Complications of Stoma in Patients with Anorectal Malformation

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ABSTRACT

Background: The procedure of creating stoma is the initial surgical step in the treatment of patients with congenital anorectal malformation. It has the advantages of decompressing the distended colon, preventing fecal contamination of the urinary tract and protecting the final perineal repair but it carry a lot of complications, some of them are simple while the other are serious.

Objectives: To highlights the prevalence and type of complications in addition to their relation to the type and site of commonly performed stoma and the best strategy to avoid them.

Methods: In this prospective study (from Oct 2011 to Aug 2015), we followed up all the patients with congenital anorectal malformation who visit our center of pediatric surgery at the central child teaching hospital. The type of anorectal malformation, whether a diverting stoma is indicated or not, type of stoma performed, which part of the bowel is used, age of the patient during creation and during closure of stoma in addition to the rate and type of complication related to stoma and stoma closure were evaluated.

Results: We evaluated 75 patients with stoma out of total 87 patients with anorectal malformation during 4 years of study. Male: female ratio was 1.4:1. The most common types of malformation in male was imperforate anus with rectourethral fistula (33 cases) while in female it was imperforate anus with rectovestibular fistula (23 cases). The other rare types were rectovesical fistula, imperforate anus without fistula, rectoperineal fistula, rectal atresia, congenital pouch colon syndrome, cloaca and complex syndromic anorectal malformation. The prevalent type of stoma was separated (42) followed by loop (29), end stoma (2), and window stoma (2). The most common location of stoma was in the descending colon (41), then sigmoid colon (24), transvers colon (5), ileum (3) and pouch colon (2). Total complication rate was 45% (34/75). The complication rate was higher in loop stoma than in separated stoma, the main complication of loop stoma was prolapse, megarectum formation and urinary tract infection, while the wound problems like infection, dehiscence, evisceration, reversed direction and stenosis were the remarkable problems of separated stomas. More than 60% of complications occur at age older than 4 months. There was no significant difference in mortality rate between loop and separated stomas, regardless the location of stoma.

Conclusion: The ideal stoma in patients with anorectal malformation is separated descending colostomy due to its low incidence of complications and valuable advantages compared with other types of stomas. Although minor procedure, formation of stoma should be performed by experienced hands. Earlier closure of stoma after completing surgical repair significantly decreases complication rate.

Keywords: Anorectal malformation, Stoma, Complication.

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Anorectal malformations include a collection of many congenital abnormalities not only in the anus and rectum, but also genitourinary system, sacral spine and perineum.

A previous International classification[1,2] was suggested in 1970 depending on the concept of level of anomalies in relation to levator ani; high types for anomalies above the levator and low types for those anomalies below the levator, while intermediate types describes anomalies which are translevator. Recently, the Krickenbeck conference established by Professor Holschneider in Cologne, Germany 2005[3] proposed a new international criteria which are a modification of Pena' classification to evolve a uniform scoring mode for treatment and follow up of anorectal malformations.

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Table.1: Krickenbeck classification [3].

Major clinical groups	Rare/regional variants
Perineal (cutaneous) fistula. Rectourethral fistula: – Prostatic – Bulbar. Rectovesical fistula. Vestibular fistula. Cloaca. ARMs with no fistula. Anal stenosis.	Pouch colon atresia. Rectal atresia/stenosis. Rectovaginal fistula. H-type fistula. Others.

The term "imperforate anus" has traditionally been used to describe all anorectal abnormalities in females and males. Stoma is frequently performed as an initial step in the stage management of anorectal malformation in children with anorectal malformations especially those with high types, it usually performed in the neonatal period (when direct reconstructive surgery in the first few days of life is not possible)[4]. The stoma is then closed few weeks after complete reconstructive surgery

Different types and locations of stoma can be performed depending on the type of anorectal malformation and patient's condition. Separated stomas are generally preferred by the pediatric surgeons as repeatedly emphasized by Alberto Pena to achieve total diversion of feces[4], while loop stoma is easier to be done and takes short time. In congenital pouch colon syndrome and other rare types of anorectal anomalies[5, 6], one of the following proximal diversion stomas may be used; end colostomy (after excision of the pouch and fistula), window colostomy (just opening on the anterior surface of the colonic pouch), Transverse colostomy (in case of incomplete pouch colon), and proximal ileostomy (in case of complete pouch colon).

