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ORIGINAL ARTICLE

Prescription Drugs and Their Effects on Swallowing

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Abstract The impact of medications on the physiology of swallowing has received much attention in dysphagia literature. This article reviews the potential effects of medications commonly prescribed in an adult continuing care and rehabilitation facility on swallowing. An audit of medications prescribed to 153 adults accessing age-related respiratory, neurology, and learning disability services was performed. This was followed by an investigation of relevant sources to identify the potential side effects of these medications. One side effect, namely, xerostomia, which our investigations revealed could be a side effect of 24.8% of the medications used at our institution, was further investigated. The prevalence of xerostomia was then investigated in a randomly selected sample of ten subjects whose dysphagia had been confirmed by videofluoroscopy. It was found that six of the ten dysphagic clients displayed xerostomia. Review of the medications of these ten subjects indicated that all were using from three to nine drugs that could cause xerostomia. This article highlights the need for health-care professionals to consider the potential effects of these medications on swallowing and, indeed, the general presentation of clients.

Keywords Dysphagia · Xerostomia · Medications · Side effects · Drug-induced · Deglutition · Deglutition disorders

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The impact of medications on the physiology of swallowing has often been referred to in the literature [1–12]. As practising clinicians, our own clinical observations during dysphagia assessment have often highlighted the effects of such factors as low arousal, general awareness states, and xerostomia on clients' functional swallow abilities. Best practice guidelines of the Royal College of Speech and Language Therapists (RCSLT), *Communicating Quality 3*, notes that "eating and drinking is a highly complex, multi-system skill involving anatomic stability, neuromuscular control and coordination, sensory perception, gastrointestinal function, cardio-respiratory support and integration from the autonomic nervous system" [13]. Because medications may affect one or more of these elements, awareness of the possible effects of drugs is an integral part of the assessment process for clients referred for dysphagia. Review of medications is listed as part of the clinical evaluation of eating, drinking, and swallowing difficulties in current RCSLT Clinical Guidelines [14]. In addition, it can be postulated that all of the following aspects recommended for consideration in the clinical evaluation [14] may potentially be affected by medications:

- vocal tract function
- general motor skills/posture
- nutrition and hydration
- respiratory status
- presence of gastro-esophageal reflux
- management of secretions
- cognitive levels
- level of alertness
- oral hygiene
- dental health
- dietary preferences

- the individual's ability to participate
- emotional state, mood, and behavior [14].

The potential of medications to improve swallowing difficulties has been noted by Logemann [1], e.g., to reduce drooling and the medications used in the treatment of progressive neurologic disorders such as Parkinson's disease and multiple sclerosis. Sueli Monte et al. [2] suggested a role for levodopa in the oral phase of deglutition. Fonda et al. [3] detailed a case study of a patient with Parkinson's disease whose dysphagia improved with adjustment of levodopa medication timing. The American Speech-Language-Hearing Association (ASHA) [4] also notes that medications may enhance swallow function. Yorkston et al. [5] acknowledged that "some of the motor events related to eating and swallowing may be enhanced with the medication"; they also highlight the importance of timing of medication administration.

Conversely, the potentially negative effects of medications on swallowing have been noted in various literature fields, including speech and language therapy, neurology, and psychiatry. Logemann [1] observed that certain antidepressant medications could exacerbate poststroke swallowing difficulties, and also referred to the impact of xerostomia caused by medications or their interactions. Ruschena et al. [6] hypothesised that while the increased risk of death by choking in people with schizophrenia could not be isolated to one particular medication, the risk is higher due to a combination of inherent predispositions and the use of certain antipsychotic drugs such as thioridazine. They recommended increased monitoring of the reflexes involved in swallowing and reflux prevention. Stewart [7] published a case of dysphagia induced by the atypical neuroleptic risperidone, noting that the risk of dysphagia is generally lower with these medications than with older, "typical" neuroleptic medications. Awareness of this significant but reversible side effect was therefore recommended. Polypharmacy intervention and the potential risk for drug interactions when multiple medications are prescribed are well documented in the literature [8, 9].

Stoschus and Allescher [10] outlined the three major mechanisms by which medications could induce dysphagia, namely, (1) when dysphagia is a normal drug side effect, (2) when dysphagia is a complication of the drug actions, and (3) when there is medication-induced esophagitis.

