Clinical Nutrition (2001) **20(5)**: 423–428

doi:10.1054/clnu.2001.0467, available online at http://www.idealibrary.com on IDEAL®

ORIGINAL ARTICLE

Inadequate fluid intakes in dysphagic acute stroke

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Abstract—Background and Aims: To investigate the fluid intakes of patients with dysphagic acute stroke and to evaluate the effect of disability, the ward speciality and the type of fluid given on oral intake. *Methods*: Patients were prospectively recruited and randomly assigned to receive powder-thickened fluids or ready prepared pre-thickened fluids. Parenteral, enteral and oral fluid intakes, urine output, clinical sequelae and the frequency of requests for biochemical measures of hydration were recorded for a maximum of fourteen days. *Results*: 24 patients with dysphagic acute stroke requiring thickened fluids were recruited from a large teaching hospital. Mean thickened fluid intake was 455 ml/d (SEM $\pm$ 70) resulting in the use of an extra 742 ml/d ($\pm$132) of supplementary fluids. This did not result in an adequate total intake due to insufficient volumes being given for too short a period. Patients not on specialist stroke units who received pre-thickened fluids drank almost 100% more than those on powder-thickened fluids ($P = 0.04$). *Conclusions*: Fluid intakes in this patient group are insufficient to achieve requirements. Hospital staff must ensure adequate fluid intakes in patients at risk of dehydration, which should include both an adequate prescription and provision of supplementary fluids. Pre-thickened drinks improve oral fluid intake in patients with dysphagic acute stroke on non-specialist wards. © 2001 Harcourt Publishers Ltd.

Key words: cerebrovascular accident; deglutition disorders; dehydration; drinking

Introduction

The United Kingdom Department of Health recommends that the fluid intake of hospitalised patients should be a minimum of 1500 ml per day from food and drinks (1). Despite these guidelines inadequate fluid intakes can occur in both the elderly hospital population (2) and in stroke patients (3, 4).

Dysphagia can be defined as a disorder of swallowing mechanics resulting in impairment in the safety, efficiency or quality of eating and drinking and is common following acute stroke (5, 6). Dysphagia can predispose the stroke patient to aspiration (7), chest infection (8), malnutrition (9) and dehydration (10). Dehydration may be associated with a poor outcome in stroke, with evidence linking a raised plasma osmolality on admission to an increase in mortality at three months (11).

The incidence of aspiration is increased when patients with dysphagia ingest liquids of low viscosity (12) and it is routine practice for some of these patients to be prescribed thickened fluids. This is usually achieved using commercial thickening powders made from modified maize starch. However, these may not be ideal in that different quantities are required depending upon the brand used (13), there is inter-subject variability in the understanding of the viscosity achieved (14) and they may negatively affect the taste of some drinks (15). This is supported by studies showing insufficient intakes of powder-thickened fluids (16–18).

Fruit flavoured, ready-made pre-thickened drinks have now been developed that do not require mixing, are of a standard viscosity and could potentially improve supply and uptake of oral fluid. The aim of this study was to investigate the fluid intakes of patients with dysphagic acute stroke and to evaluate the effect of disability, ward speciality and the type of fluid given on oral intake. The study also aimed to monitor the incidence of the clinical sequelae of dehydration and to measure the frequency of requests for biochemical parameters of hydration.

Materials and methods

Patients

Patients were consecutively recruited to the study if they fulfilled the inclusion criteria of a newly diagnosed acute stroke and dysphagia requiring syrup-consistency fluids. A diagnosis of acute stroke was taken from symptomology (19), computed tomography scan (20) or magnetic resonance imaging scan (21). Dysphagia was diagnosed by a Speech and Language Therapist or videofluoroscopy (22). Patients diagnosed with dysphagia using only a screening tool were not included due to the lack of specificity of such tools and therefore the potential for recruitment of patients without dysphagia (23). In

order to recruit a sample of patients who were representative of the subject population and in order to maximise numbers eligible there were no exclusion criteria. Patients or their caregivers provided written informed consent before recruitment and the study was approved by the Wandsworth Local Research Ethics Committee.

Patients were randomly assigned to receive fluids thickened on the ward with powder-thickener as is routine clinical practice (control subjects) or ready prepared pre-thickened drinks (intervention group). For ethical reasons, patients in the intervention group were also allowed hot drinks thickened with powder-thickener as requested. The powder-thickener used (Vitaquick, Vitaflo Ltd, UK) consists of modified maize starch and can be used in both cold and hot drinks. The ready-prepared pre-thickened drinks (Resource Thickened Drink, Novartis Consumer Health, UK Ltd) were available in both apple and orange flavours and were of syrup-consistency. Patients were randomly assigned using a two-way randomization table before any clinical details had been taken. The ward and its speciality was noted for inclusion in the statistical analysis.

