

Factors predicting failure of redo Nissen fundoplication in children

Maurizio Pacilli · Simon Eaton · Despoina Maritsi · Pedro J. Lopez · Lewis Spitz · Edward M. Kiely · David P. Drake · Joseph I. Curry · Agostino Pierro

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Abstract Recurrence of gastro-oesophageal reflux (GOR) following redo Nissen fundoplication represents a significant clinical problem. The aim of this study was to identify factors predicting failure of redo Nissen fundoplication. The notes of children who underwent redo Nissen fundoplication for recurrent GOR in a single institution between June 1994 and May 2005 were reviewed. Data are reported as median (range), or as numbers of cases. Multiple logistic regression analysis, using type of first fundoplication, neurological status, presence of gastrostomy, age-weight, retching-gas bloat after first fundoplication, associated anomalies, oesophageal atresia and length of follow-up as factors, was used to generate a model to identify factors predicting recurrent vomiting (failure) after redo. Eighty-one children underwent redo Nissen fundoplication 15.9 months (0.2–176) after the initial Nissen fundoplication. In 29, the first Nissen was laparoscopic. Age at redo Nissen fundoplication was 3.3 years (0.3–15.9) and weight 12.8 kg (5–60). Thirty-four children (42%) presented with recurrent vomiting (failure). Overall, the model successfully predicted vomiting (failure) after redo fundoplication ($P = 0.009$). Open surgery at first fundoplication ($P = 0.011$) and neurological impair-

ment ($P = 0.046$) were both significant predictors of redo failure in the model, whereas presence of gastrostomy ($P = 0.035$) and older-heavier age-weight ($P = 0.028$) were associated with significantly better results. Retching-gas bloat, associated anomalies and oesophageal atresia were not significant predictors of failure. Redo Nissen fundoplication has a high failure rate. Risk factors are open fundoplication at first operation and neurological impairment. Redo fundoplication after primary laparoscopic Nissen has a lower risk of failure.

Keywords Gastro-oesophageal reflux · Nissen fundoplication · Recurrence · Redo Nissen fundoplication

Introduction

Antireflux surgery for gastro-oesophageal reflux (GOR) is advocated in the presence of severe symptoms persisting despite maximum medical treatment and the success rate in large series varies from 95–98% in neurologically normal (NN) children to 70–85% in neurologically impaired (NI) children [1–5]. The recurrence of GOR following antireflux surgery represents a clinical problem and requires redo fundoplication in the majority of cases. Few reports have evaluated the efficacy of redo Nissen fundoplication in children [6–8]. The purpose of the present study was to appraise the results following repeated surgery for recurrent GOR on a large series of children in order to identify factors predicting failure of redo Nissen fundoplication.

M. Pacilli · S. Eaton · D. Maritsi · P. J. Lopez · L. Spitz · E. M. Kiely · D. P. Drake · J. I. Curry · A. Pierro
Institute of Child Health and Great Ormond Street Hospital for Children, University College London, London, UK

A. Pierro (✉)
Department of Surgery, Institute of Child Health,
30 Guilford Street, London WC1N 1EH, UK
e-mail: pierro.sec@ich.ucl.ac.uk

Materials and methods

A review of patients that underwent redo Nissen fundoplication for recurrent GOR between January 1994 and May 2005 at Great Ormond Street Hospital for Children, London, by five different pediatric surgeons was conducted. The study was approved by the Institute of Child Health and Great Ormond Street Hospital for Children Research Ethics Committee. Patients' characteristics, incidence of symptoms, management and outcome were reviewed from inpatient and outpatient records. Recurrence of GOR and failure of intervention was defined by the presence of recurrent vomiting after surgery and confirmed by 24-h pH study and/or by an upper gastro-intestinal contrast study. Data are reported as median (range), or as numbers of cases, and were compared by Fisher's exact test or Mann-Whitney test where appropriate. Multiple logistic regression analysis (SPSS v 13.0) was used to generate a model to identify factors predicting recurrent vomiting (failure) after redo Nissen fundoplication. We generated a model using the following factors: type of first fundoplication, neurological status, presence of gastrostomy, age-weight, length of follow-up, associated anomalies, oesophageal atresia, retching (unsuccessful effort to vomit) and/or gas bloat (abnormal gasses distension of the stomach) after the first fundoplication.

