

Original Article

Implementation of Sialorrhoea Improvement Program to Improve Drooling Problem in Children

SY HAU, HMY NG, JYY NGAN, CWL LAU, CH KO

Abstract

Objective: Drooling is a common problem in children with neurological problem, leading to physical and psychological complications. The aim of this study is to share our experience on managing this group of children and evaluate the effectiveness of a Sialorrhoea Improvement Program. **Method:** Retrospective review of children attending the Drooling Clinic of Caritas Medical Centre in Hong Kong from May 2015 to October 2023. Under the Sialorrhoea Improvement Program, children were managed jointly by paediatric neurologists and occupational therapists. They received treatment including occupational therapy, transdermal scopolamine and/or botulinum toxin injection. For anterior drooling group, severity was measured by Drooling Severity (DS), Drooling Frequency (DF), Visual Analogue Scale (VAS), 10-minute drooling quotient (DQ10), and the number of bibs per day. For posterior drooling group, severity was measured by the number of chest infection over 6 months. Baseline and post-treatment outcome scores were compared. **Results:** 23 children with 28 treatment episodes were included. Among 17 episodes in anterior drooling; DS improved from 3.7 (baseline) to 2.5 (post-6 months, $p<0.005$). DF improved from 3.2 (baseline) to 2.1 (post-6 months, $p<0.005$). DQ10 improved from 30.0% (baseline) to 7.2% (post-6 months, $p<0.005$). VAS improved from 6.2 (baseline) to 3.5 (post-6 months, $p<0.005$). Number of bibs per day improved from 5.5 (baseline) to 3.1 (post-6 months, $p<0.005$). Subgroup analysis demonstrated improvement of DS, DF, DQ10, VAS, number of bibs per day in both transdermal scopolamine and botulinum toxin injection. Among 11 treatment episodes in posterior drooling, the mean number of chest infection over 6 months diminished from 3.5 to 1.5 post botulinum toxin injection ($p=0.007$). Regarding safety profile, side effects with allergy and transient tiredness were reported in transdermal scopolamine group. None experienced side effect with botulinum injection. **Conclusion:** Sialorrhoea improvement program with occupational therapy, transdermal scopolamine and botulinum toxin injection, provided a sustained improvement in children with anterior drooling problem. Side effects were more common with transdermal scopolamine. Botulinum toxin A injection is effective to decrease posterior drooling and reduce frequency of chest infection from aspiration.

Key words

Botulinum injection; Drooling; Scopolamine; Sialorrhoea

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Introduction

Drooling is defined as unintentional loss of saliva from the mouth. It is a normal physiological phenomenon in infants below 18 months. However, it is considered pathological after four years of age.¹ It can be classified into anterior drooling, where saliva spills from the lip of the mouth,² or posterior drooling, where saliva spills over the tongue into the faucial isthmus of the pharynx.³ It occurs as a result of neuromuscular and sensory dysfunction, hypersalivation or maxillofacial abnormality.⁴

The overall prevalence of significant chronic drooling in childhood is 0.6%, it increases to 58% for children with severe neurological condition such as cerebral palsy.² The prevalence of anterior drooling and posterior drooling in children with cerebral palsy is about 40% and 10-15% respectively.³ Severe drooling can lead to physical and psychological complications, including skin irritation, dehydration, recurrent aspiration pneumonia, social embarrassment and psychological stress on the child and caregivers.²⁻⁵

Management of drooling requires a multidisciplinary team approach.⁶ Treatment options include behavioural and oromotor training, pharmacological interventions and surgical management. In this study, we aim to share our experience in managing children with drooling problem in Caritas Medical Centre of Hong Kong. We would like to evaluate the effectiveness of the Sialorrhoea Improvement Program in this paediatric rehabilitation centre.

Method

This is a retrospective analysis conducted in the Caritas Medical Centre in Hong Kong. Paediatric patients with drooling problem were managed in the Drooling Clinic.

