International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 13, Issue 1, pp: (299-308), Month: April 2025 - September 2025, Available at: www.researchpublish.com

Incidence of enterocolitis in post-trans-anal Swenson pull-through in children with Hirschsprung disease

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DOI: https://doi.org/10.5281/zenodo.15715850

Published Date: 22-June-2025

Abstract: **Introduction: Hirschsprung disease (HD) or congenital megacolon is an ancient disease first described in 1887 by Hindu surgeons. It is characterized by an absence of ganglion cells in the myenteric and submucosal plexus in the distal colon, making the condition a considerable surgical cause of early childhood constipation, soiling, and enterocolitis (EC).**

Surgical correction represents the definitive treatment. Swenson, Duhamel, and Soave, in addition to State and Rehbein, are well-known surgical procedures described with various modifications.

Methods: In our study, 80 cases of Hirschsprung disease have been identified, investigated, and operated on in different hospitals in Najaf city over 7 years.

Aim: This study aims to measure the incidence and severity of EC in HD patients treated with the trans-anal Swenson pull-through operation (TSPT).

Results: The follow-up period ranged from 2 to 5 years. Questionnaires and medical record reviews have been used to assess the incidence and severity of EC among patients with the Swenson operation.

Conclusion: We concluded that the incidence and severity of the EC were less in the cohort operated on with TSPT than among the patients who underwent a two-stage Swenson procedure.

Keywords: **Hirschsprung disease, total aganglionic disease, Swenson operation, enterocolitis.**

1. INTRODUCTION

Hirschsprung disease (HD) is an ancient disease belonging to the late eighteenth century, where most of the discovered children died from EC, malnutrition, or other associated anomalies [1].

It occurs in 1 per 5000 live births [1], and 80% of cases are identified postnatally with an ultrasound performed to investigate causes of intestinal obstruction. However, plain radiographs may demonstrate a dilated bowel throughout the abdomen, and a water-soluble contrast enema may reveal the classical transitional zone later in infancy.

It is a congenital disease (inherited as a sex-modified multifactorial trait) [2], characterized by the absence of parasympathetic ganglion cells in the myenteric and submucosal plexuses. This absence gives rise to a narrow non-peristaltic segment and a dilated normal segment above it with hypertrophied nerve trunks [3].

HD represents an important cause of chronic constipation in the pediatric age group; however, a perforated cecum or appendix can be the initial presentation. Surgical correction represents the mainstay of treatment [1].

Topical hydrocortisone may be used as an adjuvant in the treatment of postoperative enterocolitis, based mainly on its anti-inflammatory effects [4].

The Swenson operation is one of the surgical procedures described and practiced in North America to correct HD. Depending on the surgeon's preference and bowel involvement, it is performed as a single pull-through or multi-stage operation with proximal colostomy [1].

More than two-thirds of the patients (80%) are involved in the recto-sigmoid junction. Another 10% have a pathology extending to the proximal colon, and the last 5-10% has a total colonic aganglionic state (TCA) with the characteristic question mark sign on contrast enema and variable involvement of the small intestine [1].

Diagnosis:

Ultrasound was the initial tool used to indicate the problem during fetal life; however, only long-segment disease or total agangliosis can be detected antenatally. A plain radiograph is a straightforward and informative technique used to examine any newborn exhibiting signs of intestinal obstruction due to its availability and sensitivity in determining air distribution and obstruction levels. Nevertheless, a contrast enema followed by a lateral view radiograph is a crucial technique for assessing the level of agangliosis (transitional zone) in the postnatal period [3]. A full-thickness rectal biopsy represents the gold standard diagnostic method for this condition. Also, levelling biopsy through laparoscopic or umbilical biopsy was used infrequently in this study. Manometry or the Recto-anal inhibitory reflex (RAIR) measurement is used to assess older children suspected to have HD [1], where maintenance of RAIR excludes the condition [3].

Data collection:

Information about biopsy-proven patients referred to the histopathology unit (Al Basmala medical laboratory) was extracted, categorized, analyzed, and evaluated over 2-5 years postoperatively.

