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Accuracy of contrast swallow study in assessment of caustic esophageal stricture length in children: Agreement study☆,☆☆

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ABSTRACT

Background: Caustic esophageal stricture length assessment is essential for planning endoscopic management and predicting its prognosis. We aimed to assess the accuracy of contrast swallow study (CSS) in measuring stricture length in comparison to endoscopy (definitive investigation for actual length measurement).
Method: Medical records of caustic esophageal strictures between 2010 and 2020 were retrospectively reviewed. Reliability study was done to compare between radiological and endoscopic measurement of stricture length.
Result: 124 CSSs for 91 patients were analyzed. Six studies showed no stricture, single stricture was reported in 101 studies, double strictures were reported in 16 studies, triple strictures were reported in one study (136 radiological stricture). Endoscopy revealed 133 true strictures. Number of the strictures was consistent between CSS and endoscopy in 112 studies (90.3%) and different in 12 studies (9.7%). Eight endoscopies revealed strictures not reported in CSS (5.5% false negative strictures), while 10 CSSs reported 11 strictures that were not detected during the endoscopy (7.6% false positive strictures). Reliability analysis revealed interclass correlation coefficient = 0.6 (95% CI 0.5 to 0.7) indicating moderate reliability.
Conclusion: CSS is not accurate in assessing caustic esophageal stricture length. Combination of CSS and endoscopic investigation is better for proper evaluation of these patients.
Level III of evidence

Accidental caustic ingestion is still a common cause of esophageal stricture in the developing country with variable degrees of esophageal affection resulting in a very wide range of injuries [1,2]. In practice, we face a wide range of stricture lengths from a localized one to a stricture involving the whole esophagus. The first line of management is endoscopic dilatation in almost all cases [3,4]. Many authors reported that the stricture length is an important prognostic factor for the success of dilatation program [5–7]. Long strictures need a longer period of management with less success rate than short strictures [8,9]. The primary assessment of established esophageal stricture and associated dysphagia is usually the contrast swallow study (CSS) which gives the first impression for the stricture length and the degree of injury. Thereafter, and based on CSS result, surgeon may inform the parent about the primary expectation regarding the prognosis, and may take an early decision to perform a feeding gastrostomy. In this work, the authors were attempting to assess the accuracy of CSS in evaluating caustic esophageal stricture length as compared to the definitive endoscopic investigation.

1. Patients and methods

Medical records of patients with caustic esophageal strictures managed in the pediatric surgery department, Ain Shams University, during the period from 2010 to 2020 were reviewed. We included in this retrospective analysis the well documented good quality CSS done for caustic stricture cases. All these cases had a session of endoscopic dilatation after these contrast studies reporting the actual length of the stricture. This was done using flexible upper GI endoscopy (Pentax® Europe GmbH EPM-3500, 22527 Hamburg, Germany). In symptomatic patients with dysphagia, our protocol is to perform the first contrast swallow 4 weeks after caustic ingestion to schedule the first endoscopic session 6 weeks after ingestion. And during the dilatation program we usually repeat the CSS for follow up after 3, 6, and 12 months to document the progress of dilatation in coherence of clinical symptom of dysphagia.

We compared the endoscopic findings with the radiological assessment of the CSS to estimate the accuracy of the initial data about

Abbreviation: CSS, contrast swallow study.

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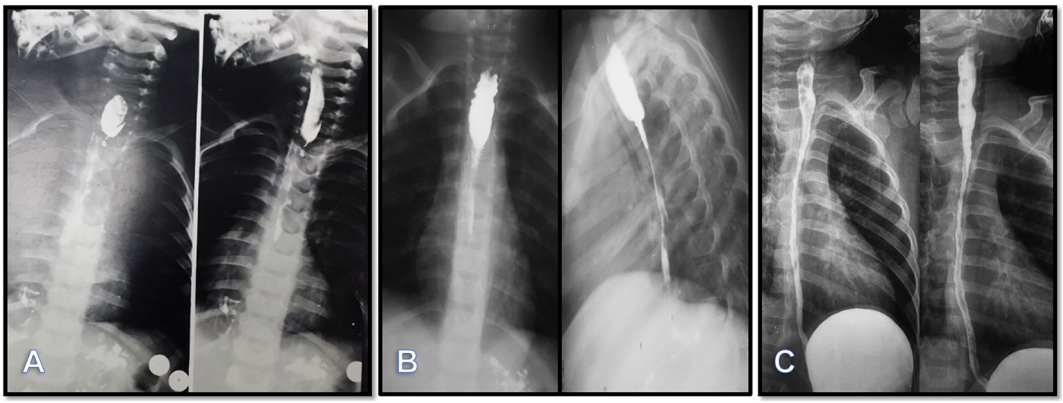

Fig. 1. Contrast studies reported a long radiological esophageal stricture that revealed a short actual stricture on endoscopy; **A:** 11 cm radiological length versus 2 cm endoscopic length, **B:** 7 cm radiological length versus 2 cm endoscopic true stricture, **C:** 12 cm radiological length versus 1 cm endoscopic length.

stricture length given by this imaging modality. Radiological stricture is stated when there is a constant narrowing of the esophagus in serial films, while endoscopic measurement of the stricture is estimated after esophageal dilatation measuring the length of the esophagus with denuded mucosa after dilatation in centimeters. These CSSs were further divided into two groups, initial CSS and follow up CSS, and both were compared to their endoscopic findings accordingly.