Carl and Johnson [11] outlined the etiology of medication-induced dysphagia, observing how medications affect motor function, lubrication, and gastrointestinal motility, and describing how medications affect the central nervous system. ASHA [4] notes that "gastroesophageal reflux severe enough to impact oral intake, dry mouth, and altered taste are just a few other common complications of drugs given routinely to individuals with whom the speech-language pathologist works, typically the elderly, the very young, or the neurologically impaired." They observe that these populations may be at increased risk of side effects due to differences in metabolising drugs compared with the general population. Difficulties as seemingly innocuous as taste disturbances may have far-reaching effects on eating, drinking, and swallowing [12].

Because our preliminary research [using resources 15, 16] revealed a large number of medication side effects that could affect swallowing, it was decided to focus on the incidence of one potential side effect within a small sample ($n = 10$) of the total ($n = 152$) who were randomly selected from a cohort of subjects whose oropharyngeal dysphagia had been videofluoroscopically confirmed. Xerostomia is defined as "dryness of the mouth resulting from diminished production of saliva" [11]. Xerostomia is a symptom rather than a disease and has three main causes: medical conditions, a side effect of radiation to the head and neck, or a side effect of many medications [17]. Medical conditions causing xerostomia include Sjogren's syndrome, bone marrow transplants, endocrine disorders, nutritional deficiencies, and trauma to the head and neck area [18]. Radiation treatment focused on or near a salivary gland may cause temporary or permanent damage. With regard to medications, the National Institute of Dental and Craniofacial Research [19] states that over 400 medications cause xerostomia. These include antiparkinsonian agents, antidepressants, antipsychotics, antihistamines, analgesics, tranquilizers, and antihypertensives.

Xerostomia can have significant effects on eating, drinking, and swallowing. In the oral preparatory stage of deglutition, xerostomia may affect bolus formation—saliva is not available to mix dry foods into a cohesive bolus. Also, the client is at an increased risk of mouth infections and dental caries. Clients wearing dentures may have difficulty retaining them. Xerostomia may affect ability to chew foods, swallow initiation, and bolus transport as well as overall sensory perception and comfort when eating. This could affect the types of food selected by the client, i.e., he/she may avoid dry, crunchy, and sticky foods. In the esophageal stage of swallowing, xerostomia may cause reduced stomach acid neutralisation, increasing the risk of esophageal lining injury. It should also be noted that there are enzymes in saliva which aid digestion [12, 17, 18, 20].

This article attempts to review the medications prescribed in an extended care/rehabilitation facility and their potential side effects that may impact on swallowing. In addition, the following questions were addressed: (1) What percentage of medications prescribed in this facility have xerostomia as a listed side effect? (2) Of a random

sample of ten people with confirmed oral/pharyngeal dysphagia, how many subjects were using medications that could cause xerostomia? (3) What percentage of our random sample of ten, currently using medications with xerostomia as a listed side effect, presented with xerostomia (radiation therapy, Sjogren's syndrome, bone marrow transplant, endocrine disorders, and nutritional deficiencies excluded)?

Methodology

A review of the medications in use with 153 adults accessing the age-related health-care services, the respiratory, neurology, and intellectual disability services was undertaken during August 2006 in a continuing care and rehabilitation context. The potential side effects of these medications were researched by the authors using the following resources: the British National Formulary (BNF) handbooks, the Martindale reference [15], and the manufacturers' patient-information leaflets (PILs) available via the Electronic Medicines Compendium [16]. These sources informed the compilation of side-effects information in Appendices 1, 2, and 3. Where available, the frequency of the side effects was noted. The headings under which the information was tabulated may be found in Appendix 1.

One specific side effect was focused on: The number of medications with xerostomia as a reported side effect was calculated from all drugs prescribed in our institution and this number was converted to a percentage of the total. Ten clients with oropharyngeal dysphagia (diagnosed by a combination of bedside swallow and videofluoroscopic evaluations) were selected randomly from a cohort of subjects whose dysphagia had previously been diagnosed videofluoroscopically. The severity of dysphagia in the ten clients ranged from mild to severe according to the Dysphagia Outcome and Severity Scale (DOSS) [21]. The presence or absence of xerostomia was determined by SLT assessment, discussion with the client, and discussion with care-givers when more appropriate. These data were analysed in relation to the incidence of xerostomia in these clients. Further details regarding the clients' gender, age, oropharyngeal severity, medical diagnoses, and medications are noted in Appendix 2.