The data include age at presentation, age at operation, sex of patient, presenting problem, level of colonic involvement, associated comorbidities, type of operation, length of hospital stay, and complications. Patients are followed through outpatient clinic visits or by phone contact. The patients' characteristics are shown in the table below:

Table 1: patients' character

Patient's character		Range/number	Mean/ percentage
Age of presentation		4 days to 18 years	\
Age of operation		4 days to 18 years	\
Sex	**Male**	57	71%
	Female	23	29%
Associated problems		5	6%
Level of colonic involvement	**Recto-sigmoid**	63	78%
	Others	18	22%
Trisomy 21(Downe syndrome)		None	None
Low birth weight		None	None

Exclusion criteria:

Cases with chronic constipation or bowel obstruction owing to hypogangliosis state, meconium ileus, colonic atresia, and cases with previous abdominal surgery for non-HD causes were excluded from the study.

2. METHODOLOGY

Throughout 7 years (2017, Jan to 2024, Dec), 80 children, including 57 boys and 23 girls with biopsy-proven HD, have been identified, operated on, and evaluated over 2-5 years. Questionnaires and medical record reviews were used in the follow-up period.

12 patients out of 80 (15%) were presented in the neonatal period, and 68 cases identified beyond this age. 13 cases presented with signs and symptoms of intestinal obstruction, while chronic constipation was the main symptom (28 cases out of 80 making 35%) of referral to the pediatric surgical department for older children. 3 cases presented with perforated bowel (cecum/appendix). 5 cases were identified to have congenital heart disease-associated anomalies in the study group.

Out of the study cohort, 50 patients have been assigned for a multi-staged Swenson procedure with a de-functioning stoma created initially and a plan for colostomy closure with pull-through in a 1 to 8-month period of separation. Details of the two-stage Swenson procedure are out of the scope of this paper.

Surgical procedure:

The patients were admitted to the hospital 24-48 hours earlier for investigation, resuscitation, and bowel preparation. Restrict fluid diet for 48 hours, with frequent rectal irrigation (using 50 ml normal saline) or enemas (using more than 50 ml normal saline) initiated at home every 6-12 hours. Oral antibiotics Cefix (third-generation cephalosporin) and Flygle (metronidazole), in addition to laxatives (polyethylene glycol), were used in bowel preparation. Isotonic fluids and electrolyte replacement are used in resuscitation.

After urinary intubation with a suitable-size Foley catheter, the classical Swenson single-stage pull-through procedure is started by placing the patient in the prone Jackknife position and application of the Lonestar anal retractor to expose the anorectal area. Partial thickness submucosal rectal dissection commenced at 1.5-2 cm proximal to the dentate line, then carefully progressing to full thickness to minimize the risk of future incontinence. Dividing of anchoring tissues and ligaments is performed using a fine diathermy needle, taking special consideration to the blood supply and nerve plexus extensively distributed in the area. Complete mobilization of the anal canal and distal rectum enables proper differentiation between the narrow, non-peristaltic segment and the dilated one just proximal. A 15 -20 cm section from the transitional zone is determined and divided. Then, with a single-stage procedure, a complete excision of the spastic, non-peristaltic segment with primary single-layer anastomosis using 4\0 absorbable suture is completed. Children operated on with this technique (30) are allowed oral feeding after 48 hours and are usually discharged home within 48 hours. Rectal examination (dilatation) or the use of rectal preparations is forbidden for 21 days postoperatively. The main indication for the single-stage Swenson procedure is a short-segment disease in an otherwise healthy child.

3. RESULT

Our study revealed that 12 patients developed enterocolitis (EC). And, we identified that 6 patients (7%) developed incontinence, 5 patients (6%) developed fistula in ano, and 6 patients (7%) developed stricture requiring redo pull-through. 3 deaths (4%) among operated patients were reported over a 2–5-year follow-up period.

Perianal skin excoriation and soiling were found to be more common in younger patients undergoing TASPT operations than the two-staged Swenson counterparts. Fistula in ano developed in 30% of TASPT, while only 8% in the classical two-stage Swenson-operated group.