Although formation of stoma is considered as a protective and life-saving procedure, an obvious morbidity and mortality risks are not uncommon even with careful technique[7,8]. Incorrectly constructed stoma can complicate or delay the management of these malformations and can even lead to death[9,10]. These complications may include: mislocation (stoma too close to each other, stomas widely separated from each other, stomas located too distally in the sigmoid which interfere with the pull-through, inverted stomas), skin excoriation, prolapse, stenosis, retraction, parastomal hernia, bleeding, skin infection and disruption of skin bridge. In addition to the general surgical complications after stoma closure such as intestinal obstruction, wound infection, incisional hernia, anastomotic leak and sepsis.

Children often have to live with their stomas for several weeks or months, and mistakes made at the initial stoma creation result in long-term misery for the patient and the family, that is why creation of a proper stoma really is a difficult operation[11] and should not be assigned by default to the lowest-ranking surgeon who happens to be taking call after a long day in the operating theatre.

This study evaluates our experience with stoma formation and closure in children with anorectal anomalies over a four year period in our department of pediatric surgery in terms of problems arising from type and location of the stoma.

Methods

A total of 87 patients with anorectal malformations were admitted to Central Child Teaching Hospital in Baghdad for the period from October 2011 to August 2015. Twelve patients were excluded from the study because nine of them were simple low type (covered, membranous anus,

anocutaneous fistula) and they were had a primary reconstructive surgery without a diverting stoma and the remaining three patients were lost follow up. So the study was conducted on 75 out of 87 patients. The study also included 13 patients out of 75 patients already operated before implementing this study or those who were operated in some other hospital and consult our center or referred for either definitive surgery or with complications of stoma.

The patients were examined generally by careful inspection of the perineum for any absent or abnormally located anus, any fistulous opening, and meconium discharge per fistula or per urethra. Initial resuscitation was done with intravenous fluid, nasogastric tube decompression and broad spectrum antibiotics for abdominal distention, dehydration and sepsis especially for those cases of delayed presentation. Radiological investigation were done in form of invertogram, prone cross table lateral view, ultrasound, C.T scan or MRI for initial assessment and search for any associated anomalies. A decision was taking whether the patient can be managed by single stage anorectoplasty or should be planned for a protective diverting stoma then delayed repair of definitive corrective surgery (anorectoplasty) before stoma closed later on. The collected demographic data were sex, type of anorectal malformation, and age of patient at stoma creation, the type of stoma (whether a loop, divided, end and window). The level of the stoma (sigmoid, descending, transverse colon and ileum), a distal loop contrast study (high pressure distal colostogram) was done before anorectoplasty to define the level of the fistula and reveal development of megarectum as defined by the radiologist's report.

We followed up the patients during the period of study to determine if the patients developed any complications or mortality related to stomas formation or stoma closure; such as prolapse, infection, retraction, stenosis, skin excoriation, parastomal hernia, development of megarectum, UTI, intestinal obstruction, anastomotic leak, sepsis, incisional hernia and need for surgical revision.

A written informed consent was taken from the parents or guardian to decline their child participation in this research study.

The results were expressed as number (%), and analyzed by Pearson test using SPSS-version18 software (IMB Corporation). A P- value of less than 0.05 was accepted to be significant.

Results

There were 75 patients with stoma as a part of their staged treatment for high and intermediate type of anorectal malformation, (59%) boys and (41%) girls with a male: female ratio of 1.4:1. The types of anorectal malformation are shown in figure 1.

The stoma types and their location were performed according to the type of malformation and patient condition. The most common type was separated stoma which was done in 42 patients (56%), while loop stoma was done in 29 patients (38.6%). End stoma was performed in two patients (2.6%) and window stomas in two patients (2.6%) after resection of pouch colon or in rare cases of complex anorectal malformations. Descending colon was the prevalent location of stoma in this study (41 patients 54.6%) while the sigmoid colon was the location of stoma in 24 patients (32%). Other sites of stoma included transverse colon (6.6%), ileum (4%), and pouch colon (2.6%), (Table 2).