Results

During the study period 850 children underwent Nissen fundoplication for GOR. Overall, 81 children (9%) underwent an open redo Nissen fundoplication for recurrent GOR (Table 1) at a median of 15.9 months (0.2–176) after the initial fundoplication. In 29, the first Nissen fundoplication was laparoscopic and this group of patients has been divided in two periods of minimally invasive surgery. The percentage of failure was

16% during the first 5 years and 9% in the most recent years of minimally invasive surgery ($P = 0.1$).

There were 31 neurologically normal (NN) children (15 males) and 50 neurologically impaired (NI) children (32 males). The time to redo fundoplication was 17.7 months (1.1–176) for the NN children and 12.6 months (0.2–110) for the NI children and was not statistically different between the two groups ($P = 0.27$). Duration of follow-up after the redo fundoplication was 21.6 months (1.5–121). Associated anomalies were present in 16 (52%) of the NN patients and in 27 (54%) of the NI patients. Esophageal atresia and tracheo-esophageal fistula accounted for 38% of the anomalies in the NN group. The age at first fundoplication was 17 months (0.2–175) and weight was 8.4 kg (1.7–53.3). The age and weight at redo fundoplication were 17 months (0.2–175) and 12.8 kg (5.0–60.0) respectively. A concomitant gastrostomy was inserted in 10 (32%) NN children and 39 (78%) NI children during the first fundoplication and in 13 (42%) NN children and 42 (84%) NI children at redo Nissen fundoplication. The mechanism of failure found at redo fundoplication was disruption \pm herniation of the wrap in 41 patients (51%), intact wrap herniation in 36 patients (44%), and intact wrap in four patients (5%). Intraoperative complications at redo Nissen occurred in 1 NI child (left pneumothorax). Postoperative complications, including chest infections, prolonged mechanical ventilation and bleeding from the gastrostomy site, occurred in 4 (13%) of NN children and 14 (28%) of NI children.

Ten (32%) NN children and 24 (48%) NI children presented with recurrent vomiting following redo Nissen fundoplication. Seven patients in the NN group are currently under medical treatment, the remaining three patients underwent a third fundoplication that was unsuccessful in two. Thirteen patients with recurrent GOR in the NI group died in other hospitals (six of them were under medication for GOR), eight patients are currently under medical treatment and the remaining three underwent a third fundoplication that was unsuccessful in two. Gastro-intestinal symptoms including retching, gas bloat, dysphagia and dumping syndrome were present in 40 (49%) of children following the first fundoplication and in 39 (48%) children following redo fundoplication. Respiratory symptoms, including recurrent aspiration pneumonia, asthma and bronchopulmonary dysplasia were present in 43 (53%) after the first fundoplication and in 14 children (17%) following redo fundoplication ($P = 0.0001$).

The multiple logistic regression model successfully predicted vomiting (failure) after redo ($P = 0.009$),

Table 1 Recurrence rate for first fundoplication between January 1995 and May 2005

Type of fundoplication	Number of fundoplication	Number of redo fundoplication	%
Open Nissen (1995–May 2005)	603	52	9
Laparoscopic Nissen (1998–2002)	100	16	16
Laparoscopic Nissen (2002–May 2005)	147	13	9
Total	850	81	9

with a Nagelkerke pseudo- r^2 value (analogous to the r^2 value obtained for a linear regression) of 0.34. The results from the logistic regression analysis are summarized in Table 2. Open surgery at first fundoplication ($P = 0.011$) and neurological impairment ($P = 0.046$) were both significant predictors of redo failure in the model, whereas presence of gastrostomy ($P = 0.035$) and older–heavier age–weight ($P = 0.028$) were associated with better results. Retching–gas bloat, associated anomalies and oesophageal atresia were not significant predictors of failure.

Discussion

This study demonstrates that redo Nissen fundoplication is associated with a high incidence of failure. Risk factors are open fundoplication at first operation and neurological impairment.

The overall failure rate for first Nissen fundoplication in our hospital is 9%. These data reflect the data in the literature on large series of patients [1]. Interestingly, the failure rate has remained unchanged in the last 10 years when compared to a previous study conducted at our hospital including patients between 1980 and 1995 [6]. Laparoscopic Nissen fundoplication has been performed at Great Ormond Street Hospital (GOSH) since 1998 and has become the technique of choice for the surgical treatment of GOR. Lately, this technique provides similar results to the open technique and the initial high failure rate (Table 1) of the laparoscopic technique is likely related to the learning curve [9, 10].

As in previous reports [6, 11, 12], we found that the surgical failure is mainly related to the herniation and disruption of the wrap. These data suggest that the failure rate of Nissen fundoplication might be related to the technique itself despite the improvements in the surgical practice.