Results and Discussion

In total, 221 medications were found to be prescribed for the 153 adults. For the purposes of this summary, these drugs were grouped according to either the systems they affected or their primary effect. Systems-affected categorisation included medications targeting the cardiovascular system, medications used in the intervention of psychiatric illnesses, medications used in dementia treatment, medications used to treat respiratory conditions, and medications for gastrointestinal problems (Appendix 3, Table A as compiled from [15, 16]). Primary-effect categorisation included analgesia, antibiotics, antidiabetic medications, antiepilepsy medications, antimuscarinic medications, anti-parkinsonism medication, antispasmodic medications, antispasticity medications, contraceptives and hormones, corticosteroids, hypnotics, medications used in the management of osteoporosis, medications used primarily in the treatment of nausea/vertigo, and muscle-relaxant medication (Appendix 3, Table B as compiled from [15, 16]).

Table 1 gives the prevalence of potential side effects of the 221 medications under review. Review of the resources available revealed that 5% of the medications specifically referred to "swallowing difficulties" [15, 16]; however, this figure is potentially misleading because the incidence of other side effects that may directly affect swallowing is significantly higher. Of interest is that over 60% of medications prescribed have been identified in the resources as having gastrointestinal effects, including reflux and pharyngitis. Equally alarming is the fact that over 60% of medications prescribed were found to potentially affect a person's general presentation, including alertness levels and fatiguability.

Thirty-one percent of medications had other relevant side effects such as weight loss and coughing. It should be noted that the American Academy of Otolaryngology–Head and Neck Surgery states that "angiotensin-converting-enzyme (ACE) inhibitors may induce a cough or excessive throat clearing in as many as ten percent of patients" [22]. Twelve percent of medications caused taste disturbances, and the impact of taste disturbances on dietary intake has been highlighted by Mattes et al. [14] who found that disorders of taste and smell resulted in changes in food acceptability, and that "chemosensory dysfunction may be associated with nutritionally important dietary alterations."

Table 1 Percentage of total medications with categorised potential side effects

Effect on swallowing specified	(12/221)	5.4%
Dry mouth; other oral-stage effects	(70/221)	31.7%
Taste disturbances	(17/221)	12.2%
Gastrointestinal effects	(143/221)	64.7%
Effect on general presentation	(133/221)	60.2%
Other relevant effects	(69/221)	31.2%

As reflected in Table 1, 31% of medications were found to contribute to dry mouth and other oral-phase effects. Fifty-five of the 221 medications (24.8%) specifically referred to xerostomia as a possible side effect. The need to consider this side effect is highlighted by other current findings, e.g., the National Institute of Dental and Craniofacial Research [19] states that over 400 medications cause dry mouth. The incidence of xerostomia and other oral-stage effects was not evaluated in all 153 clients due to resource limitations in terms of staff. Of the ten clients randomly selected, six (60%) had xerostomia as evidenced by a combination of oral peripheral examination, client report, and care-giver report (Appendix 2). Of these six clients, all were found to be using from three to nine medications that listed xerostomia as a side effect (Fig. 1).

It is acknowledged that medications that cause xerostomia are used in the treatment of excessive salivation, as had been prescribed to two of the ten subjects who had previously been specifically diagnosed with excessive oral secretions. While these two subjects did not present at the time of the study with xerostomia, it was recommended that they be monitored for potential development of xerostomia. None of the remaining eight subjects had previously presented with excessive oral secretions, according to medical and SLT chart reviews. It is acknowledged that complicated presentations related to such diagnoses as traumatic brain injury/road traffic accidents, which two of the ten subjects had, may also contribute to xerostomia. It is also acknowledged that a limitation of this study is the small sample size.

Conclusions

Given the fact that all six of the ten clients who presented with xerostomia in our study were using medications that may cause xerostomia, it may be proposed that the medications may have contributed to this problem for many, if not all, of these clients. Even when medications causing xerostomia are prescribed in the treatment of excessive oral secretions, the potential for the patient to develop xerostomia as a side effect should also be considered. For this study, the incidence of xerostomia was selected as one side effect that affects eating, drinking, and swallowing in an attempt to infer the incidence of these side effects within the dysphagic population. It is recommended that further studies, on a larger scale and using more sophisticated statistical analysis, be undertaken to evaluate the incidence of medication side effects in dysphagic clients. This article attempted to bring the issue of medication side effects to the forefront of dysphagia research.

It is clear that medication reviews form an important element of the assessment process, and provide the clinician with valuable information "to predict how the individual will cope with eating and drinking and [to determine] the ongoing assessment procedure" [2]. It highlights the need for health-care workers to consider the client holistically, taking into consideration all factors that may affect his/her physiologic functioning and general presentation. There is also the potential for more effective management of clients through interdisciplinary communication, as medications are within the remit of a number of health professionals, including the pharmacist and the physician.