Anastomotic strictures developed in 6 patients (7%) operated on with two-stage Swenson while no anal stenosis or stricture is reported following TASPT.

Our study revealed that 6 out of 80 patients (7%) have developed pseudoincontinence (soiling secondary to fecal impaction) following a two-stage Swenson pull-through. Six cases out of 80 (7.5%) required re-do pull-through operations for severe stricture not responding to conservative management. Three cases of death were reported over the follow-up period (4%).

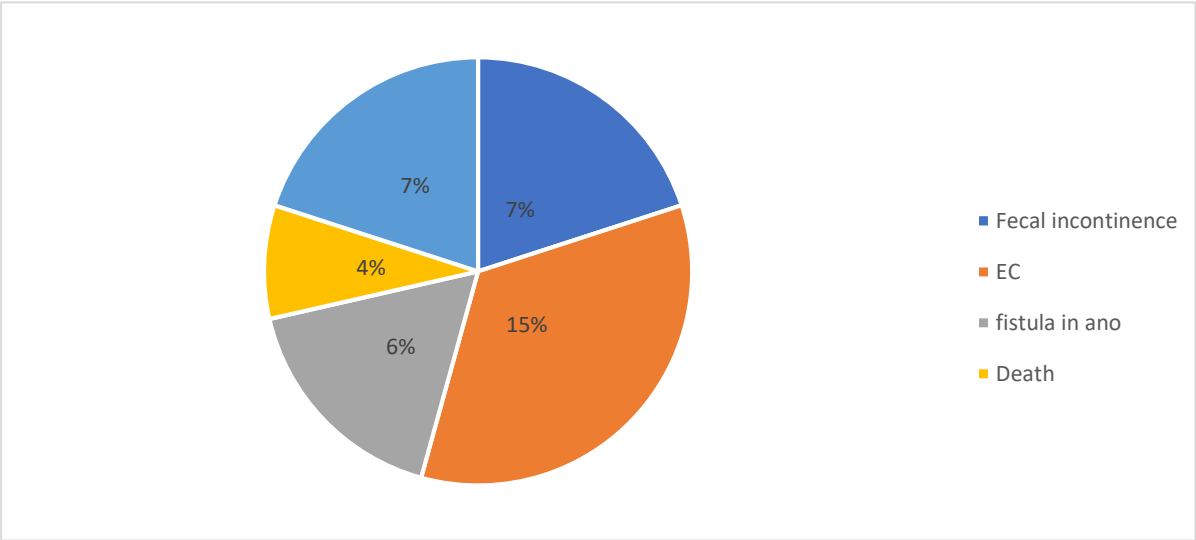

Figure 1: Percentage of complications after TASPT

4. DISCUSSION

EC was a significant cause of morbidity, mortality, decreased quality of life, and increased costs of healthcare services in HD children before and after surgical correction. Although no data are available to compare the incidence and severity of the condition before surgical intervention, our study demonstrated that 12 patients out of 80 (15%) developed EC. This finding was comparable to the results produced by China's study published in 2017, which demonstrated the incidence of EC among children operated on with the minimally invasive Swenson operation was 15.2% [5], and a meta-analysis study published in 2021 which revealed that the incidence of EC is 15.6% among children operated on with different surgical techniques [6].

EC in the post-Swenson procedure is likely attributed to patient, technical, or mechanical factors. Patient factors include age at presentation, age at surgical correction, level of colonic involvement, and presence of other associated cardiac, central nervous system (CNS), spine, gastrointestinal (GI), or genitourinary (VACTERL) anomalies [1]. Our study demonstrated that children operated on early in their lives (within the first 3 months) have a better postoperative course in terms of the number and severity of EC, hospital admissions, adhesive intestinal obstruction, sepsis, and death. However, Ruth A. Lewit and colleagues, in their 2022 study, speculated that the risk of developing Hirschsprung-associated enterocolitis (HAEC) is independent of the type of surgical technique or the age of surgical correction, with a tendency to decrease as the child approaches school age [6]. Also, the study revealed that trisomy 21 is associated with a higher risk of HAEC, even in surgically corrected individuals [6]. This is largely attributed to an underlying immunodeficiency status [7]. TCA is associated with a higher incidence of HAEC [5]. However, the results obtained are biased by using various surgical techniques and including patients with different levels of colonic involvement. This may limit general transferability and necessitate caution when interpreting data [6]. The initial management lines involve health education to the family regarding signs and symptoms of EC, when to seek medical care, rectal irrigation, probiotics and\or prebiotics, and antidiarrheal agents. We avoided long-term, low-dose antibiotic use to eliminate GI side effects and minimize the risk of developing *Clostridium difficile* colitis, which may represent a diagnostic challenge in the HD cohort even without a recent history of antibiotic exposure [9].