Anterior Drooling:

Subjects

Children seen in the Anterior Drooling Clinic of the Caritas Medical Centre between April 2016 to October 2023 were recruited in the study.

Inclusion criteria to the anterior drooling program were children aged less than 18 years old with underlying neurological deficits, children suffered from anterior drooling, children with drooling leading to disability and complications, children with supportive family to participate in serial assessments and therapies.

Exclusion criteria to the anterior drooling program were children aged more than 18 years old, children lack of family support resulting in poor treatment compliance, children with history of surgical treatment to reduce drooling, children with marked deterioration in neurological function.

Intervention

Under the Sialorrhoea Improvement Program, children were managed jointly by paediatric neurologists and paediatric occupational therapists as day-patients.

A comprehensive medical assessment, social evaluation, motor and oromotor assessment were conducted in all children. Medical condition was reviewed, which included the underlying medical diagnosis, disease comorbidity, current drug use, feeding and neurological functions. Social evaluation included intrinsic motivation and self-management. Motor and oromotor assessment looked into children's head control, positioning, mouth closure, lip seal and swallowing. The probable mechanism of drooling was formulated and the drooling complications were identified. Goal and options of treatment were discussed with caregivers.

Under the program, all subjects received occupational therapy. The therapy targeted on (1) postural control training, (2) oromotor training and (3) behavioural therapy. Postural control training aimed to achieve good posture with proper trunk and head control. Oromotor training aimed to provide a general sensory stimulation with the use of tools and techniques like brushing, stroking and vibration. Hyposensitive could increase sensory awareness and improve oral perception and self-awareness. Oromotor therapy helped in normalising the muscle tone of lip, cheeks and tongue, and develop good lip, tongue and jaw control. Children were taught to slurp-swallow on demand, stay dry and improve swallowing frequency. Behavioural therapy was provided if patient had too little swallowing or wiping. Intervention strategies included instruction with prompting, positive and negative social reinforcement, as well as self-management procedure. These promoted frequent swallowing and wiping in children. Apart from out-patient training, home program was conducted to focus on oromotor training and stimulation. Home training was carried out by caregivers for five to 10 minutes twice a day, five days per week.

Further stepping up to pharmacological treatment would be offered if patients had suboptimal improvement with first line occupational therapy. The decision was made based on multidisciplinary clinical assessment

incorporating assessment scores, including Drooling Severity Scores (DS), Drooling Frequency (DF), and Visual Analogue Scale (VAS), 10-minute Drooling Quotient (DQ10), and the number of bibs per day, alongside caregiver treatment preferences. Occupational therapy remained consistent before and after initiation of second line pharmacological treatment. Drug options included transdermal scopolamine and intraglandular botulinum toxin A injection. Transdermal scopolamine was an anticholinergic medication applied as a patch behind the ear. On the other hand, intraglandular botulinum toxin A injection was a more invasive intervention. Informed consents were obtained prior to injections. Toxin was injected with a special designed 25-Gauge needle to the parotid gland (1/3 total dose) and submandibular gland (2/3 total dose) under ultrasound guidance. One to two sites for each gland were targeted. The total injection dose of botulinum A toxin was 2-4 unit/kg. Treatment choice was individualised and based on discussion with caregivers. Option for botulinum toxin A might be offered to patients who could not comply with regular patch application every 48 to 72 hours, and those who could not tolerate side effects such as skin allergy, dry mouth, drowsiness or confusion. Scopolamine is contraindicated in glaucoma.

Outcome Assessment

Anterior drooling severity was measured by subjective and objective scores. Subjective scores included DS, DF, and VAS. Objective scores included DQ10, and the number of bibs per day. Assessment was performed at baseline, 1-month post treatment, 3-month post treatment and 6-month post treatment. Subjective scores were rated by the same caregivers at different timepoints. Objective scores were rated by designated occupational therapists.