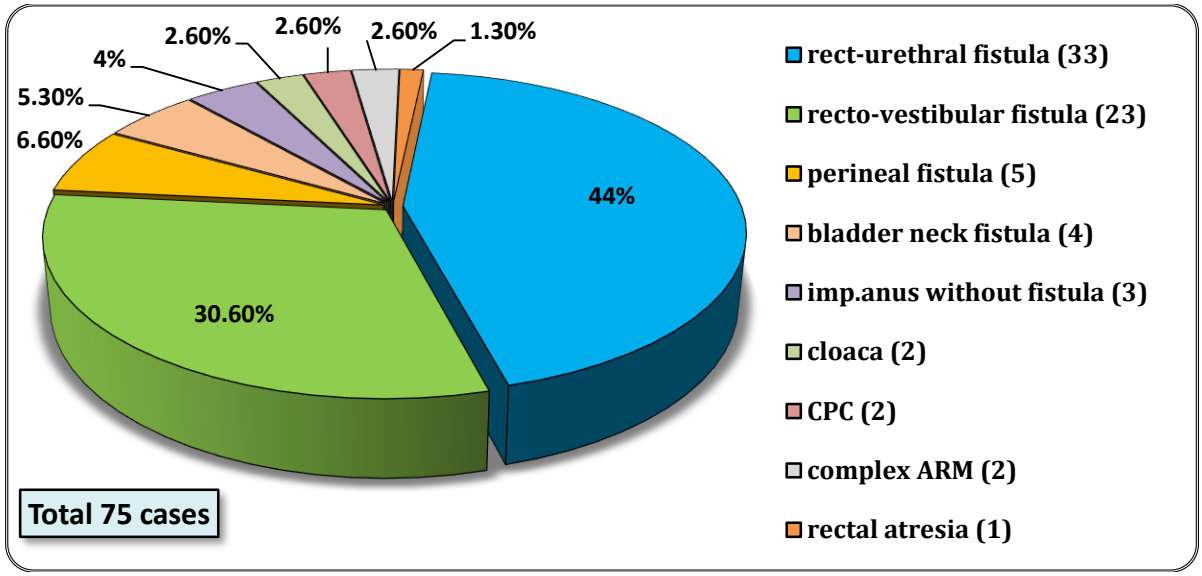

Figure 1: Types of anorectal malformation.

Table 2: Stoma types and their location.

		Type				Total
		Separated	Loop	End	window	
Location	Descending	28	13	0	0	41(54.6%)
	Sigmoid	12	11	0	1	24 (32%)
	Transverse	2	3	0	0	5 (6.6%)
	Ileum	0	2	1	0	3 (4%)
	Pouch colon	0	0	1	1	2 (2.6%)
Total		42 (56%)	29(38.6%)	2(2.6%)	2(2.6%)	75 (100%)

A total of 34 patients (45.3%) suffered from complications related to stoma. In all the patients there were 78 complications, five of them were excluded from the statistical analysis because they were developed in uncommon types or sites of stoma (end, window, ileum and pouch colon). Regarding the type of stoma; the complication rate was 75.8% in patients with loop stoma and 28.5% in those with separated stoma, this difference was significant (P-value 0.000). Details of the complications are placed in (Table.3); skin excoriation was the most frequent complication 13 cases (17.3%), followed by prolapsed stoma, wound infection, megarectum and other complications. Prolapse was the second most frequent complication seen totally in nine patients (12%), especially with loop stoma (8 out of 29) compared to one case of prolapse out of 42 separated stomas (P-value 0.001). Development of megarectum due to fecaloma formation was obvious in loop stoma (5 cases out of 29) compared to two cases of megarectum out of 42 separated stomas (P-value 0.043). Recurrent urinary tract infection was present in 5.3% of loop stoma and 1.3% of separated stoma with P-value of 0.013.

Table 3: Complications related to stoma type (formation and closure).

Complication	No. (%)	Loop	Separated	p-value
Skin excoriation	13(17.3)	8(10.6%)	5(6.6%)	0.048*
Prolapse	9(12)	8(10.6%)	1(1.3%)	0.001**
Wound infection	8(10.6)	3(4%)	5(6.6%)	0.420
Megarectum (fecaloma)	7(9.3)	5(6.6%)	2(2.6%)	0.043*
Stenosis	6(8)	2(2.6%)	4(5.3%)	0.350
Recurrent UTI	5(6.6)	4(5.3%)	1(1.3%)	0.013*
Sepsis	5(6.6)	2(2.6%)	3(4%)	0.969
Evisceration	3(4)	1(1.3%)	2(2.6%)	0.790
Anastomotic leak	3(4)	2(2.6%)	1(1.3%)	0.360
Retraction	2(2.6)	1(1.3%)	1(1.3%)	0.793
Intestinal obstruction	2(2.6)	2(2.6%)	0	0.087
Incisional hernia	2(2.6)	1(1.3%)	1(1.3%)	0.793
Reversed direction	2(2.6)	0	2(2.6%)	0.239
Parastomal hernia	2(2.6)	1(1.3%)	1(1.3%)	0.793
Death	4(5.3)	1(1.3%)	3(4%)	0.519
Total number of complications	73	41	32	0.037*
Number of patients with one or more complications	34(45.3)	22(75.8%)	12(28.5%)	0.000**

* = statistically significant correlation at 0.05 level
** = statistically significant correlation at 0.01 level

Table 4: Complications related to stoma site (formation and closure).