The contrast swallow studies were done with 65 kW x-ray generator, Luminous dRF MAX, Siemens ®. As it was a retrospective study, the documented images were saved in a JPEG format. The images were converted back to its original DICOM format using assistant program called JPEG to DICOM converter; then the images were analyzed with measuring the stricture length in centimeters using RadiAnt DICOM viewer.

Reporting of the CSS was done by single consultant radiologist, and the endoscopic assessment was done by one consultant pediatric surgeon who had more than 10 years' experience in performing endoscopic dilatation. The study was approved by the institutional review board at pediatric surgery department, Ain Shams University.

Statistical analyses were performed using SPSS version 22 (IBM© Corp., Armonk, NY). Quantitative data are expressed as median and interquartile range, while categorical data were presented as absolute number and percentage. Interrater reliability analysis (Agreement testing) was done to measure the interclass correlation coefficient (ICC). Obtained ICC was computed using a single-rating, absolute-agreement, 2-way random-effects model. Based on the 95% confident interval of the ICC estimate, ICC values less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively [10].

2. Result

One hundred and twenty-four contrast swallow studies for 91 patients (44 boys and 47 girls) were enrolled for this study. Their age ranged from 1 to 8 years (median = 2.5 years). These documented 124 CSS included six studies with no stricture, 101 studies with single stricture, 16 studies with double strictures, and one study reported triple strictures. Contrast studies showed 136 radiological strictures while, on the other hand, endoscopy revealed 133 strictures (true strictures). Collectively, radiological and endoscopic, we had 144 sets of strictures for which agreement study was performed. Number of the strictures was the same (single or two strictures) in both CSS and endoscopy in 112 studies (90.3%), while it was different in 12 studies (9.7%). Eight endoscopies revealed strictures that were not reported in radiological studies (5.5% false negative strictures), while 10 radiological studies reported 11 strictures that were a false impression not detected during the endoscopy (7.6% false positive strictures). There were cases where CSS reported a long radiological esophageal stricture that revealed a short actual stricture on endoscopy (Fig. 1) and vice versa.

Reliability analysis done for all 144 sets of measurements revealed ICC = 0.6 (95% CI 0.49 to 0.7) that indicates moderate reliability (Table 1). And Bland Altman Plot chart showed moderate agreement between both sets of measurements (Fig. 2).

Reliability analysis done for initial CSS group only (73 studies) revealed ICC = 0.58 (95% CI 0.41 to 0.71), while analysis of follow up group (71 studies) revealed ICC = 0.61 (95% CI 0.44 to 0.74).

3. Discussion

Esophageal stricture length is considered an important prognostic factor for success or failure of endoscopic dilatation management, and it gives a prediction for the duration of management needed which is a question that child's parents frequently ask to be prepared for that journey of management [5–7]. Contrast swallow study is the standard investigation to evaluate patient's dysphagia after caustic ingestion [11–13]. Many pediatric surgeons and endoscopists depend on CSS results to inform the parents about their primary expectation of the dilatation management outcome, and some may take a surgical decision of esophageal replacement or establishing a feeding gastrostomy based on the primary contrast study report [14]. On our practice, we observed and were faced with many situations where we were surprised with an endoscopic finding that is far away from the radiological data. So, we conducted this retrospective agreement study to compare between stricture length measurements as reported by CSS and the actual length as measured by endoscopy. Our data revealed that there is only moderate agreement between both measurements with ICC of 0.6 indicating moderate reliability of radiological assessment of the esophageal stricture length. And in further evaluation of our data, there was a very small difference in the accuracy between initial CSS and late follow-up

Table 1
Intraclass Correlation Coefficient calculation for the agreement between radiological and endoscopic length measurements.