Drooling Severity and Drooling Frequency

Drooling Severity and Drooling Frequency are questionnaire based assessment, where caregivers are asked to rate severity and frequency. Drooling Severity scores from 1-5, while Drooling Frequency scores from 1-4.^{7,8}

The severity of drooling is categorised into five levels. A score of 1 indicates that the individual is dry and never drools. A score of 2 represents mild drooling, where only the lips become wet. A score of 3 reflects moderate drooling, with wetness on both the lips and chin. A score of 4 describes severe drooling, where saliva extends to the point that clothing becomes damp. A score of 5 signifies profuse drooling, causing wetness on clothing, hands,

trays, and surrounding objects.

Drooling frequency is graded on a four-point scale. A score of 1 means the person never drools, 2 indicates occasional drooling, 3 reflects frequent drooling, and 4 signifies constant drooling.

Visual Analogue Scale

Visual Analogue Scale rates the drooling severity on a 10-point visual scale. Caregivers are asked to score the extend on a 10 cm-line. A higher score indicates greater severity.⁹

10-minute Drooling Quotient

10-minute Drooling Quotient is a semiquantitative, direct observational method. It quantifies the number of drooling episodes occurred. DQ is defined as the percentage of observed drooling occasions out of 40 (the number of 15s interval in 10 minutes). Two measurements are included and the score is averaged.⁷

Number of Bibs per Day

It is the number of bibs changed per day due to drooling.¹⁰

Posterior Drooling: Subjects

Children aged 1-18 years with severe to profound grade neurological deficits with recurrent aspiration pneumonia who were long-term residents at the Developmental Disabilities Unit of Caritas Medical Centre between May 2015 to October 2023.

Intervention

Botulinum toxin A was injected with a special designed 25-Gauge needle to the parotid gland (1/3 total dose) and submandibular gland (2/3 total dose) under ultrasound guidance. One to 2 sites for each gland were targeted. The total injection dose of botulinum A toxin was 2-4 unit/kg.

Outcome Assessment

Subjective and objective assessment scores could not be applied in posterior drooling. Instead, posterior drooling severity was indirectly estimated by the number of the chest infections over a censored period of six months. Chest infections were identified based on documented physician diagnosis, supported by clinical presentation of fever, cough, sputum production, tachypnoea, and investigation showing pneumonic changes on Chest X-ray. Assessment was performed at baseline six months

before treatment, and six months post-treatment. Data were extracted from the in-patient documentation and electronic patient records.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26.

For anterior drooling, outcome scores at baseline, 1-month post-treatment, 3-month post-treatment and 6-month post-treatment within the same intervention group were analysed by Friedman's test, which is the non-parametric alternative to the one-way ANOVA with repeated measures. Subgroup comparison was analysed by Mann-Whitney U test.

For posterior drooling, baseline and post-treatment chest infection episodes were analysed by Wilcoxon Signed Rank test.

Statistical significance was defined as two-tailed probability <0.05.

Results

Twenty-seven children were identified from the Sialorrhoea Improvement Program of Caritas Medical Centre from May 2015 to October 2023. They were referred from the Developmental Disability Units (DDU) and Ventilator Assisted Care Unit (VAC) of the Caritas Medical Centre, other paediatric units or special schools. The total treatment episodes with occupational therapy, transdermal scopolamine or botulinum toxin injection were 36. Eight treatment episodes were excluded. Among the eight episodes, six had incomplete data. Patients discontinued from treatment with transdermal scopolamine because of adverse side effects in the remaining two episodes. A total of 23 children with 28 treatment episodes were included for analysis of treatment outcome. There was 16 children with 17 treatment episodes in anterior drooling group; seven children with 11 treatment episodes in posterior drooling group.

