

The outcomes of fundoplication and gastrostomy in neurologically impaired children in a tertiary care hospital in Saudi Arabia

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ABSTRACT

الأهداف: تقييم هذه الدراسة نتائج تشنية فوهة المعدة و تفميم المعدة في الأطفال المصابين بإعاقات عصبية في مدينة الملك عبدالعزيز الطبية بالحرس الوطني، الرياض، المملكة العربية السعودية.

الطريقة: في هذه الدراسة تمت مراجعة ملفات طبية بتأثر جعي لـ ١٧٨ من الأطفال المصابين بإعاقات عصبية حتى سن ١٤ سنة، والدراسة تشمل الذين عملوا تشنية فوهة المعدة و تفميم المعدة بين الأعوام من ١٩٩٩ و ٢٠١٤ م.

النتائج: بعد عملية تشنية فوهة المعدة وجدنا أن معدل الإصابة (للشخص-في الشهر) لجميع حالات النوم في المستشفيات (0.95 vs. 0.13, $p<0.001$) ، ومعدل النوم بسبب الارتداد المعدى المريئي (vs. 0.09, $p>0.001$ 0.67) ، ومعدل النوم بسبب نوبات الصرع (vs. 0.01 0.21, $p<0.001$) ، وكل زيارات قسم الطوارئ (vs. 0.23, $p=0.94$) ، والزيارات بسبب الارتداد المعدى المريئي (vs. 0.61, $p>0.001$) ، والزيارات بسبب الصرع (vs. 0.12, $p>0.001$) ، والزيارات بسبب الصرع (vs. 0.24, $p<0.001$) ، 0.01 انخفضت بشكل ملحوظ. و وجدنا أن معدل الوفيات بعد عملية تشنية القاع ٣٥٪. على أن الخطير المتوقع للوفاة هو للذكور (p=0.027, odds ratio: 2.2) وللأطفال في حال اللا انعاش (odds ratio: 5.2, $p<0.001$, odds ratio: 5.2) غالبية الأطفال الذين ماتوا خلال عام بعد العملية كانوا الأطفال في حال اللا انعاش.

الخاتمة: عملية تشنية فوهة المعدة مع تفميم المعدة هي فعالة في الحد من النوم في المستشفيات و زيارات قسم الطوارئ المتكررة من الارتداد المعدى المريئي و نوبات الصرع عند الأطفال المصابين بعجز عصبي . و نظرًا لارتفاع معدل الوفيات في غضون عام من عمل عملية تشنية فوهة المعدة مع تفميم المعدة في الأطفال الذين يعانون من حال اللا انعاش، فقد تكون الأدوية المضادة للارتجاع وتفميم المعدة بدليلاً مناسب.

Objectives: To evaluate the outcomes of fundoplication and gastrostomy (GT) in neurologically impaired (NI) children.

Methods: A retrospective review of medical charts was performed on 178 NI children up to the age of 14 years inclusive, who underwent fundoplication and GT between 1999 and 2014.

Results: After fundoplication, the incidence-rate (person-month) of all hospital admissions (0.95 versus 0.13; $p<0.001$), gastroesophageal reflux (GER) - related admissions (0.67 versus 0.09; $p<0.001$), and admissions for seizures (0.21 versus 0.01; $p<0.001$) were significantly decreased. Furthermore, all emergency department visits (0.94 versus 0.23; $p<0.001$), GER visits (0.61 versus 0.12; $p<0.001$), seizure visits (0.24 versus 0.01; $p<0.001$) were significantly reduced. The mortality rate after fundoplication was 35%. The risk factors for predicting mortality were being male (odds ratio: 2.2, $p=0.027$) and being a do not resuscitate (DNR) child (odds ratio: 5.2, $p<0.001$). Majority of the children that died within a year after the procedure were DNR.

Conclusions: Fundoplication with GT is effective in reducing hospital admissions and emergency department visits from GER and seizures in NI children. Because of high mortality within a year of fundoplication with GT in DNR children, anti-reflux medications with GT might be an alternative.

Saudi Med J 2019; Vol. 40 (8): 810-814
doi: 10.15537/smj.2019.8.24052

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Received 10th March 2019. Accepted 28th July 2019.