Also, our study produced 6 patients (7%) who developed incontinence, 5 patients (6%) developed fistula in ano, 6 patients (7%) who developed stricture requiring redo pull-through, and 3 deaths (4%) among operated patients over a 2–5-year follow-up period.

Younger patients undergoing TASPT operations demonstrated an increased incidence of perianal skin excoriation and soiling compared to their two-staged Swenson counterparts. This is largely attributed to poor hygiene and the relatively malnourished state of young infants. It is effectively treated with Stomahesive topical preparations and frequent diaper changes.

Fistula in ano developed in 30% of TASPT, while only 8% in the classical two-stage Swenson-operated group. We suggested that an underlying Crohn’s disease or technical variations were possible causes. Repair was performed following a temporary diversion, with closure and anastomosis after 1-2 months.

Technical factors such as the type of surgical procedure (Duhamel and Soave vs Swenson) and single-stage vs. two-stage Swenson operation demonstrated paramount effects on quality of life, cost of health services, and adherence to the treatment plan. However, J Hagens and colleagues, in their study published in 2021, showed that no significant difference in incidence and severity of HAEC for patients operated on with various surgical techniques [6]. On the other hand, subgroup analysis of the pooled data confirmed higher postoperative HAEC in TASPT (14.5%) in comparison to combined abdominal approach (13.4%) and laparoscopically assisted only (10.5%) [6].

Mechanical factors, such as anastomotic leaks [8], intestinal obstructions, bowel perforations, and the need for redo pull-through, are shown to be less prevalent among patients operated on with single-stage TASP compared to the two-stage technique. This is likely attributed to the extensive manipulation of bowel during an open approach in contrast to the minimally invasive (trans anal) technique and the presence of a residual aganglionic segment as no frozen section facility is available.

Anastomotic strictures developed in 6 patients (7%) operated on with two-stage Swenson while no anal stenosis or stricture is reported following TASPT. The stricture resolved completely with frequent dilatation. Chronic inflammation and fibrosis are the suggested causes.

Our study revealed that 6 out of 80 patients (7%) have developed pseudoincontinence (soiling secondary to fecal impaction) following a two-stage Swenson pull-through. 4 out of the 6 (80%) were treated successfully with anti-constipation agents (lactulose syrup, Movicol sachets, Sinasoid tablets) and bowel management techniques. One of the remaining two cases

was a female child who was treated previously with multiple stages Swenson procedure and presented later with complete incontinence following a sphincterotomy operation for severe constipation in another country. The last case was a young child who was operated with TASPT early in infancy (at 3 months of age) and presented later with complete incontinence. Medical treatment has failed so far, bowel management techniques will be implemented when the child ages. Younger-age children (before toilet training) and the prolonged use of anal retractors during surgery may compromise the sphincteric complex.

Six cases out of 80 required re-do pull-through operations for severe stricture not responding to conservative management, fistula formation, and wound dehiscence. All of them had previously had the two-stage technique.

Three cases of deaths were reported over the follow-up period (4%), two of them because of severe EC with the possibility of misdiagnosed *pseudomembranous colitis* (PMC). Therefore, we implemented an urgent medical intervention with frequent rectal irrigation, intravenous fluid, restricted oral intake, and an antibiotic against Clostridium difficile (oral vancomycin showed promising results) or a culture-guided treatment if no improvement is reported following the use of an empirical antibiotic. An obligatory stool examination strategy for Clostridium difficile toxin for all HD patients who develop signs and symptoms of colitis has recently been implemented at Al Zahraa Pediatric Hospital, and multidisciplinary teamwork is highly recommended. The third case of death was due to an associated celiac crisis.