Table 1a shows the demographic data of the anterior drooling group. Mean age of children was 10.5 years (range 1-17 years). Male to female ratio was 1:1. 64% of children suffered from cerebral palsy. 70% had moderate to severe mental retardation. Epilepsy was observed in 41% of children. Half of the children were non-ambulatory, while four required gastrostomy feeding. In addition to

occupational therapy, there were seven treatment episodes of transdermal scopolamine, five treatment episodes of botulinum toxin injection. The results demonstrated an overall sustained improvement of drooling over six months with Sialorrhoea Improvement Program (Table 2). DS decreased from 3.7 (baseline) to 2.5 (post-6 months, $p<0.005$). DF decreased from 3.2 (baseline) to 2.1 (post-6 months, $p<0.005$). DQ10 decreased from 30.0% (baseline) to 7.2% (post-6 months, $p<0.005$). VAS decreased from 6.2 (baseline) to 3.5 (post-6 months, $p<0.005$). Number of bibs decreased from 5.5 (baseline) to 3.1 (post-6 months, $p<0.005$). Similarly, both transdermal scopolamine and botulinum toxin injection demonstrated a sustained improvement of drooling over 6 months in the subgroup analysis, with a statistical significant reduction of DS, DF, DQ10, VAS, number of bibs from baseline (Table 3). When comparing transdermal scopolamine and botulinum toxin injection, no significant difference in the outcome scores were observed. Mean difference of DS between six months post treatment and baseline was -1.5 in transdermal scopolamine subgroup vs -1.5 in botulinum subgroup ($p=0.64$). Mean difference of DF between 6 months post treatment and baseline was -1.3 in transdermal scopolamine subgroup vs -1.8 in botulinum subgroup ($p=0.63$). Mean difference of DQ10 between 6 months post treatment and baseline was -22.8 in transdermal scopolamine subgroup vs -36.0 in botulinum subgroup ($p=0.20$). Mean difference of VAS between six months post treatment and baseline was -3.0 in transdermal scopolamine subgroup vs -2.7 in botulinum subgroup ($p=1.00$). Mean difference of number of bibs between 6 months post treatment and baseline was -2.6 in transdermal scopolamine subgroup vs -2.4 in botulinum subgroup ($p=0.53$). For safety profile, three children experienced allergic reaction with local itchiness and redness around patch, one child had transient increased tiredness. No adverse effect was reported in the botulinum toxin injection group.

Table 1b shows the demographic data of the posterior drooling group. Mean age of children was six years (range 1-11 years). Male to female ratio was 1:1.3. Majority had cerebral palsy, mental retardation and epilepsy. All of them were non-ambulatory with gastrostomy feeding. All patients received botulinum toxin injection. The mean number of chest infection over 6 months diminished from 3.5 before treatment to 1.5 post-treatment ($p=0.007$) (Figure 1). Two children received repeated botulinum injections in consecutive years as drooling worsen after six months. No adverse side effects were reported.

Table 1a Demographics of patients with anterior drooling

Treatment episode	Sex	Age (yr)	Diagnosis	Feeding	Degree of disability	Intervention	Botulinum toxin injection site and dose	Side effect
1	M	10	CP, moderate MR	Oral	Non-ambulatory	Occupational therapy	–	–
2	M	4	Maxillofacial problem (underbite teeth)	Oral	Ambulatory	Occupational therapy	–	–
3	M	1	CP, severe MR	PEG	Non-ambulatory	Occupational therapy	–	–
4	F	6	Angelman syndrome, severe MR, epilepsy	Oral	Ambulatory	Occupational therapy	–	–
5	F	12	CP, severe MR, epilepsy	Oral	Non-ambulatory	Occupational therapy	–	–
6	M	13	Dyskinesia, mild MR	Oral	Ambulatory	Occupational therapy, Transdermal scopolamine	–	Allergy: itchiness and redness around patch
7	F	13	CP, mild MR	Oral	Ambulatory	Occupational therapy, Transdermal scopolamine	–	–
8	M	17	CP, mild MR	Oral	Ambulatory	Occupational therapy, Transdermal scopolamine	–	–
9	F	12	Suspected mitochondrial disease severe MR, epilepsy	PEG	Non-ambulatory	Occupational therapy, Transdermal scopolamine	–	–
10*	M	16	CP, severe MR	Oral	Ambulatory	Occupational therapy, Transdermal scopolamine	–	Allergy: redness around patch
11	M	16	CP, moderate MR, epilepsy	Oral	Ambulatory	Occupational therapy, Transdermal scopolamine	–	Tiredness
12	F	6	Severe MR	PEG	Non-ambulatory	Occupational therapy, Transdermal scopolamine	–	Allergy: redness around patch
13	M	12	CP, severe MR, epilepsy	Oral	Non-ambulatory	Occupational therapy, Botulinum toxin injection	R parotid, L submandibular gland 2 unit/kg	–
14*	M	15	CP, severe MR	Oral	Ambulatory	Occupational therapy, Botulinum toxin injection	R parotid, L submandibular gland 1.3 unit/kg	–
15	F	10	Hemiparesis, moderate MR, epilepsy	Oral	Ambulatory	Occupational therapy, Botulinum toxin injection	L parotid, R submandibular gland 1.5 unit/kg	–
16	F	12	CP, mild MR	Oral	Non-ambulatory	Occupational therapy, Botulinum toxin injection	Bilateral parotid and submandibular gland 3 unit/kg	–
17	F	4	CP, severe MR, epilepsy	PEG	Non-ambulatory	Occupational therapy, Botulinum toxin injection	Bilateral parotid and submandibular gland 4.4 unit/kg	–