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Neurologically impaired (NI) children frequently have oropharyngeal dysfunction and gastroesophageal reflux disease (GERD). Oropharyngeal dysfunction in NI children has reported prevalence over 90%.¹ Because oropharyngeal dysfunction may be associated with repeated pulmonary aspirations, chest infections, and life-threatening events enteral feeding is required. Enteral feeding could be through either a nasogastric tube or a gastrostomy (GT). The GT use is more convenient and associated with a substantial increase in nutritional status as by weight gain, a significant reduction in feeding times, ease of administration of medications and improvement in the quality of life of the caregiver.¹⁻³ Gastroesophageal reflux disease has a reported incidence as high as 70% in NI children.¹ Treatment of GERD in NI children includes the use of acid-suppressant drugs, proton pump inhibitors (PPIs) and histamine-2 receptor antagonists. For both healing of erosive esophagitis and relief of symptoms, which is successful in most patients, PPIs are superior to histamine-2 receptor antagonists.¹ Medical treatment may fail in some NI children and ultimately those with severe manifestations of recurrent pulmonary aspirations or failure to thrive do require anti-reflux surgery, fundoplication.¹

Because fundoplication leads to an impressive overall improvement of symptoms, it has become the surgical treatment of choice for treatment of GERD in NI children.^{4,5} Potential outcomes that evaluate the impact of anti-reflux surgical intervention include resolution of symptoms, nutritional outcome, children's quality of life, morbidity and mortality.¹ This study aims to evaluate the outcomes of fundoplication and GT in NI children at our institution.

Methods. After obtaining approval from the Institutional Review Board and Scientific Research Committee at the King Abdulaziz Medical City-Riyadh (KAMC-R), a retrospective cross-sectional study was conducted on NI children ≤14 years with GERD who had fundoplication and GT between 1999 and 2014 which was the inclusion criteria.

Our exclusion criteria were children older than 14 years old and any child who had fundoplication performed in another institute.

Data obtained from the medical charts included patients' demographics, clinical presentation, diagnoses,

radiological investigations, surgical procedures, complications, mortality, frequency of admissions and emergency department (ED) visits before and after fundoplication. Preoperative investigations included upper gastrointestinal (UGI) contrast study, milk scan, UGI endoscopy, and barium swallowing assessment. All patients had treatment of GERD with anti-reflux medications including proton pump inhibitors or histamine-2 receptor antagonists for minimum of 6 weeks and were fed through a nasogastric tube. Indications for surgery in NI children with objectively proven GERD and adequate anti-reflux therapy included repeated pediatric intensive care unit and ward admissions from recurrent pulmonary aspirations, cases of pneumonia, or life-threatening events, failure to thrive and recurrent vomiting.

The data was entered and analyzed using Statistical Package for Social Sciences, version 24.0 (IBM Corp., Armonk, NY, USA). The analysis used frequencies and proportions for categorical variables and mean with standard deviation for continuous variables. Paired sample t-test and the incidence rate (person-month) were used to compare the mean of hospital admissions and ED visits. Also, multivariate analysis to predict the mortality risk factors was done by binary logistic regression. Any $p<0.05$ was considered significant.

Results. A total of 178 NI children underwent fundoplication with GT, 108 being males with a male-to-female ratio of 1.5:1. The mean age at fundoplication was 37.5 months (range 2-163 months). The neurological problems included hypoxic-ischemic encephalopathy (HIE) in 51 children (29%) (Table 1). Eighty NI children (49%) were spastic and 66 children (37%) were flaccid. Before fundoplication and GT, tracheostomy was performed in 12% of the children and 6% had scoliosis. The most common clinical presentations of the children were either respiratory or gastrointestinal symptoms (Table 1).

Diagnostic investigations for GERD included UGI contrast studies in 76.4% of children and milk scan in 51.7% of children. The GT was performed in 8% of NI children before fundoplication, 90% with the procedure and 2% after. Laparoscopic fundoplication (LF) was performed in 58% of NI children. The mean age and mean follow-up at fundoplication insertion was 36 months (range 1-163 months) and GT was 44 months (range 0.25-206 months). Early postoperative complications (61%) were from the GT site-or tube-related problems (Table 2). The majority of the complications was from GT site infection and leakage. Some late complications (3%) occurred in NI children who had open fundoplication (OF), which included 3

Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

Table 1 - Patient demographics, neurological diagnoses and clinical presentation.

Variables	n
<i>Gender</i>	
Male	108
Mean age at fundoplication	3 years
Median follow-up	2.4 years (Range: 1 month - 17.2 months)
<i>Neurologically related diagnoses</i>	
Hypoxic-ischemic encephalopathy	51
Seizure disorder	33
Syndromes	33
Cerebral palsy	32
Encephalopathy	11
Congenital malformation	8
Metabolic	6
Traumatic brain injury	3
<i>Respiratory clinical presentation</i>	
Recurrent episodes of aspiration	127
Mechanical ventilation	65
Chronic cough	54
<i>Gastrointestinal presentation</i>	
Nasogastric tube-fed	144
Failure to thrive	98
Recurrent vomiting	62

Table 2 - Predictors of mortality risk factors.

