



## Original Article

## Gastrostomy and fundoplication in neurologically impaired children: A benefit-risks confrontation.

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**Abstract:****Background**

For children with neurological impairment (NI) and swallowing incoordination feeding gastrostomy is usually required. This procedure may cause or aggravate preexisting gastroesophageal reflux disease (GERD). Fundoplication has been advocated at the time of gastrostomy placement in these patients. The purpose of this study is to evaluate clinical impact and risk-benefit balance of fundoplication and gastrostomy tube placement in patients with NI due to cerebral palsy, Hypoxic ischemic encephalopathy, brain tumors, and Dandy-Walker syndrome.

**Methods**

This study is a ten-year retrospective analysis including 180 cases of gastric tube placement in neurologically impaired children performed in a single institution.

**Results**

One hundred eighty patients underwent gastrostomy tube (GT) placement (94 open versus 86 laparoscopic). Concomitant fundoplication was performed in 44 cases. Three different types of tube were used during the procedures. There were differences between the two groups in gender but not in age distribution or comorbidity. Fundoplication was laparoscopic in 29 cases (33.7%) and open in 15 (16.0%). Postoperative diarrhea was more frequently observed with the Mickey tube ( $p=0.008$ ). the hospital stay was longer after Mic tube placement ( $p=001$ ). Sequelae after gastrostomy tube placement were observed in 21 cases ( $p=0.015$ ). five postoperative cases of death were noted ( $p=0.015$ ). The recurrence rate of reflux was 71% and mortality rate was 63% on long term follow-up.

**Conclusions**

In this study on NI and swallowing disorder unresponsive to medical treatment, open or laparoscopic fundoplication and gastrostomy reduced nausea and pain after feeding, but not Apparent life-threatening event in infancy (ALTE). Potential increased risk of complications and the procedure results instability may indicate the implementation of new management guidelines.

**Key words**

Fundoplication; Gastrostomy; Neurological impairment; Children, Outcome.

## Introduction

Neurological impairment (NI) in children is frequently associated with oropharyngeal dysfunction, swallowing incoordination, delayed gastric emptying and gastro-esophageal reflux disease (GERD). Consequent complications include persistent vomiting, reflux esophagitis, recurrent aspiration pneumonia that may lead to malnutrition [1].

Feeding gastrostomy has commonly been used in neurologically impaired children to provide adequate nutritional support. It allows weight gain, improve the seizures control, and may provide a better life quality for the patient and the caregiver [2]. The gastrostomy tube insertion can be surgical, endoscopic, or percutaneous. The procedure may induce or aggravate a preexistent GERD. Associated fundoplication rapidly became a standard in the treatment of reflux symptoms in NI children [3].

The aim of this study is to assess the benefit-risk balance of gastrostomy and fundoplication in these highly dependent patients.

## Patients and Methods

### Study design

This study is a single institution retrospective analytic study which assessed the indications and outcomes of GT placement performed for NI children in the department of pediatric surgery king Fahad Medical City Riyadh, Kingdom of Saudi Arabia over 10 years (2010-2019).

### Population

One hundred eighty patients were included in the study. Patients aged below one year and over 14 years were excluded as well as the NI patients with GT placement who responded favorably to anti-reflux medications. Medical records were retrospectively reviewed and analyzed. Data collected included sex, age, nationality, diagnosis circumstances, and indications for procedure. The type of the procedure (Open Stamm GT Placement, Laparoscopic GT Placement, Concomitant Fundoplication), the gastric tube used (Foley Catheter, Mickey Tube, Mic Tube), and the perioperative courses were noted.

### Data analysis

Data was analyzed using the Statistical Package for Social Sciences (SPSS) version 22.0 (IBM Corp., Armonk, NY, USA). The Chi-square test (X<sup>2</sup>) was used for the comparative study. Significance was retained for P value <0.05. Discrete variables such as sex, past medical history, and indications for the procedure were presented as numbers and percentages. Continuous variables such as age, weight, operative time, and length of hospital stay were expressed as a mean, with standard deviation. Outcomes of procedures performed were evaluated using ANOVA test, comparing the indications for the procedure, comorbidities, and postoperative complications.

### Bibliographic review

We reviewed literature using several search engines and databases: Pub Med, Medline, Scopus, Science Direct, and Google scholar using the following keywords: Fundoplication; Gastrostomy; Neurological impairment; Children, Outcome. Twenty relevant papers published over the past fifteen years were collected and reviewed.

### Ethical considerations

This study was performed according to the guidelines of the Scientific Research Committee at the king Fahad Medical city.

## Results

Gastrostomy Tube placement was performed for the 180 included cases. The procedures were performed either laparoscopically (47.8%) or open (52.2%). Sex ratio was 1.6. Most of the patients were of Saudi nationality. The indication of the surgery was severe GERD in more than half of the cases. Clinical patients data is summarized in table 1.