Our data suggest that redo Nissen fundoplication is ineffective in controlling GOR in 42% of the children. Similarly, other authors [12, 13] have reported a recurrence rate following redo Nissen fundoplication of between 28 and 34%. Following redo fundoplication we also documented an elevated persistence of symptoms of altered gastric motility (48%) including retching, dysphagia, gas bloat and dumping syndrome. These symptoms were present in 49% of the children after the first fundoplication, and persisted after the redo fundoplication. Lundell and colleagues [14] have reported that GOR is often associated with an altered motility of the whole intestine and Alexander and colleagues [15] have documented that an altered gastric motility is frequently present in NI children with GOR. In particular, retching is a common problem following Nissen fundoplication and it is been reported in a high percentage (50%) of children requiring redo fundoplication for recurrent reflux. Retching is associated with disturbed gastric-electrical control activity [16], alterations in gastric emptying [17–19], and may be related to vagal nerve dysfunction following Nissen fundoplication [16]. Persistent retching might itself lead to wrap disruption due to an increased pressure on the wrap. Indeed, we found that patients who had the first Nissen fundoplication performed laparoscopically

Table 2 Multiple logistic regression analysis of factors predicting vomiting after redo Nissen fundoplication

	Vomiting after redo	No vomiting after redo	Risk of redo failure (95% CI)	P value
Open first fundoplication	25	27		
Laparoscopic first fundoplication	9	20	0.20 (0.06–0.70) vs. open	0.011
Presence of retching and gas bloat	19	20	0.35 (0.03–5.04) vs. absence of retching and/or gas bloat	NS
Neurologically normal	10	21		
Neurologically impaired	24	26	4.81 (1.03–22.41) vs. unimpaired	0.046
No associated anomalies	16	22		
Associated anomalies	18	25	0.84 (0.71–2.68) vs. no anomalies	NS
No oesophageal atresia	32	40		
Oesophageal atresia	2	7	0.20 (0.03–1.44) vs. no atresia	NS
Gastrostomy at first fundoplication	20	29		
No gastrostomy at first fundoplication	14	18	5.13 (1.12–23.26) vs. gastrostomy	0.035
Age at redo (years)	3.2 (0.6–15.2)	3.5 (0.3–15.9)		
Weight at redo (kg)	12.4 (6.5–30.2)	13 (5–60)	1.005 (1.001–1.010) younger–lighter vs. older–heavier	0.028
Length of follow-up (months)	27.9 (1.3–109.1)	18.7 (1.1–25.4)	1.06 (0.84–1.32) shorter vs. longer	NS

NS not significant

presented with a lower incidence of recurrent vomit following redo Nissen fundoplication. This could be related to the fact that the laparoscopic technique might reduce the incidence of vagal nerve dysfunction and thus preserve gastric motility since during the procedure the dissection and manipulation of oesophagus and stomach are less traumatic compared to the open procedure.

The recurrence rate following redo Nissen fundoplication in our series is higher for NI children (48%). Different studies have documented that the results of the first fundoplication are negatively influenced by the presence of neurological impairment and associated anomalies, both in children [6, 8, 20–24], and infants [25] and several authors [24–30] have reported that the fundoplication is associated with a higher recurrence rate in patient with repaired oesophageal atresia (up to 24%). Associated anomalies were present in about 50% of the patients that required redo fundoplication. In particular, oesophageal atresia was the most frequent associated anomaly in the NN children. The results of the multivariate analysis in our model suggest that the presence of neurological impairment is also a risk factor for failure after redo Nissen fundoplication; however, we found that the presence of associated anomalies is not a risk factor for failure after redo Nissen fundoplication.

The presence of gastrostomy has shown to be associated with better results following redo fundoplication. Up to 50% of patients following antireflux surgery are incapable of belching [31, 32] and this could lead to increase of the intragastric pressure with consequent disruption of the wrap. In patients with gastrostomy the opening of the gastrostomy tube during feeding leads to a decompression of the stomach and thus less tension on the wrap. The multiple regression analysis also showed that the results of redo Nissen fundoplication are better in older children with higher weight and could be related to the “maturation” of the gastro-oesophageal junction with ageing.

In conclusion our data on a large series of patients that underwent redo-Nissen fundoplication suggest that this procedure has a high failure rate since it is ineffective in controlling GOR in approximately 30% of the NN children and 50% of NI children. Risk factors are open fundoplication at first operation and neurological impairment. Redo fundoplication after primary laparoscopic Nissen has lower risk of failure.

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