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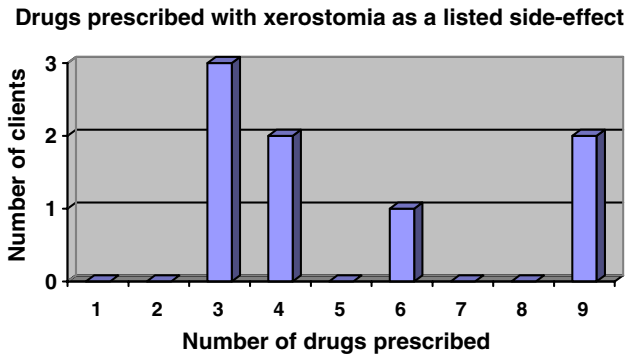

Fig. 1 Number of medications with xerostomia as a side effect being used by each client ($n = 10$)

Appendices

Appendix 1 Headings under which information regarding medications was tabulated (information compiled from [15, 16])

Brand name
Generic name
Drugs group
Effect on swallowing, if specifically referred to in the literature
Dry mouth and other oral-stage effects, e.g., gum hyperplasia, etc
Taste disturbances
Gastrointestinal difficulties, e.g., nausea, vomiting, reflux, etc
Effect on speech, if specifically referred to in the literature
Effect on voice/hearing specified, e.g., dysphonia, hearing loss, etc.
Effect on general presentation, e.g., depression, ataxia, etc.
Other relevant effects, e.g., coughing, weight loss, etc.

Appendix 2 Client information of randomly selected sample of ten

Client	Gender	Age	Severity of oropharyngeal dysphagia[a]	Medical diagnoses	Medications[b]	Xerostomia present
A	F	68	Mild	COPD, hypertension, mild chronic renal impairment, anxiety and depression	*Ipratropium bromide*, alendronate sodium, calcium carbonate, salmeterol xinafoate/fluticasone propionate, *tiotropium*, prednisolone, *lansoprazole*, alprazolam	Yes
B	M	65	Mild	Road traffic accident, alpha1 antitrypsin deficiency	Codeine linctus, calcium carbonate, lormetazepam, deflazacort, *ipratropium bromide/salbutamol sulfate, furosemide*, finasteride, colistin sulfate, *amlodipine besilate*	Yes
C	M	65	Severe	COPD	*Ipratropium bromide/salbutamol sulfate, montelukast*, aspirin, *venlafaxine hydrochloride, esomeprazole, furosemide*, prednisolone, spironolactone, *tramadol*, sodium alginate, *piperacillin/tazobactam*, domperidone, prochlorperazine mesilate, amoxicillin, *hyoscine*	Yes
D	F	77	Mild	COPD, depression	Ceftriaxone sodium, *haloperidol, venlafaxine hydrochloride, furosemide*	Yes
E	M	43	Moderate	Communicating hydrocephalus, ataxia, L hemiparesis, dysarthria	Amoxicillin, lamotrigine, *tizanidine, prochlorperazine mesilate, escitalopram*, sodium alginate	No
F	M	59	Severe	Brainstem infarct, multiple cerebrovascular accidents	Sodium valproate, aspirin, *bicalutamide, buprenorphine, hyoscine, fludrocortisone acetate, ipratropium bromide/ salbutamol sulfate, esomeprazole*	Yes
G	M	60	Severe	Multiple system atrophy	*Paroxetine, carbidopa/levodopa*, fludrocortisone acetate, *esomeprazole*, aspirin, *baclofen*	No
H	M	70	Severe	Intellectual impairment	*Fludrocortisone acetate, furosemide, citalopram hydrochloride, ramipril, hyoscine, desloratidine, prochlorperazine mesilate,* ciprofloxacin, *lansoprazole*, amoxicillin, budesonide, *ipratropium bromide/salbutamol sulfate*	Yes
I	F	30	Mild-moderate	Traumatic brain injury	*Sertraline*, sodium valproate, propranolol hydrochloride, *trazodone hydrochloride, prochlorperazine mesilate*	No; excessive salivation
J	M	67	Mild-moderate	Multiple cerebrovascular accidents	*Hyoscine, lorazepam, ipratropium bromide/salbutamol sulfate*	No; excessive salivation

COPD = chronic obstructive pulmonary disease

[a] DOSS rating scale [21]

[b] Italics indicates those medications that have xerostomia listed as a side effect

Appendix 3

Table A Systems-affected categorisation: information compiled from relevant resources [15, 16]