Table 1: Patients clinical characteristics

Variables	Categories	n (%)
Gender	Male	111 (61.7%)
	Female	69 (38.3%)
Nationality	Saudi	177 (98.3%)
	Non - Saudi	3 (1.7%)
Previous Surgery	Yes	6 (3.3%)
	No	174 (96.7%)
Fundoplication	Yes	44 (24.4%)
	No	136 (75.6%)
Indication	GERD	51 (28.3%)
	Feeding Intolerance	6 (3.3%)
	Swallowing disorder	40 (22.2%)
	More than one indication	83 (46.1%)
Procedure type	Open	94 (52.2%)
	Laparoscopic	86 (47.8%)
ASA Status	ASA I	11 (6.1%)
	ASA II	62 (34.4%)
	ASA III	106 (58.9%)
	ASA IV	1 (0.6%)
Type of GT used	Foley Cath	113 (62.8%)
	Mickey Tube	56 (31.1%)
	Mic Tube	11 (6.1%)

Three types of GT were used: Foley catheter (62.8%), Mickey Tube (31.1%), Mic Tube (6.1%). There was no statistically different distribution with the gender ( $p=0.670$ ), age ( $p=0.223$ ), weight ( $p=0.420$ ), and previous abdominal surgery ( $p=0.521$ ). The tube was inserted by laparoscopic surgery in almost half of the cases. The operative time was comparable in open vs laparoscopic group ( $p=0.665$ ). Hospital stay was significantly longer in case of open procedure ( $p=0.005$ ). Concomitant fundoplication was performed in 44 cases mostly associated with laparoscopic GT insertion ( $p=0.006$ ). Feeding was started earlier in laparoscopic group ( $0.94 \pm 1.16$   $p=0.175$ ).

Procedure's outcomes were variable. Uneventful recovery was observed in 77.8% of cases. Complicated postoperative course was noted in 19.4% of cases. The death rate was 2.8 % in our study. Leakage from the insertion point and diarrhea were the most frequent postoperative complications (22.8 and 15% respectively). Tube insertion revision was needed in 10 of our patients. The analysis showed a significantly increased risk of leakage and tube revision with the Foley catheter ( $p=0.036$  and  $0.34$  respectively). The Mic tube was associated with longer hospitalizations ( $p=0.008$ ). However logistic regression did not confirm that as independent factor ( $p=0.162$ ). The Mickey tube was the most associated with postoperative diarrhea ( $p=0.008$ ) and appear as independent in the analytic study (0.0012).

Postoperative aggravation of the neurological symptoms was frequently noted in the postoperative course. It was transitory in more than 90%of cases. Severe neurological aggravation was significantly associated with complicated GT insertion ( $p=0.015$ ) and led to death in all the cases ( $p=0.002$ ). GT leakage appears as independent factor leading to general and neurological status deterioration ( $p<0.01$ ). All cases of death recorded were in patients with complicated postoperative course.

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Concomitant fundoplication was associated with postoperative status improvement in all the laparoscopic cases. However, that appear independent only for patients with previous severe GERD ( $p=0.028$ ). Open fundoplication was significantly associated with longer operative time and feeding pain ( $p=0.03$  and  $0.016$  respectively). The analysis showed higher overall morbidity of 19.4%. The morbidity seems to be higher in the open procedures group and after Nissen fundoplication (33% and 22% respectively). However, no significance was retained ( $p=0.236$ ). The recurrence rate of reflux was 71% and mortality rate was 63% on long term follow-up.

Table 2 summarized the outcomes of different procedures.