*10 and 14 were same patient

CP: cerebral palsy; MR: mental retardation; PEG: percutaneous gastrostomy

Table 1b Demographics of patients with posterior drooling

Treatment episode	Sex	Age (yr)	Diagnosis	Feeding	Degree of disability	Botulinum toxin injection site and dose	Side effect
1	M	4	CP, severe MR, epilepsy	PEG	Non-ambulatory	R parotid, L submandibular gland 2.9 unit/kg	–
2	F	6	CP, severe MR, epilepsy	PEG	Non-ambulatory	R parotid, L submandibular gland 1.9 unit/kg	–
3	F	8	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 3.6 unit/kg	–
4*	F	2	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 4.8 unit/kg	–
5*	F	3	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 4 unit/kg	–
6*	F	4	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 4.4 unit/kg	–
7*	F	5	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 5 unit/kg	–
8	M	9	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 3.5 unit/kg	–
9	F	1	CP, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 3.6 unit/kg	–
10#	M	10	Suspected mitochondrial disease, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 4.1 unit/kg	–
11#	M	11	Suspected mitochondrial disease, severe MR, epilepsy	PEG	Non-ambulatory	Bilateral parotid and submandibular gland 3.3 unit/kg	–

*4, 5, 6, 7 were same patient; #10, 11 were same patient

CP: cerebral palsy; MR: mental retardation; PEG: percutaneous gastrostomy

Table 2 Anterior drooling; change in Drooling parameter over 6 months in Sialorrhoea Improvement Program (n=17)

Parameter	Baseline		1-month		3-month		6-month		p value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
DS	3.7	0.90	3.2	1.08	2.6	0.87	2.5	0.94	<0.005
DF	3.2	0.98	2.4	0.63	2.3	0.60	2.1	0.75	<0.005
DQ10	30.0%	25.56%	18.5%	22.69%	8.9%	9.17%	7.2%	14.83%	<0.005
VAS	6.2	2.03	4.9	1.93	4.1	2.38	3.5	2.40	<0.005
No of bibs	5.5	4.24	3.5	3.27	3.3	3.32	3.1	3.11	<0.005

DS: Drooling Severity Scores; DF: Drooling Frequency; DQ10: 10-minute Drooling Quotient; VAS: Visual Analogue Scale; SD: standard deviation