Details of the inclusion criteria were extracted from medical notes and scan reports, together with age, sex, past medical history and relevant medication. On recruitment to the study patients were weighed on the ward using sit-down or sling scales. Due to the absence of such equipment on all wards, two patients had their weight taken from recent out-patient medical notes or estimation from two independent observers (dietitian and nurse). Fluid requirements were calculated as 30 ml/kg of body weight. However, for two patients with a body weight of less than 50 kg, a minimum requirement of 1500 ml/day was set. This method of fluid requirement calculation has been shown to be adequate for preventing dehydration in the elderly population (24). The standard 20 point-scale Barthel score was performed at the beginning and end of the measurement period by interview with the patient's nurse. The Barthel score rates 10 functions on a scale from 0 (fully dependent) to 20 (independent), is sensitive to change and is reliable in stratifying disability (25). A patient's average Barthel score was taken as the mean of the scores at inclusion in the study and at the end.

Measurement

The staff-nurse and health-care assistant looking after the patient, together with the Ward Sister or Charge Nurse, were informed of the aim of the study and to which group the patient had been randomly assigned. Staff were asked to continue usual practice with regards to hydration and to record all fluid intakes and outputs hourly on fluid balance charts provided. The patient was provided with an adequate supply of either powder-thickener or pre-thickened drinks at the bedside in line with usual practice. In order to improve the accuracy of volume estimation patients were also provided with a cup that was calibrated in 10 ml increments from which to drink all thickened fluids. Intakes of parenteral and enteral fluids were taken from the content of the fluid containers, the rate of the infusion pump and the length of infusion period and recorded on the same fluid balance chart. Urine output was recorded for all patients with a urinary catheter in situ using calibrated collection bags for accuracy. This data was not collected for patients without a urinary catheter due to the potential for inaccurate nursing estimation of urinary incontinence (26) or for patients receiving diuretics.

A summary of instructions for staff was placed by the patient's bed, in the patient's nursing and medical notes and the ward visited daily by the researcher to ensure compliance in recording. Medical and nursing notes were reviewed daily and fluid intakes, outputs and clinical details noted. The incidence of chest infections and urinary tract infections (UTI) was monitored to indicate the clinical sequelae of aspiration and dehydration respectively. A diagnosis of a chest infection was based upon clinical and radiological evidence, and a diagnosis of a UTI was taken from microbiology reports of a positive urine culture. The frequency of requests for biochemical parameters of hydration, including serum electrolyte, urea and creatinine concentrations and plasma osmolality, was taken from the hospital biochemistry computer database. Data was collected for fourteen days or until the patient no longer required thickened fluids.

Statistical analyses

Data was entered into spreadsheets (Microsoft Excel, version 97) and the mean and standard error of the mean calculated for fluid intakes and urine outputs. The inter-group means were compared using Student's *t*-test for unpaired data. Fisher's exact test was used to compare the incidence of UTI between groups using the statistical analysis package Stata (version 5.0, Stata Corporation, Texas).

Results

Twenty-four patients with acute dysphagic stroke requiring thickened fluids were recruited to the study

Table 1 Mean fluid intakes in all 24 patients

	Mean daily fluid intake[1]	
	ml	% daily requirements
Total oral	455 (70)	22 (3)
Total enteral	424 (137)	20 (7)
Total parenteral	318 (95)	17 (5)
Total non-oral	742 (132)	37 (7)
Total fluid intake	1197 (99)	59 (5)

[1]Mean (±SEM)

between May 1999 and December 1999. The mean age of the patients was 72.3 years (SD ± 13.4), the mean Barthel score was 4.0 (± 5), and the mean body weight was 67.7 kg (± 12.7). The data collected represented a total of 240 patient-days. No patient refused admission to the study.

Fluid Intake

The mean daily intake of thickened fluid was 455 ml/d representing an average of 22% of the daily fluid requirements for those patients (Table 1). This inadequate intake resulted in the need for supplementary enteral and parenteral fluids. Despite this the average total fluid intake for the study period was only 1197 ml/d, corresponding to only 59% of the patients' fluid requirements.

This data represents average intakes of oral and non-oral fluids for the whole of the monitoring period. However, they do not indicate whether the inadequate supplementation was due to inadequate volumes being given every day or adequate volumes that were not being given for enough days. The data was analysed to show the volumes of supplementary fluids given per day calculated only for those days on which they were prescribed (Table 2).