No transfusion was performed, no intensive care admission, and all the operations were uneventful with an average time of 30-60 minutes and 2- 3 hours for TASPT and the classical two-staged Swenson techniques, respectively. Table 2 summarizes the percentage of complications following the Swenson operation:

Table 2: Comparison of complications between single-stage and multi-staged Swenson procedures.

Complication	Single stage Swenson TASPT		Two-staged Swenson	
	Number	Percentage %	Number	Percentage %
EC	NTR	NTR		100%
Incontinence\soiling	1	3.3%	4	8%
Skin excoriation	30	100%	50	100%
Stricture	NTR	None	4	8%
Re-do pull-through	NTR	None	6	12%
Leaking	1	3.3%	NTR	NTR
Death	NTR	NTR	3	6% due to severe EC

Table 3: Incidence of EC among patients operated with various surgical techniques

Author	Year of publication	Country	Study design	Number of patients	Surgical technique	Colonic involvement			Pre-op EC	Post-op EC
						S-HD	L-HD	TAHD		
Downey et al	2015	USA	Cohort	24	Soave, Duhamel	21	2	4	7	7
Le-Nguyen et al	2019	Canada	Case-control	171	Swenson, Soave, Duhamel	130	21	14	25	33
Neuvonen et al	2015	Finland	Cohort	146	Soave	121	10	15	24	64
Pini Prato et al	2019	Italy	Case-control	385	Soave, Duhamel	273	27	74	66	87
Lin et al	2020	China	Case-control	95	Soave	78	17	0	19	15
Ouladsaiad et al	2016	Morocco	Cohort	15	TERPT	13	2	0	6	4
Parahita et al	2018	Indonesia	Cohort	100	Soave, Duhamel	93	7	0	9	15
Adiguzel et al	2017	Turkey	Cohort	50	Soave	41	0	0	11	10
Chung et al	2019	China	Cohort	96	Soave, Duhamel	96	0	0	10	20
Yan et al	2020	China	Cohort	9	Duhamel	0	0	9	3	5
Elhalaby et al	1995	USA	Cohort	168	Swenson, Soave, Duhamel	124	27	10	21	44
Fortuna et al	1996	USA	Cohort	82	Soave, Duhamel	66	11	5	10	20
Foster et al	1990	USA	Cohort	63	Swenson, Soave, Duhamel	44	5	9	6	4
Harrison et al	1986	USA	Cohort	139	Swenson, Soave, Duhamel, Myectomy	95	21	14	23	13
Ikeda and Goto	1984	Japan	Nationwide	1628	Swenson, Soave, Duhamel	1239	186	137	475	180
Jung	1995	Korea	Cohort	137	Duhamel	90	19	4	35	12
Kleinhaus et al	1979	USA	Nationwide	1196	Swenson, Soave, Duhamel	299	609	90	179	99
Li et al	2006	China	Cohort	252	Soave	147	4	1	20	34
Menezes and Puri	2006	Ireland	Cohort	259	Swenson, Soave, Duhamel, Myectomy	209	50	0	43	56
Moore et al	1996	South Africa	Cohort	178	Swenson, Soave, Duhamel	123	41	14	30	19
Pini Prato et al	2008	Italy	Cohort	112	Swenson, Soave, Duhamel	80	6	22	39	25
Ramesh et al	1999	Malaysia	Cohort	40	Rehbein, Swenson, TERPT, Myectomy	27	10	3	5	3
Reding et al	1997	Belgium	Cohort	59	Swenson, Duhamel, Myectomy	45	3	8	13	17
Rescorla et al	1992	USA	Cohort	260	Swenson, Soave, Duhamel, Myectomy	174	61	25	15	32
Sauer et al	2005	Canada	Cohort	24	Soave, Duhamel	19	2	3	7	0
Singh et al	2003	Australia	Nationwide	126	Soave, Duhamel	76	22	7	15	17
Surana et al	1994	Ireland	Cohort	135	Swenson, Soave, Duhamel	98	25	12	25	20
Teitelbaum et al	1988	USA	Cohort	80	Swenson, Soave, Duhamel, Myectomy	68	5	7	15	5
Teitelbaum et al	2000	USA	Case-control	181	Soave	134	26	16	27	55

