based on subjective measures in seven of 10 patients. Over a six-week period, patients were treated 30 times with needles placed in five locations in the tongue. Further study of the effectiveness of acupuncture in the treatment of sialorrhea is warranted. If sialorrhea continues to interfere with the patient's health and quality of life after non-invasive measures have been tried, medication, radiation, and surgical therapy should be considered [17].

Pharmacologic management [18]

1. Antimuscarinic Drugs: Like:

- Amitriptyline
- Atropine
- Benzatropine
- Trihexyphenidyl hydrochloride (benzhexol hydrochloride)
- Glycopyrronium bromide (glycopyrrolate): oral, nebulized and subcutaneous
- Hyoscine hydrobromide (scopolamine hydrobromide): oral, topical, subcutaneous and nebulized

2. Beta-Blockers

3. Botulinum Toxin

There are no randomised double-blind studies that compare the different therapeutic options available for the management of sialorrhea. An in-depth systematic review of the medical literature investigating the efficacy of anticholinergic drugs to treat drooling in children with multiple disabilities found that because of the methodological drawbacks within the studies and the small number of reports, no general conclusion could be reached and a meta-analysis could not be performed.

The authors concluded that there was some evidence that at least three anticholinergic drugs (benzatropine, glycopyrronium and trihexyphenidyl hydrochloride) are effective in the treatment of drooling in this patient group. However, it could not be concluded that one anticholinergic drug was preferable to others .The choice of drug should be based on its pharmacological and adverse effect profile as well as the limited results of available published studies. Selection of a particular compound should be based on individual response and side effects. Clearly, larger randomised controlled trials are required before the place of each of these drugs in the management of hypersalivation can be established [19].

Hyoscine Hydrobromide

Three small, short-term studies have investigated the use of transdermal hyoscine patches for the management of hypersalivation in adults and children. Transdermal hyoscine patches offer several advantages over other treatments including ease of administration, maintenance of steady state concentrations and a low incidence of systemic side effects compared with other anticholinergics. Hyoscine patches may be particularly useful for patients with intractable swallowing difficulties (e.g. head and neck cancers) who may have problems with drooling or choking owing to the normal production of saliva. Hyoscine hydrobromide can also be given by non-topical routes but there is less evidence to support this [20-22].

Glycoyrronium

Glycopyrrolate is best known for its drying properties and a limited central nervous system activity. It is slower in onset and produces less tachycardia than atropine or hyoscine. Benefits of using glycopyrronium include its long duration of action and its inability to cross the blood-brain barrier thus reducing central adverse effects (e.g. sedation, restlessness).

A 1mg/5ml oral solution of glycopyrronium has been approved for use in the United States to reduce chronic severe drooling in children with neurological disorders and may be imported. Anticholinergics are contraindicated in patients with glaucoma, obstructive uropathy, gastrointestinal motility disorders, and myasthenia gravis. Also, these medications often are poorly tolerated in elderly patients who have multiple comorbidities. Adult dose is .5 mg orally, one to three times daily. Children dose is 0.04 mg per kg per dose orally, q8- 12h.[23]

Other Drugs

The dose of oral benzatropine, which can be given as a single daily dose, should be titrated individually for each patient, starting with a low dose and increasing, as indicated, by small weekly increments until therapeutic benefit is achieved or side effects occur. Benzatropine often produces sedation, or less commonly, dysphoria and restlessness.

Transdermal scopolamine, applied as a patch behind the ear, was well tolerated in short-term studies, but its use was limited by side effects of urinary retention and blurred vision. Trihexyphenidyl hydrochloride, modafinil, beta-blockers and botulinum toxin have been used in certain situations with some success [24].

Botulinum Toxin

It was in 1822 that a German poet and physician, Justinus Kerner, discovered that patients who suffered