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.605	.491	.699	4.063	143	143	.000

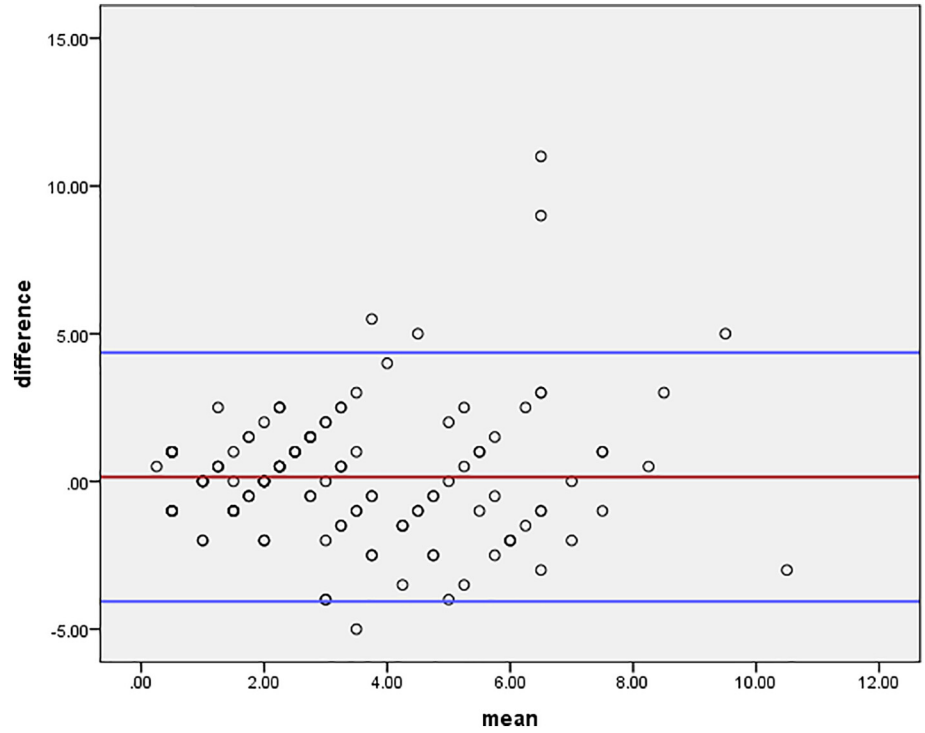

Fig. 2. Bland Altman Plot chart showed the moderate agreement between radiological and endoscopic measurements of the stricture length.

CSS where both showed moderate agreement with the true endoscopic findings (0.58 and 0.61, respectively).

Interclass correlation coefficient is a reliability index that reflects strength of association and agreement between different readings. It ranges from 0 that indicates no association to 1 that represents a perfect agreement. There are many guidelines for interpretation of ICC value, and it is to be noted that it is the judgment of researcher to accept or reject the variations in the measurement according to the clinical situation [10]. And so in this current work, and based on our institution experience in that field, we think that we can't take accurate decision for patient prognosis according to CSS results based on that low ICC.

The fallacy in the radiological results for assessing the actual stricture length could be explained by underfilling of the contrast in the normal part of the esophagus distal to a short narrow stricture giving the false impression of long stenosis or the presence of false distal stricture. On the other hand, failure of CSS to detect distal true stricture can be explained by the poor filling of the normal esophagus between the two strictures that show no discrepancy in the esophageal caliber in between and no dilatation proximal to the distal stricture. In another situation, a contrast filling of diffusely stenosed esophagus may give the impression that there is no narrowing as the whole esophagus has the same caliber without discrepancy especially if there was a mild diffuse narrowing. Another explanation for this difference between CSS and endoscopy is the lag between the time of the CSS and the time of endoscopy session in some cases, where there may be possibility for resolution of some esophageal wall edema versus progression of the fibrosis with more stenosis.

To our knowledge, this is the first agreement study in English literature to assess the accuracy of CSS in measurement of esophageal stricture length in children. In adult literature, Szczesniak and his colleagues assessed the accuracy of videofluoroscopic swallow examination in detection of cricopharyngeal radiation strictures where they revealed diagnostic sensitivity and specificity of 0.76 and 0.58, respectively [15].

Our study is limited by its retrospective design and included only the well reported cases presented during the study period. The endoscopic evaluation was done by a consultant surgeon who has a long experience in endoscopic dilatation that potentiate the accuracy of the endoscopic assessment, the blinded review of the radiologic findings, and good sample size over long study period would strengthen the overall conclusions of our study. Further prospective study with blinded review of videofluoroscopic imaging compared with blinded endoscopic assessment is justified to substantiate our findings.

Another issue that should be addressed is the risk of repeated exposure to ionizing radiation when following up these patients with CSS, so asking for follow up CSS should be judged carefully according to each patient condition. On the other hand, endoscopy has its added stress on child and his parents plus the risk of anesthesia exposure, so endoscopy should be restricted to symptomatic patients and not be used library as a follow up investigation for these patients.

In conclusion, although these findings don't justify a change in the current protocol of management and we still recommend the CSS as a primary workup for assessing the caustic esophageal stricture, surgeon should be cautious while depending on it for actual assessment of stricture length, planning for patient's management protocol, and expecting patient's prognosis. Combination of both CSS and endoscopic investigation is recommended for proper and more accurate evaluation of caustic esophageal stricture patients.

Disclosures

The authors have no conflicts of interest or financial ties to disclose.

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