Drugs groups—main system affected	Effect on swallowing specified	Dry mouth; other oral-stage effects	Taste disturbances	Gastrointestinal effects	Effect on general presentation	Other relevant effects
Cardiovascular		Dry mouth; gum hyperplasia	Y R	Y	Lethargy; fatigue; confusion; myalgia; muscular cramps and weakness; dizziness; peripheral neuropathy and myopathy (usually reversible); ataxia; depression O	Rhinitis; persistent cough; dyspnea; pulmonary alveolitis, pneumonitis and fibrosis; chest pain
Psychiatric		Dry mouth; increased salivation; black tongue; inflammation of tongue and mouth	"Bad taste" in mouth	Y; indigestion	Sedation; tremor; extrapyramidal symptoms; movement disorders and dyskinesia; confusion; ataxia; muscle weakness; depression; impaired concentration	Coughing; increased (or decreased) appetite; weight gain (or loss); chest pain R; respiratory depression; nasal stuffiness; rhinitis
Dementia treatment				Y	Dizziness; confusion; fatigue; agitation	Loss of appetite; weigh loss
Respiratory		Dry mouth		Y F; increased risk of gastro-esophageal reflux disease (GERD) reported	Dizziness; tremor; sedation; psychomotor impairment; CNS stimulation; dehydration; convulsions; arthralgia; myalgia; drowsiness	Coughing; respiratory depression in sensitive clients; upper respiratory tract infections; dyspnea
Gastrointestinal		Dry mouth	Y R	Y; pharyngitis	Dizziness, insomnia, myalgia, arthralgia; depression, tiredness; confusion	Chest pain; weight gain; cough; sinusitis; rhinitis

Y = yes, Y F = frequently reported, Y O = occasionally, Y R = rarely

Table B Primary effect categorisation: information compiled from relevant resources [15, 16]

Drugs groups—main effect of drug	Effect on swallowing specified	Dry mouth; other oral-stage effects	Taste disturbances	Gastrointestinal effects	Effect on general presentation	Other relevant effects
Muscle relaxant		Dry mouth		Y	Drowsiness; fatigue	
Antidiabetic			Y	Y		
Antimalarial				Y	Confusion	Visual disturbances
Nausea/vertigo		Dry mouth			Drowsiness; fluctuating consciousness; ataxia; tiredness; tremor; extrapyramidal effects; depression	Weight gain; nasal congestion
Hypnotics	Y		Bitter/metallic taste	Y R	Drowsiness and lightheadedness; confusion and ataxia; muscle weakness; amnesia; loss of coordination	
Antiparkinsonism		Dry mouth	Y	Y	Dyskinesia; dizziness; depression; abnormal involuntary movements	Anorexia
Antiepilepsy		Hypersalivation in infants; salivation changes; gingival hypertrophy and tenderness; mouth ulcers; inflamed tongue R		Pharyngitis	Confusion; impaired concentration; changes in alertness levels; muscle hypotonia; coordination disturbances; tremor; reversible extrapyramidal symptoms; reversible dementia associated with reversible cerebral atrophy; amnesia; arthralgia; myalgia; ataxia	Dyspnea; coughing; loss of appetite; weight gain
Corticosteroids	Y	Candidiasis		Esophageal ulceration and candidiasis	Depression; tiredness; muscle wastage; muscle cramps; arthralgia; tremor; confusion; proximal myopathy	Weight gain
Contraceptives, hormones		Dry mouth; weakness in facial muscles		Y	Fatigue; drowsiness; dizziness; depression; arthralgia; full or partial loss of muscle control	Breathlessness; weight changes; chest pain O
Osteoporosis	Y	Glossitis R		Y		
Antimuscarinic		Dry mouth		Y; esophagitis	Dizziness; confusion	Chest pain
Antibiotics	Y	Candidiasis; oral ulcerations	"Bad taste" in mouth; taste disturbances	Y; esophagitis	Unsteady gait and tremor; drowsiness; arthralgia; myalgia; arthralgia; muscle weakness; depression; confusion; CNS toxicity; neuropathy; extrapyramidal symptoms	Dyspnea; chest pain; pneumonitis
Analgesia	Y	Dry mouth	Y R	Y	Depression; drowsiness; confusion; myalgia, and muscle weakness	Alveolitis, dyspnea; respiratory depression; chest pain; blurred vision
Antispasticity	Y	"Pins and needles" around mouth; dry mouth; pooling of saliva		Y	Generalised muscle weakness; drowsiness; depression	

CNS = central nervous system

Y = yes, Y F = frequently reported, Y O = occasionally, Y R = rarely

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