Suita et al	1996	Japan	Nationwide	1121	Swenson, Soave, Duhamel, Myectomy	877	135	109	326	188
Suita et al	2005	Japan	Nationwide	1103	Swenson, Soave, Duhamel, TERPT, Myectomy	856	143	104	191	117
Ali	2010	Egypt	Cohort	28	Soave	15	6	0	7	4
Chiengkriwate et al	2007	Thailand	Case-control	50	Duhamel	41	9	0	9	18
Giuliani et al	2011	Italy	Cohort	70	Soave, Duhamel	60	10	0	10	2
Hackham et al	2004	USA	Cohort	66	Soave, Duhamel	52	14	0	13	17
Haricharan et al	2008	USA	Cohort	52	TERPT	40	12	0	3	19
Langer et al	2003	Canada, USA, Mexico	Cohort	141	Soave	110	7	0	20	9
Mattioli et al	2008	Italy	Cohort	46	Swenson, Soave, Duhamel	38	8	0	11	4
Mir et al	2001	Turkey	Cohort	10	Duhamel	9	1	0	1	2
Singh et al	2007	Canada	Cohort	52	Swenson	46	6	0	5	6
Wang et al	2004	China	Cohort	61	Soave	58	3	0	22	13
Wu et al	2009	China	Cohort	97	Swenson	89	8	0	17	19
Zhang et al	2014	China	Cohort	127	TERPT	113	14	0	43	2
Fujiwara et al	2007	Japan	Cohort	35	Soave	35	0	0	0	7
Gao et al	2001	China	Cohort	34	Soave	34	0	0	5	2
Langer et al	1999	USA	Cohort	9	Soave	9	0	0	2	2
Pratap et al	2007	Nepal	Cohort	65	Soave	65	0	0	30	3
Sapin et al	2006	France	Cohort	21	Swenson, Soave	21	0	0	1	1
Weidner and Waldhausen	2003	USA	Cohort	15	Swenson	15	0	0	1	2
Zakaria et al	2012	Egypt	Cohort	40	Soave	40	0	0	9	3
Escobar et al	2005	USA	Cohort	36	Soave, Duhamel	0	0	36	3	11
Hoehner et al	1998	Canada	Cohort	29	Soave, Duhamel	0	0	29	1	16
Menezes et al	2008	Ireland	Cohort	58	Swenson, Soave, Duhamel	0	0	58	13	31
Wildhaber et al	2005	USA	Cohort	25	Swenson, Soave, Duhamel	0	0	25	5	11
Yeh et al	2014	China	Cohort	9	Cohort	0	0	9	3	5

S-HD (short segment Hirschsprung disease), L-HD (long segment Hirschsprung disease), TCA (total aganglionic colon), TERPT (transanal endorectal pull-through).