Most patients were prescribed some supplementary fluid. However on the days that it was prescribed the amount given achieved an average of 64 % or less of those patients' requirements. Of the patients prescribed supplementary fluids during the study period, they were given them only for an average of 64–67% of the days.

Symptoms of dehydration

For those patients with a urinary catheter in situ ($n = 17$) mean urine output was 1162 ml/d (SEM ± 78). With a mean total daily fluid intake in these catheterized patients of 1272 ml/d (± 115), their mean fluid balance was only + 110 ml/d (SEM ± 75). During the study period a total of 7 UTI's were diagnosed in six different patients all of whom were catheterised, whilst only one patient was diagnosed with aspiration pneumonia. There was no statistically significant difference in the incidence of chest infection or UTI between those receiving powder-thickened fluids or ready prepared pre-thickened fluids.

Physicians requested measurement of biochemical parameters of hydration at least once for every patient, these were repeated on average every 3.5 days (SD ± 2). Of the seventy-one samples requested, the mean results for serum sodium, urea and creatinine concentrations were 137 mmol/l (SD ± 5), 7.6 mmol/l (± 3.7) and 80 μmol/l (± 22) respectively, excluding data for one patient with chronic renal failure. During the time course of the study, two patients had a hypernatraemia (serum sodium > 145 mmol/l), twelve patients a hyperuraemia (serum urea > 8 mmol/l) and three patients a hypercreatininaemia (serum creatinine > 120 μmol/l). There were no statistically significant differences in total fluid intake and fluid balance on the days these abnormal samples were taken compared to the days when normal values were found. In addition, serum concentrations of sodium, urea and creatinine did not correlate with daily total fluid intake, fluid balance, previous days total fluid intake or previous days fluid balance (data not shown). There were no requests for measurement of plasma osmolality for any of the patients during their enrolment on the study.

Factors affecting fluid intake

The affect of disability on intake was compared by plotting Barthel score against oral fluid intake (Fig. 1). There was an inverse association between disability and oral fluid intake in the study population, those with a lower Barthel score tended to drink less. However, the

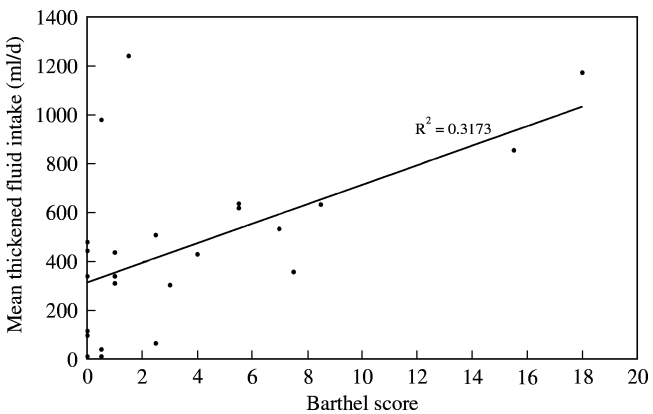

Fig. 1 Comparison of oral thickened fluid intake and level of disability.

Table 2 Number of patients receiving supplementary fluids, the percentage of days for which they were given and the volume infused on those days

Type of fluid	No. of patients	% of days they received supplementary fluids[1]	Mean volume infused	
			ml/d	% requirements
Enteral	11	64% (11)	1307 (174)	64 (8)
Parenteral	10	67% (9)	1087 (94)	55 (6)

[1]Mean (± SEM)

Table 3 Baseline characteristics for inter-group analysis

	Sample size (*n*)	Total no. days monitored	Mean Age[1] (year)	Barthel score	Weight (kg)
Acute Stroke Unit					
Powder thickened	6	67	63.2 (17.4)	4 (7)	74.1 (8.9)
Pre-thickened	6	54	76.5 (14.9)	3 (3)	69.4 (13.2)
Non-specialist ward					
Powder thickened	7	68	70.6 (8.1)[2]	3 (3)	62.7 (12.8)
Pre-thickened	5	51	80.6 (6.3)[2]	5 (6)	64.9 (15.6)

[1]Mean (±SD).
[2]Significantly different $P = 0.04$.