from botulism complained of severe dryness of mouth which suggested that the toxin causing botulism could be used to treat hypersalivation. However, it was only in the past few years that botulinum toxin type A (BTx-A) has been used for this purpose. BTx-A binds selectively to cholinergic nerve terminals and rapidly attaches to acceptor molecules at the presynaptic nerve surface. This inhibits release of acetylcholine from vesicles, resulting in reduced function of parasympathetic controlled exocrine glands. The blockade though reversible is temporary as new nerve terminals sprout to create new neural connections.Studies have shown that injection of botulinum toxin to parotid and submandibular glands, successfully subsided the symptoms of drooling [25]. There is wide variation in recommended dosage, most studies suggest that about 30- 40 units of BTx-A injected into the parotid and submandibular glands are enough for the symptoms to subside The injection is usually given under ultrasound guidance to avoid damage to underlying vasculature/ nerves. The main side effects from this form of treatment are dysphagia, due to diffusion into nearby bulbar muscles, weak mastication, parotid gland infection, damage to the facial nerve/artery and dental caries. Patients with neurological disorders who received BTX-A injections showed a statistically significant effect from BTX-A at 1 month post injection, compared with control, this significance was maintained at 6 months. Intrasalivary gland BTX-A was shown to have a greater effect than scopolamine. The effects of BTx-A are time limited and this varies between individuals. Intraglandular injection of botulinum toxin type A recently has been reported to improve sialorrhea under ultrasound guidance, botulinum toxin type A was injected into the bilateral parotid and submandibular glands of 10 adult patients. Nine of the patients improved, and no patient had complications. Treatment response lasted approximately five months, making repeat treatments necessary for long-term control [26].

Gastroesophageal Reflux Control

Many developmentally delayed or neurologically impaired patients who have sialorrhea also have significant gastroesophageal reflux. It has been postulated that controlling reflux will reduce drooling; however, this conjecture has not been confirmed by research, and it is unlikely that control of reflux has any clinically significant effect on sialorrhea [27].

Radiation Therapy

Radiation to the salivary glands is a reasonable treatment option in elderly patients who are not candidates for surgery and cannot tolerate medical therapy. Radiation produces xerostomia that may last months to years. The dose may be titrated to reach the desired effect, and treatment can be repeated as necessary. Malignancies induced by radiation therapy typically do not occur until 10 to 15 years after treatment and, therefore, are less of a concern in patients who are elderly and debilitated [28].

Surgical Options

Surgical options in the treatment of sialorrhea include surgery on the salivary glands and ducts, and surgery to denervate the glands. Surgery to denervate the salivary glands is performed through the middle ear, where the tympanic plexus and chorda tympani travel before entering the major salivary glands. The procedure is relatively simple and fast, and does not require general anesthesia. This surgery has few side effects, and patients typically do not complain of loss of taste. Unfortunately, salivary function returns within six to 18 months, when nerve fibers regenerate. The most definitive treatment of sialorrhea is surgery to excise the major salivary glands or to ligate or reroute the major salivary ducts. This procedure typically involves a combination parotid duct ligation or rerouting with either submandibular gland excision or duct rerouting. Sublingual gland excision is suggested if the submandibular ducts are rerouted to prevent formation of salivary retention cysts. Preservation of salivation with reduction of drooling has been demonstrated following rerouting of the parotid and submandibular ducts to the posterior oropharynx, and rerouting procedures spare patient's external scars and the risk of facial nerve injury.

Wilke, a Canadian plastic surgeon, was the first to propose and carry out parotid duct relocation to the tonsillar fossae to manage drooling in patients with cerebral palsy. One of the best studied procedures, with a large number of patients and long term follow up data, is submandibular duct relocation. Intraductal laser photocoagulation of the bilateral parotid ducts has been developed as a less invasive means of surgical therapy. Early reports have shown some impressive results. Overall surgery reduced salivary flow and drooling can be significantly improved often with immediate results – 3 studies noted that 80 – 89% of participants had an improvement in their control of their saliva [29-31]. Two studies discussed changes in quality of life. One of these found that 80% of those who participated improved across a number of different measures including receiving affection from others and opportunities for communication and interaction. Most evidence regarding surgical outcomes of sialorrhea management is low quality and heterogeneous. Despite this, most patients experience a subjective improvement following surgical treatment. Surgical treatment is indicated in failure of medical treatment profuse drooling with low awareness level, severe aspiration. Bleeding, tongue swelling with airway obstruction, submandibular abscess, lingual nerve injury & aspiration pneumonia [32].

CONCLUSION

A comprehensive treatment plan depends from the etiology and incorporates several stages of care: correction

of reversible causes, behaviour modification, medical treatment, and surgical procedures. Anticholinergic drugs prescribed by doctors in conjunction with behaviour modification strategies. In general, surgical procedures are considered after proper diagnosis of the cause and evaluation of non-invasive treatment options. Sialorrhea can have a major effect on life quality of individuals. Therefore its diagnosis & management should be of major concern to the diagnostician.

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