Complication	No. (%)	Descending	Sigmoid	P-value
Skin excoriation	13(17.3)	7(17%)	5(20.8%)	0.711
Prolapse	9(12)	3(7.3%)	6(25%)	0.047*
Wound infection	8(10.6)	3(7.3%)	5(20.8%)	0.113
Megarectum (fecaloma)	7(9.3)	4(9.7%)	3(12.5%)	0.735
Stenosis	6(8)	4(9.7%)	2(8.3%)	0.851
Recurrent UTI	5(6.6)	3(7.3%)	2(8.3%)	0.885
Sepsis	5(6.6)	2(4.8%)	3(12.5%)	0.273
Evisceration	3(4)	1(2.4%)	2(8.3%)	0.282
Anastomotic leak	3(4)	2(4.8%)	1(4.1%)	0.897
Retraction	2(2.6)	2(4.8%)	0	0.279
Intestinal obstruction	2(2.6)	1(2.4%)	1(4.1%)	0.703
Incisional hernia	2(2.6)	2(4.8%)	0	0.279
Reversed direction	2(2.6)	0	2(8.3%)	0.062
Parastomal hernia	2(2.6)	0	2(8.3%)	0.062
Death	4(5.3)	2(4.8%)	2(8.3%)	0.538
Total number of complications	73	34	39	0.003**
Number of patients with one or more complications	34(45.3)	20(48.7%)	14(58.3%)	0.465

* = statistically significant correlation at 0.05 level
** = statistically significant correlation at 0.01 level

Regarding the location of stoma; complication rate was found to be higher in the sigmoid colon compared with descending colon regardless of stoma type (58.3% versus 48.7%) but it was statistically insignificant (p = 0.465), whereas the total number of complications was higher in sigmoid colon than that in descending colon (p = 0.003 statistically significant). There were no significant differences between the

two sites of stomas regarding other types of complications, (Table 4).

Sixty seven stomas out of 75 were closed during the study period; the mean age at closure was 14 months (range 9 – 20 months). The follow up period after closure of stoma revealed complications related to stoma as following; wound infection 3 cases (4.4%), anastomotic leak 3 cases (4.4%), intestinal obstruction 2 cases (2.9%), incisional hernia 2 cases (2.9%) and sepsis in one case, (total 11 out of 78 complications).

Ages of the patients at which complications developed were shown in figure 2.

There were four reported deaths directly related to stoma formation and no death reported from stoma closure. This represents a mortality rate of 5.3%. The cause of death was severe wound infection and sepsis in three patients (one of them developed evisceration and burst abdomen) and high output ileostomy with electrolytes disturbance in the last patient.

A rescue operation was needed in 16.4% of all complications (12 cases) and those patients had to have surgical intervention for: evisceration in three cases, refashioning of stenosed stoma in three cases, laparotomy for intestinal obstruction in two cases, anastomotic leak in one case, retracted stoma in one case, prolapse in one case and incisional hernia in one case.

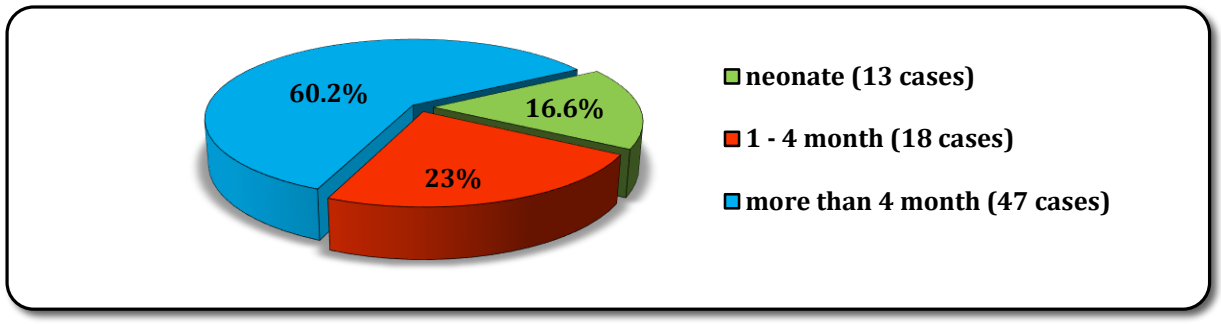

Figure 2: Age at which complications developed.

Figure 3: Prolapsed stoma.

Figure 4: Stenosed stoma.

Figure 5: Skin excoriation

Figure 6: Infection, disruption.