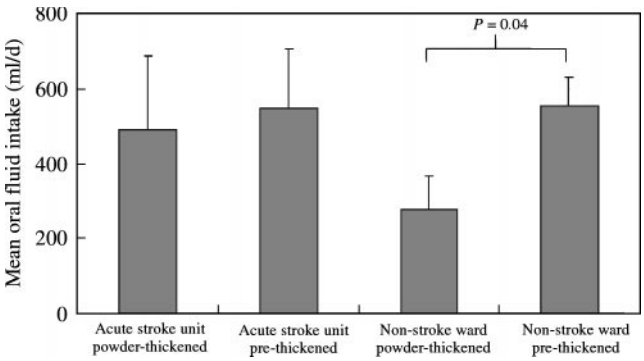

Fig. 2 Inter-group comparison of the mean daily oral fluid intake (±SEM) depending upon ward and type of fluid given.

distribution of the data-points indicates that a low Barthel score does not always predispose a patient to lower fluid intake.

Oral fluid intakes were then analysed in sub-groups depending upon the ward the patient was on and what type of fluid was given. Baseline characteristics for each group are shown in Table 3. Figure 2 shows the mean oral thickened fluid intake in the different patient groups. Patients not on specialist stroke wards drank 276 ml/d more if they received pre-thickened fluids as opposed to powder-thickened fluids alone ($P = 0.04$). This corresponds to almost a 100% increase in intake, although still well below individual requirements. On the Acute Stroke Unit (ASU) the type of fluid given did not affect patient intake. Of the 11 patients in the intervention group receiving pre-thickened fluids, 10 of them also chose to have hot drinks thickened with powder thickener. In this group, hot powder-thickened drinks contributed to 32% (SEM ± 7) of their total fluid intake.

Discussion

An instruction for thickened fluids may be viewed by staff as 'a prescription for dehydration' (27). The results presented here confirm that in the stroke population oral intakes of thickened fluid are hugely inadequate and indeed no patient was able to achieve their daily fluid requirement through oral intake alone. The mean intake of 455 ml approximates to only 2½ hospital cups of fluid every day.

This sub-optimal intake supports previous studies suggesting that dysphagia predisposes the patient to dehydration (10), despite this observation few published studies have measured actual intake.

Garon et al. (16) compared thickened fluid intake in dysphagic stroke patients some of whom were also allowed free access to normal water. Those who were allowed only to drink thickened fluids had a mean daily intake of 1210 ml/d, with no differences in total fluid intakes compared with patients also allowed normal water. Ramage et al. (17) demonstrated a mean total fluid intake in 29 nursing home residents with all-cause dysphagia of 1432 ml/d. These values are greater than in the current study and the disparity is likely due to sample differences and methodologies. Garon et al. (16) excluded patients with poor cognition and patients who were unable to hold a cup or self-feed, whilst Ramage et al. (17) were not dealing with acute dysphagia and also measured the fluid contribution from food.

Philip and Greenwood's (18) study of 21 chronic-care hospital patients requiring thickened fluids and pureed diet demonstrated that of the 594 ml/d of thickened fluids offered to the patients only 301 ml/d was consumed. However an extra 733 ml/d of fluid was obtained from pureed diet. Fluid intake from food was not measured in the current study because not all patients were allowed puree diet (17 out of 24 on puree) and because variations in the menu cycle would affect intake. Furthermore, clinicians often make the decision to prescribe supplementary fluids based on data from fluid balance charts and these rarely include the fluid ingested from food.

The inadequate oral intake of thickened fluids required the use of supplementary enteral and parenteral fluids. However, the average amount given during this study period equated to a mean of only 37% of the patients' calculated requirements. If these results are then analysed to measure the amounts given only on the days when it was prescribed (Table 2) it can be seen that this problem is two-fold: an insufficient daily volume infused and for too few days.

Some of the causes of this inadequate fluid intake, namely disability, fluid type and ward speciality were

investigated here. The association between disability and lower oral fluid intakes supports previous work (2) of an inverse relationship between nursing-dependency and fluid intake. The reasons may be explained in part by the results of a questionnaire survey of hospitalized patients all of whom needed help to drink: 91% did not want to bother busy staff; and 55% were too embarrassed to ask for help (28).

Patients on non-specialist stroke wards who received fluids thickened with powder were only able to drink 278 ml/d, this is comparable to the 301 ml/d from the Philips and Greenwood (18) study. The use of pre-thickened fluids on such wards resulted in an increase in oral fluid intake of almost 100%. The reasons for this may be multi-factorial and due to both provision and consumption problems. An audit of the compliance of ward-staff in the delivery of thickened fluids to dysphagic patients, showed that the use of powder thickeners resulted in less than 50% of patients receiving fluids thickened to the correct consistency, if they were thickened at all. After the introduction of pre-thickened fluids more than 75% of patients received the correct thickness of fluid (27). Patients on the ASU did not differ in their oral fluid intake no matter what group they were randomly assigned to. This may be due to the expertise of the nursing staff in dealing with patients with dysphagia, together with extra training given to them by specialist members of the multi-disciplinary team and the support of a Clinical Nurse Specialist.