**Table 2: Procedure outcomes**

		Outcomes			P
		Death	Uneventful	Complicated	
Gender	Male	-	88 (62.9%)	23 (65.7%)	0.115
	Female	5 (100.0%)	52 (37.1%)	12 (34.3%)	
Age (months)		48.00 ± 30.1	40.27 ± 3.18	27.52 ± 5.01	0.164
Weight (kg)		5.3 ± 2.46	10.28 ± 0.47	9.76 ± 1.05	0.138
Previous Surgery	Yes	0 (0.0%)	5 (3.6%)	1 (2.9%)	0.895
	No	5 (100.0%)	135 (96.4%)	34 (97.1%)	
Fundoplication	Yes	5 (100.0%)	39 (27.9%)	5 (14.3%)	0.108
	No	-	101 (72.1%)	30 (85.7%)	
Indications	GERD	-	38 (27.1%)	13 (37.1%)	0.277
	Intolerance	-	6 (4.3%)	-	
	SD	2 (40.0%)	34 (24.3%)	4 (11.4%)	
	>1	3 (60.0%)	62 (44.3%)	18 (51.4%)	
Operative Time		60.00 ± 0.1	76.75 ± 13.91	89.44 ± 7.96	0.683
Preoperative Albumin		26.6 ± 9.4	25.29 ± 1.87	28.4 ± 4.01	0.789
ASA Status	ASA I	-	9 (6.4%)	2 (5.7%)	0.390
	ASA II	2 (40.0%)	42 (30.0%)	18 (51.4%)	
	ASA III	3 (60.0%)	88 (62.9%)	15 (42.9%)	
	ASA IV	-	1 (0.7%)	0 (0.0%)	
Ileus	Yes	-	5 (3.6%)	2 (5.7%)	0.759
	No	5 (100.0%)	135 (96.4%)	33 (94.3%)	
Diarrhea	Yes	-	23 (16.4%)	4 (11.4%)	0.483
	No	5 (100.0%)	117 (83.6%)	31 (88.6%)	
Feeding pain	Yes	2 (40.0%)	2 (1.4%)	2 (5.7%)	< 0.001
	No	3 (60.0%)	138 (98.6%)	33 (94.3%)	
Deterioration	Yes	5(100%)	27 (19.3%)	14 (40.0%)	0.015
	No	-	113 (80.7%)	21 (60.0%)	
Leakage	Yes	5 (100.0%)	25 (17.9%)	11 (31.4%)	< 0.001
	No	-	115 (82.1%)	24 (68.6%)	
Tube revision	Yes	-	7 (5.0%)	3 (8.6%)	0.612
	No	5 (100.0%)	133 (95.0%)	32 (91.4%)	
High residue	Yes	2 (40.0%)	11 (7.9%)	-	0.004
	No	3 (60.0%)	129 (92.1%)	35 (100.0%)	
Hospital stays		3.8 ± 1.49	7.26 ± 0.97	27.61 ± 15.88	0.017

## Discussion

Undernutrition in children with neurological impairments is frequently related to feeding difficulties. It may alter the quality of patient life and constitute a further comorbidity factor that interfere directly with the survival [4]. Aspiration pneumonia is the most common cause of death in children with NI. Feeding GT placement is performed to enhance nutritional status and to reduce aspiration risk. Fundoplication is usually associated to prevent or treat preexisting GERD especially due to the high failure rate of reflux medical management in this group of patients [5].

Considerable postoperative life-threatening complications have been widely described in the literature [6,7]. This may call into question whether this procedure should be performed routinely. Our study did not demonstrate objective difference in outcome between patients who underwent concomitant fundoplication and those who did not. The reflux recurrence rate was high in long term follow up and the procedures done did not improve the overall survival. The reflux symptoms were improved only for patients with severe pre-existing GERD. Some studies investigated about the reflux-related hospitalization rate which was found to be similar with or without gastrojejunostomy and fundoplication. Most of the rehospitalization were indicated due to postoperative complications and sequelae. [8].

The morbidity of surgical gastric tube insertion might be related essentially to the tube site such as disinsertion, leakage, and infection. However, the value of the own anti-reflux procedure morbidity cannot be assessed due to the lack of comparative trials and metaanalysis [9].

In our study, the operative time was longer in the cases with complicated postoperative course. Complex procedures in such fragile underlying conditions might lead to complications. However, no significance was retained in our analysis. With more involvement of the patient family and the care givers, perceptible overall life quality improvement may be observed in the first year after the procedure according to other studies [10,11]. The laparoscopic access is associated with higher parent satisfaction. There was no difference between three type of fundoplication valves in recent studies which attributed the postoperative specific morbidity to the learning curve [12,13]. Aside from the surgery related morbidity, the aim of GT insertion should allow a successful transition to oral feedings over time. This has never been described specially for severely impaired children [14]. Due to the absence of management guidelines and the consistency of surgical morbidity which may affect the overall survival of these young patients, alternatives for surgery have been proposed since a decade [15,16]. Percutaneous gastro-jejunal tube (GJT) insertion is the most cited procedure in the management of feeding difficulties in these patients. This radiologically-guided procedure does not require general anesthesia and seems to be effective in the management of feeding difficulties and improve partially the reflux symptoms with acceptable grade of evidence [17]. The endoscopy contributed to the precision of the tube insertion. Percutaneous endoscopic gastrostomy (PEG) may be a reasonable and safer nutritional option for patients with impaired enteral feeding [18].

Fundoplication is becoming questionable due to the instability of the long term results and the progress of non-surgical techniques in GERD treatment [19].

Management of reflux and undernutrition in neurologically impaired children require balanced decision-making process [20]. The available options are life-changing and require great support from patient family and highly qualified caregivers.

### Conclusion

Neurological impairment is a global condition which includes several neurologic syndromes. This condition has been creating heterogeneity in all published patients series and generated multiple analysis biases. The ethical limits and difficulties of securing parental consent for prospective randomized comparative management trials made us far from any evidence or guidelines. A comprehensive treatment approach should be assigned and adapted for each NI pediatric case. It should be done better in a multidisciplinary team including the parents and the caregivers.

**Conflict of interest:** None

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