Figure 1(a): preoperative EC

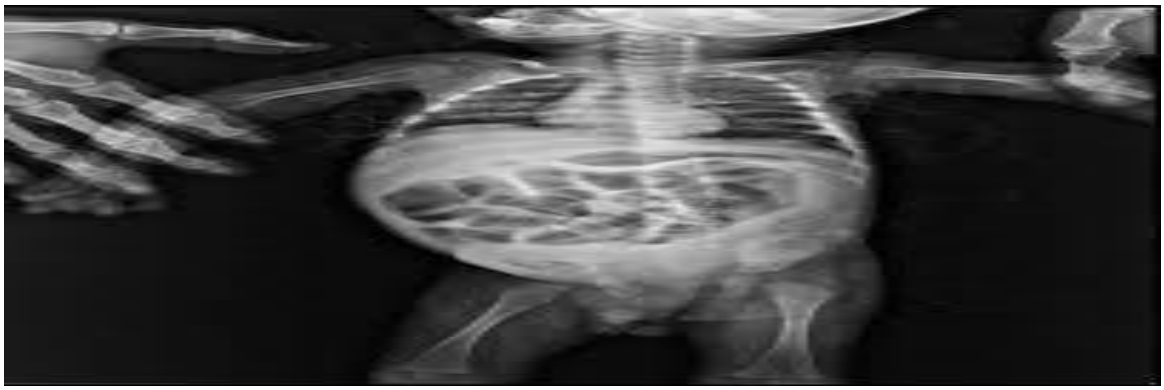

Figure 2(b): Preoperative radiograph showing EC

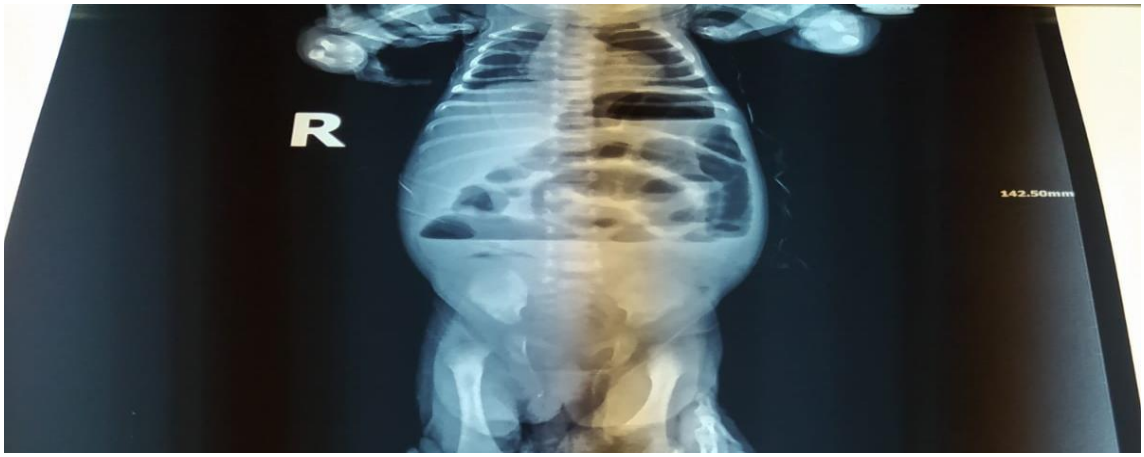

Figure 3: Preoperative radiograph showing air-fluid level (intestinal obstruction)