Discussion

Drooling is a common problem in children with neuro-disabilities, which can result in physical complications and psychological impacts.^{2,8} Objective and subjective scales have been developed to measure anterior drooling severity. Objectively, drooling can be quantified by the Sochaniwsky's technique where saliva is collected in a cup-like device held against the chin of a person with straps attaching on the head bonnet. However, result can be inaccurate because of leakage.¹¹ Another method to quantify of saliva is measuring by radioisotopes. Yet, it is invasive.¹² In our study, 10-minute Drooling Quotients and number of bibs were used for assessment, which are easier and less invasive methods.^{7,10} Subjectively, the Drooling Severity, Drooling Frequency and Visual Analogue Scale were validated scoring methods. In contrary, evaluation of posterior drooling severity is potentially more difficult as signs and symptoms can be non-specific and silent. Silent aspiration is presented in 71-97% of children with cerebral palsy. Radionuclide salivagram, video fluoroscopic swallow studies to document aspiration are not commonly used in view of its invasive nature.^{3,13}

The management of drooling is tailored to each individual with a stepwise approach. Generally, conservative management is considered as the first line treatment. However, majority of patients requires second line treatment with anti-cholinergic medication. Botulinum toxin injection and surgical approach are alternative choices.² In our study, out of 16 children with anterior drooling, 11 required second line treatment. The reason for suboptimal improvement with first line occupational therapy may be accounted by the intellectual disability with poor motivation of patients, leading to ineffective training or poor compliance. In Hong Kong, studies conducted by To et al and Yam et al revealed that Oromotor Habilitation Program and oromotor training can significantly reduce drooling severity in children.^{1,14} However, local evidence on pharmacological intervention are still lacking. Our study provides further evidence that both transdermal scopolamine and botulinum toxin injection are effective in severe cases refractory to occupational therapy alone, and the improvement is sustained to at least 6 months post-treatment.

Anti-cholinergic medication works by blocking the parasympathetic innervation of the salivary gland, reducing the production of saliva. Side effects of the drug include dry mouth, urinary retention, constipation, urinary tract infection, drowsiness, irritability, facial flushing and

skin rash.¹⁵ In our centre, we offered transdermal scopolamine. Two children experienced significant side effect warranted treatment cessation after two months. One child experienced allergy while the other child had emotional disturbance and poor appetite. They were excluded for outcome analysis. Three other children as well reported allergy with itchiness and redness around patch. In one case, allergy was transient which was subsided later. In another case, instead of applying behind the ear, scopolamine was placed on the forehead without allergy. In the last case, drug was stopped after 6 months due to persistent allergic reaction. Apart from allergy, one child reported increased transient tiredness. In the current series, side effect of transdermal scopolamine was common, accounting for 57% of cases. Although scopolamine was found to improve drooling severity, its effectiveness may be offset by the adverse side effects.

When fasting, up to 70% of saliva is produced by the submandibular gland, 20-25% by parotid gland, 10% by sublingual gland. During meal, saliva is mostly produced by parotid glands. Botulinum A toxin is a product of *Clostridium Botulinum*. It works by blocking the neuroglandular junction leading to reduction in saliva production. It is effective in 90% of children with the effects lasting for six weeks to six months.^{1,2} Faria et al demonstrated improvement in respiratory infection with shortened hospital stay and antibiotic use in neurologically impaired children.¹⁶ For safety profile, major side effects of botulinum toxin injection are dysphagia, thickened secretion, carotid artery and facial nerve damage.^{1,17} Hung et al concluded that botulinum injection was a safe, reversible and effective treatment for patient with cerebral palsy for more than 3 months with few side effects.¹ Similarly, our study demonstrated that botulinum injection provided a sustained improvement over 6 months, without any side effect reported. Currently, there is no standard guideline for the target gland injection and botulinum dosage.¹ Earlier in our program, contralateral parotid and submandibular gland were targeted. This can keep 50% of saliva during fasting and postprandial state, potentially reducing the side effect of xerostomia. After 2018, botulinum toxin was targeted on bilateral parotid and submandibular glands instead. In view of majority of saliva originating from the submandibular glands, 2/3 of total dose was given accordingly in our practice. Total botulinum injection dose was 2-4 unit/kg as suggested by recent studies.^{1,18} Further large scale study is needed to evaluate the optimal injection method and drug dose.