Powder thickeners may also negatively affect the taste of some liquids (15) and their use requires a subjective assessment of when adequate thickness is achieved. However there is no inter-subject and intra-subject agreement on when this point is achieved (14) and consequently drinks are frequently made too thick which reduces palatability and increases wastage (29). Powder-thickened fluids are therefore viewed as intolerable and a major cause of patient refusal (17). The fruit-flavoured pre-thickened drinks used here provide 372 kJ of energy per 100 ml, compared to 289 kJ/100 ml for fruit juice thickened with powder-thickener. However, the pre-thickened drinks are twice as expensive compared to the cost of the powder-thickener alone, although the cost of the powder-thickener does not take into account the cost of the fluid to be thickened (e.g. fruit juice) and this added cost may be offset by the benefits of an increased intake.

Despite the clinical importance of adequate hydration an alarmingly low fluid intake has been shown in this study. However, the level of patient disability, the ward speciality and the type of fluid given cannot solely explain this inadequate fluid intake and other factors are likely to have contributed. Ensuring adequate hydration in the clinical setting is a multi-stage process with shared responsibility and defined roles for physicians, dietitians, nurses, healthcare assistants, pharmacists and family members. The difficulties associated with maintaining hydration in the dysphagic stroke patient include problems with delivery of sufficient thickened fluids, adequate prescription of supplementary fluids and the identification of dehydration. Patients requiring thickened fluids are offered approximately 50% less fluid to drink than those requiring normal fluids (18). Reasons for this include less priority given by busy ward staff to the patients need to drink and a lack of understanding of the need for thickened fluids amongst family and staff (17, 27). Prophylactic fluid restriction following stroke may be common practice in some departments in order to reduce the extent of cerebral oedema. However, this is unlikely to be the case in this study since neither local nor national guidelines recommend this form of management following stroke (30, 31). In this instance, the inadequate prescription and delivery of supplementary fluids is more likely related to a lack of knowledge of fluid requirements amongst hospital staff (2). Dehydration may go unnoticed in this patient group because clinical symptoms such as cognitive impairment, confusion and a predisposition to UTI's are also common in stroke. Furthermore, dehydration remains difficult to diagnose biochemically, with electrolyte and urea concentrations demonstrating large inter-patient variability (32). The results of this study showed no correlation between the traditional biochemical markers of hydration and daily fluid intake or fluid balance. This supports other studies which suggests that biochemical markers are unreliable as a sole marker of dehydration (32).

The problems associated with the provision of adequate hydration to hospitalized patients has obvious similarities to the provision of adequate nutrition. However, the prevalence and consequences of undernutrition has received much more attention in the literature (33) and as a result improvements in undergraduate medical training and knowledge have been made (34). Further education and training of all grades of medical, nursing, dietetic and ward staff on fluid requirements and the importance of adequate hydration in stroke may be beneficial.

Fluid balance charts were considered to be an accurate method of recording daily fluid intake because nurses are very familiar with them and other studies have used them as a monitoring method (4, 17). However they do not measure fluid output from faeces, respiration and perspiration and therefore cannot represent absolute fluid output. Using fluid balance charts rather than direct, time intensive 24-hour observation allowed a monitoring period of 14 days which would thus reduce the error introduced by within-person variation in intake. In order to ensure compliance in recording on the charts it was not possible for this study to be conducted covertly, and it is conceivable that the presence of the researcher visiting the ward daily resulted in a change in nursing practice with respect to offering of drinks. The small sample size used in this study corresponds to the sum total of the patients requiring thickened fluids for dysphagia in

acute stroke in a large teaching hospital over an eight month period.

All hospital staff responsible for the care of patients at risk of dehydration and particularly those who are highly dependent need to be aware of the importance of adequate hydration. Education and training is required and is currently being implemented at a management level via the Nutrition Strategy Committee of the hospital.

Acknowledgements

This study was funded by Novartis Consumer Health, UK Ltd. The author thanks the Department of Speech and Language Therapy, St. George's Hospital and the Nursing and Medical staff for their involvement in this study.

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Submission date: 15 January 2001 *Accepted:* 17 April 2001 *Published online:* 6 August 2001