Figure 4: Barium enema showing transitional zone

Figure 5(a): Barium enema showing transitional zone

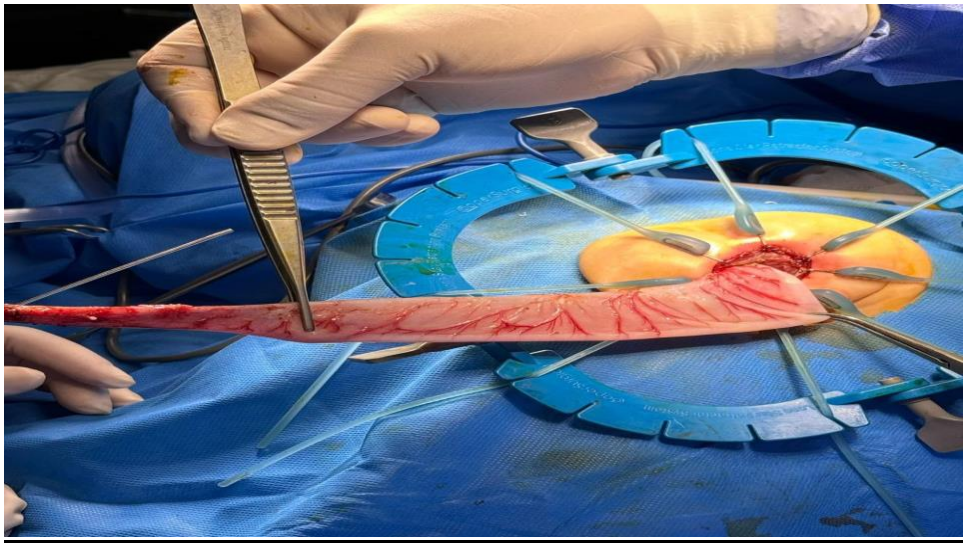

Figure 5(b): Intraoperative photos showing transitional zone

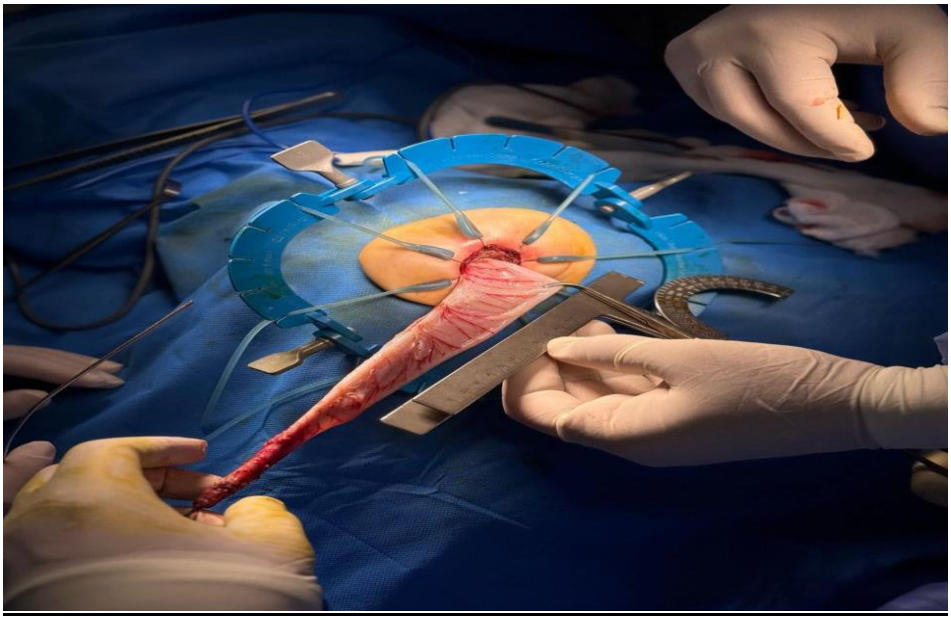

Figure 6: intraoperative photo demonstrating measurement before resection of aganglionic segment

Figure 7: Intraoperative resection of the spastic segment with 15-20cm of proximal dilated bowel

Figure 8: Rosset shape neo-anus

Figure 9: Skin excoriation and perianal fistula formation

Figure 10: Perianal abscess secondary to skin infection and blockage of fistula tract

5. CONCLUSION

EC remains a challenge and a significant cause of morbidity and mortality in Hirschsprung disease patients even after surgical correction. Although no data is available to define the number and severity of EC attacks before the surgical procedure, our study suggested that 15% of patients were affected by EC over the follow-up period. This was the highest reported number compared to other series (Table 2). Patient, technical, and mechanical factors are indicated as the main etiologies.

The patient's (or caregiver's) education about early signs and symptoms of EC, frequent rectal wash, decreased oral intake, and replacement of fluid and electrolytes, in addition to the proper use of antibiotics and probiotics, represents life-saving measures. Also, our study demonstrated that TASPT was associated with a significant reduction in attacks and severity of the EC, death-associated EC, incidence of intestinal obstruction, postoperative ileus, stricture, and the need to redo pull-through (Table 2). However, fistula in ano is identified to be associated with TASPT more than with the classical multi-staged Swenson.

Finally, TASPT was shown to be a cost-effective technique that improves quality of life and adherence to the treatment plan.

6. RECOMMENDATIONS FOR FUTURE STUDIES

- Implementing a research unit with a centralized data collection and referral system.
- Encouraging proper post-natal examination and timely reporting of delayed passing motion events.
- The availability of frozen-section services is crucial in timely identification and intervention.

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