Comparing transdermal scopolamine and botulinum

Table 3a Anterior drooling; change in Drooling parameter over 6 months in the Botulinum A toxin sub-group (n=5)

Parameter	Baseline		1-month		3-month		6-month		p value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
DS	4.2	0.44	3.6	0.54	3.2	1.09	2.8	1.10	0.027
DF	3.6	0.89	2.4	0.54	2.2	0.45	1.8	0.45	0.014
DQ10	43.0%	17.17%	29.5%	21.38%	12.5%	7.28%	7.0%	9.58%	0.011
VAS	6.4	1.24	5.3	1.08	3.8	2.70	3.1	1.72	0.039
No of bibs	7.0	3.32	5.0	4.00	5.4	3.51	4.6	2.70	0.037

DS: Drooling Severity Scores; DF: Drooling Frequency; DQ10: 10-minute Drooling Quotient; VAS: Visual Analogue Scale; SD: standard deviation

Table 3b Anterior drooling; change in Drooling parameter over 6 months in the transdermal scopolamine sub-group (n=7)

Parameter	Baseline		1-month		3-month		6-month		p value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
DS	3.4	1.27	2.5	1.13	2.2	0.75	2.1	0.90	0.012
DF	3.1	1.21	2.1	0.69	2.3	0.76	1.9	0.69	0.015
DQ10	24.6%	27.21%	17.1%	25.99%	6.4%	7.34%	1.8%	3.76%	0.047
VAS	6.0	2.07	4.5	2.54	4.1	2.33	3	2.21	0.009
No of bibs	3.4	3.36	2.1	3.13	1.6	2.15	0.9	1.21	0.007

DS: Drooling Severity Scores; DF: Drooling Frequency; DQ10: 10-minute Drooling Quotient; VAS: Visual Analogue Scale; SD: standard deviation