Variables	P-value	Odds ratio
Gender (male)	0.027*	2.2
Do not resuscitate child	<0.00*	5.2
All types of neurological impairments	1	0.0
Age at fundoplication	0.87	1.1
Type of fundoplication	0.29	0.6
Scoliosis	0.23	1.6
Tracheostomy	0.74	1.2
Gastrotomy site infection	0.36	1.7

*Any $p<0.05$ is considered significant**Table 3** - Early and late postoperative complications.

Variables	n
<i>Early GT site</i>	
Infection	127
Leakage	65
Dislodgment	54
Granuloma	26
Bleeding	5
<i>Procedural</i>	
Wound dehiscence	4
Esophageal perforation	2
Intraperitoneal leakage	2
Pleural effusion	1
<i>Late</i>	
Intestinal obstruction	3
Wrap failure	3

GT - Gastrostomy tube

patients who received an adhesive bowel obstruction that required laparotomy and adhesiolysis. And 3 patients who had wrap failure and had redo fundoplication due to the recurrence of GERD symptoms. The median hospital stay after fundoplication and GT in the wards was 23 days (range 6-117 days) and in the pediatric intensive care unit (PICU) the median stay was 13 days (range 1-25 days). After fundoplication, there was significant reduction in the incidence rate (person-month) of all hospital admissions (0.95 versus 0.13; $p<0.001$), gastroesophageal reflux (GER)-related admissions (0.67 versus 0.09; $p<0.001$), and admissions for seizures (0.21 versus 0.01; $p<0.001$). Furthermore, all emergency department (ED) visits (0.94 versus 0.23; $p<0.001$), GER-related visits (0.61 versus 0.12; $p<0.001$), seizure-related visits (0.24 versus 0.01; $p<0.001$) decreased remarkably. At follow-up 56% of children were prescribed anti-reflux medication at least once for presumed GERD recurrence without proper investigations.

The mortality rate after fundoplication and GT was 35 % during the 15-year study period. The causes of the mortality were based on clinical assessment and not post-mortem reports. They were possibly from aspiration pneumonia (43%), septic shock (26%), undetermined (22%), renal failure (6%) and 3% cardiac (3%). There were 5 deaths (3%) within the first 30 postoperative days. Using logistic regression analysis, the risk factors for predicting mortality were either being male (OR, 2.2, $p=0.027$) or do not resuscitate (DNR) child (OR, 5.2, $p<0.001$) (Table 3). Twenty DNR (14.6%) and 14 non-DNR (10.6%) children died within the first postoperative year. Survival analysis showed that more than 50% of the DNR children died within the first postoperative year. Aspiration from oropharyngeal dysfunction was significant in these children. However, there is no retrospective data to support this analysis.

Discussion. Gastroesophageal reflux disease, which include complications such as failure to thrive, esophagitis, anemia, esophageal stenosis, and aspiration pneumonia, is a problem commonly seen in NI children with a reported incidence as high as 70%.¹ Medical management remains the mainstay of treatment of GERD and is successful in most patients. However, some patients may require long term or lifelong administration of medications. Medical treatment may fail in some children and ultimately children with severe manifestations of recurrent pulmonary aspirations or failure to thrive do require anti-reflux surgery as fundoplication.^{1,4,5} The NI children represent a special group of patients with increased risk for operative

morbidity and postoperative failure and persistence or recurrence of GERD.¹

An important result of using the fundoplication procedure with GT on NI children is the improved quality of life due to better feeding and decreased episode of pulmonary aspirations. In a retrospective cohort study on caregiver perceptions and complication rates in 122 patients with NI who underwent fundoplication, the majority indicated that surgery improved weight gain, chest infections, vomiting, and feeding tolerance.¹ The present study showed that the reflux-related admissions and ED visits in NI children decreased significantly after fundoplication and GT as consistent with reports in the literature.⁴⁻⁶ In a study measuring the effectiveness of anti-reflux surgery, Oh et al⁶ showed a significant decrease in postoperative hospital visitation scores associated with reflux proving that anti-reflux surgery has significant benefits for NI children. The scores included reflux-related hospital admissions as well as emergency room or unexpected outpatient clinic visits.