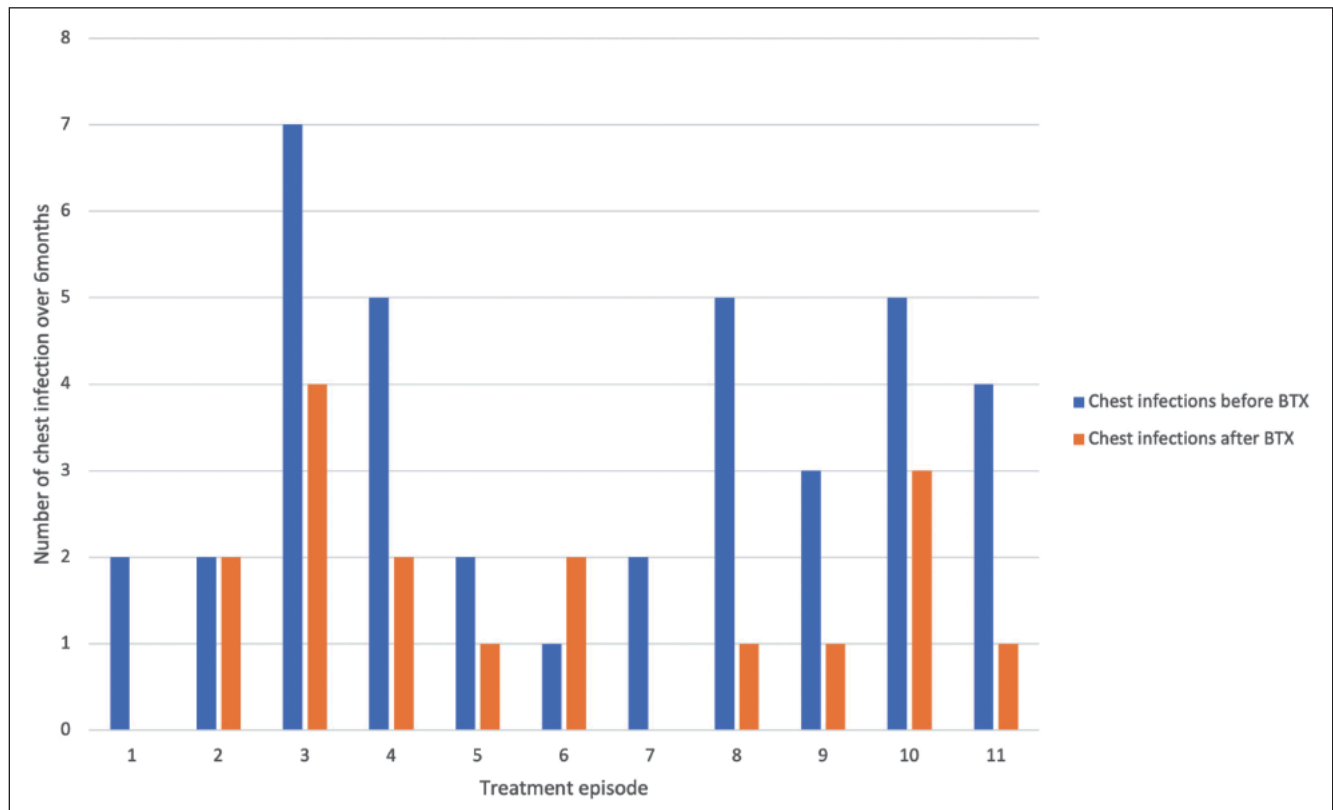


Figure 1. Posterior drooling: Number of chest infection over 6 months. Pre and post treatment analysis. Mean number of chest infection over 6 months diminished from 3.5 to 1.5 post injection (p=0.007).

injection, Hung et al revealed there is no significant difference in their effectiveness. However, transdermal scopolamine results in more severe side effects.¹ Similarly, our results revealed that both treatments offer a sustained effectiveness, yet side effect was only observed in scopolamine group. We propose that botulinum toxin injection may be a better option for children who developed adverse effect to scopolamine. However, repeated botulinum injections may be necessary as the effect will wear off naturally. Besides, its effectiveness may be diminished in the subsequent injections.¹⁹ Therefore, throughout discussion with caregivers is necessary for the treatment choice.

In our study, Table 2 presents the outcomes of all anterior drooling cases within the Sialorrhoea Improvement Program, irrespective of treatment modality. In Tables 3a and 3b, patients who received Botulinum A toxin injections or transdermal scopolamine had previously undergone occupational therapy without adequate response. Importantly, the occupational therapy regimen remained consistent before and after initiation of second-line pharmacological treatment, which minimised the likelihood that the subsequent improvements were attributable solely to occupational therapy. While it is difficult to isolate the individual therapeutic effects of occupational therapy and pharmacological treatments, the subgroups analysed specifically included patients with suboptimal initial responses to occupational therapy alone. From a pharmacokinetic perspective, the effect of Botulinum A toxin tends to tail off after 3 months, while there were no dose adjustments for the transdermal scopolamine patch during the study period. Therefore, we may infer that pharmacological treatment may have primarily contributed to the early improvements observed from baseline to 3 months post-treatment in these initial suboptimal responders, while occupational therapy play an important role in sustaining improvements from 3 to 6 months.

One of the limitations of our study is the small sample size. Secondly, the study design was non-blinded. Besides, some of the clinical information and details were lacking due to incomplete documentation in the Clinical Management System. Therefore, a further large scale, randomised controlled study is recommended to evaluate the effectiveness of different intervention of drooling.

Conclusion

This study shows that a Sialorrhoea Improvement Program with occupational therapy, transdermal scopolamine and botulinum toxin injection is effectiveness in managing children with drooling. It offers a sustained effectiveness over 6 months.

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Ethics Approval

Ethical approval was obtained from the Central Institutional Review Board of the Hospital Authority (Reference number: PAED-2023-086). Patient consent was waived by the ethics board due to retrospective nature of the research.

Conflicts of Interest

All authors have disclosed no conflicts of interest.

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