There are several pediatric reports in the literature of GERD being misdiagnosed as epileptic seizures.⁷ In the first clinical study of patients referred with a suspected diagnosis of epileptic seizures, GERD was commonly found in children with epilepsy with or without cerebral palsy.⁷ Therefore, Bayram et al⁷ concluded that NI children admitted with epileptic seizures should be evaluated for GERD. We found in our study that the seizure-related admissions and ED visits decreased significantly after fundoplication with GT. With better control of GERD after fundoplication with GT and easy administration of medication via GT, the therapeutic levels of anticonvulsant drugs are achieved resulting in proper control of seizures. Determining serum levels of anticonvulsants before and after fundoplication would be required to confirm this assumption.

The causes of pulmonary infections in NI children are generally from aspiration of gastric content due to GER or direct aspiration of food and saliva.⁸ The literature reports rates of up to 70% for GER and 38% for direct aspiration in severely NI children.⁸ Direct saliva aspiration, disordinated swallowing, gastroesophageal dysmotility, spasticity, aerophagy, chronic constipation, scoliosis or a predominantly supine position may explain the persistent pulmonary symptoms in some NI children post fundoplication as occurred in our patients.⁸ In the present study, 56% of NI children who underwent fundoplication with GT had a resumption of anti-reflux medications without proper documentation of indications and investigations in the medical charts. It is also difficult to know the

failure rates of the procedure because UGI contrast studies or milk scan were not routinely performed in the follow-up of the children. Knatten and colleagues reported that in children with recurrent GERD after fundoplication, the symptoms were milder than preoperatively and could be successfully managed conservatively.⁴

Early postoperative complications in NI children who underwent fundoplication with GT in the present study are mostly related to the GT site. The overall risk of complications with GT placement is 61%, which is within the reported range as between 10% and 82%.⁹ Thomas et al⁹ reported that the risk of GT site infection and skin excoriation was significantly higher when a GT was inserted with a fundoplication. However, there was no significant difference in complications between the method of GT placement or neurological status. Major complications reported with GT placement include GT leaks causing peritonitis, intestinal obstruction, tube dislodgement and cellulitis requiring hospitalization.⁹ In our study, the most common GT site-related complication was site infection which was managed through medical care at out-patients' facilities.

Late postoperative complications of adhesive intestinal obstruction and wrap failure occurred in children who underwent OF. Three children with adhesive bowel obstruction had adhesiolysis with a good outcome. The 3 children with a herniated wrap underwent a redo fundoplication and experienced improved well-being thereafter. The OF is an invasive surgical procedure while LF offers the advantage of decreasing surgical trauma and has become the procedure of choice in most centers. In a study comparing OF and LF in children, both procedures provided similar control of reflux and quality of life at follow-up.¹⁰

In this study, the early mortality rate (deaths within one-month post fundoplication) was 3% with none as a complication of fundoplication. DNR children had significant mortality within the first postoperative year after fundoplication. Therefore, DNR children whose symptoms are controlled with anti-reflux medications could be fed through a GT. However, if the NI child has severe GERD a jejunal tube can be inserted through the GT for enteral feed. Another option is percutaneous gastrojejunostomy (GJ) inserted by an interventional radiologist. It is less invasive, requires less recovery time, and can be removed if symptoms of GER improve. The disadvantages of GJ include the need for continuous feeding, retrograde dislodgement of the tube, tube obstruction and mechanical failure. In a report by Stone et al¹¹ GJ and fundoplication in NI patients had similar reflux-related hospitalization outcomes within the first year.

This is retrospective review of medical charts and is subject to limitations. There may be inadequate charting and lack of coordinated follow-up of patients. In addition, some patients may be treated at different hospitals and therefore the outcomes reported may be incomplete. Furthermore, because postoperative radiological investigations were not routinely performed unless the child was symptomatic some children may have had wrap re-herniation and GERD recurrence without documentation. Autopsies were not performed in Saudi Arabia and therefore causes of death were determined by clinical observation which is conjectural. Also, the sample size of the study is small. The major strength of this study emerges from the fact that it is one of the earliest reviews on the use of fundoplication with GT in NI children in Saudi Arabia.

In conclusions, fundoplication with GT insertion is effective in decreasing hospital admissions and ED visits in relation to GER and seizures in NI children. Most of the early postoperative complications are from the GT site which includes site infection and leakage. It might be appropriate to consider the use of GT or GJ with anti-reflux medications in DNR children because of the significant mortality rate within the first postoperative year. Further research is required to determine the levels of anticonvulsants before and after fundoplication with GT and its effect on the seizure control, the use of GT or GJ with anti-reflux medications in DNR children and the quality of life after surgery.

Acknowledgment. The authors gratefully acknowledge Dr. Norah AlKharashi (PhD in English translation and linguistics) and Editage (www.editage.com) for the English language editing.

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