Discussion

In spite of the fact that a definitive repair of anorectal malformation in the neonatal life without initial stoma obviate the complications of stoma[12]. It carry a great hazard to the urinary tract and other nearby structures because the precise anorectal defect is not well identified and the best way to definitely determine the patient's anorectal defect is to do a distal colostogram, which absolutely requires the presence of a colostomy. So any operation in neonatal period without this information will be a blind perineal exploration with big difficulty in finding the rectum and may injure other unexpected structures like urethra, seminal vesicles, vas deferens and even lower ureters during the process of rectum searching. Eventually, without fecal diversion, there is risk of infection and dehiscence and all of these complications may adversely affect the consequent functional prognosis.

Although many recent reports have shown the safety of one stage corrective procedure especially for girls with rectovestibular fistulas, a diverting stoma is still considered the first step in the surgical management of these malformations[13,14]. It is totally accepted that creating stoma is a minor surgical procedure, but with potentially significant morbidity[7,15].

The reported incidence of stoma related complications in children ranges from 28% to 74% as reported by Al Saleem et al[9]. Recently Desiree et al in their systemic review over 22 years reported general complication rate for all types of stomas in children in a wide range from 9 to 91%[16]. This wide range of complication rates probably depend on medical facilities, experience of surgeons and conflict in defining some complications, for example skin excoriation which were recorded in some studies they were treated in hospitals but neglected by other studies and treated as outpatients[16]. Our data show a high rate of stoma related complication (45.3%) of all patients under study which is higher than the complication rate of Lohfa B et al (26.2%)[10], but less than that reported by a study from India (69.8%)[17].

The type of diverting stoma chosen depends on healthcare resources, surgeons' training, personal experience and preference[8]. In our center, the preferred stoma was made from the descending part of the colon as separated stomas and was located in the left-lower quadrant of the abdomen, (Table 2). Due to study limitations, including rarity of other types of stoma performed and limited patients number (n=75), it was impractical to study each of the aforementioned stoma preferences separately. Thus, we focus on the two most frequent types of stoma performed included loop colostomy and divided colostomy (regardless of distance between the proximal stoma and the distal mucous fistula). We excluded transvers colostomy, pouch colon, end and window stoma from statistical analysis because of their few numbers.

We found that the total complication rate was significantly more in loop stoma (P-value 0.037) and in sigmoid colon (P-value 0.003) rather than separated and descending colon, respectively. Some authors reported high complication rates in transverse loop or descending stomas[18,19], but others found more complication related to stoma in distal colon[7,20].

The most frequent complication encountered in our patients was peri-stomal skin excoriation; it was seen more with loop rather than separated stoma with statistical significant P-value 0.048. This is may be because of difficult stoma management and chronic stool contact with skin especially when there is prolapse. The risk is usually greater in case of more proximal stoma (transverse colostomy or ileostomy) compared with a sigmoid colostomy because in the former less colon is available for absorption of salts and bile acids. Dedicated stoma nurses, advise parents on good stoma management and materials for their children definitely will lessen this problem.

The second most frequent complication was prolapse, it was more in loop, sigmoid stoma rather than separated, descending stoma (P-value 0.001).Many previous studies reported such problem[7,17,21]. Narrowing of distal orifice such as mucous fistula during formation of separated descending colostomy was proposed by Pena et al[21] to prevent prolapse.

The development of megarectum was significantly associated with loop type of stoma (P-value 0.043) but not correlated with the location of stoma. loop stoma permits the passage of stool from the proximal to the distal bowel which may lead to distal rectal pouch dilatation and fecal impaction. This prolong distention of the rectal pouch may produce an irreversible hypomotility disorder leading to severe constipation later in life[22]. Other literature showed that development of a megarectum had no relation to the stoma type (loop vs. divided)[23] and they concluded that a well fashioned loop colostomy may not lead to such complications.

Another complication that was highlighted by the current study was the correlation between the type of stoma and the development of urinary tract infection, although reports have shown no association between stoma type and UTIs[7], a common belief amongst pediatric surgeons is that loop stoma can lead to a higher incidence of UTIs through the existing of recto-urinary fistula[21]. Our results showed a higher incidence of UTIs amongst those with loop stoma (5.3%) versus (1.3%) with separated stoma, this was statistically significant (P-value 0.013), but it seems to be unaffected by the location of stoma. Really, a more detailed review of patients who developed UTIs should be taken including the presence of associated urinary tract malformations or dysfunction such as neurogenic bladder and vesicourethral reflux and whether these UTI episodes occurred before or after anorectoplasty and division of recto-urinary fistula to decide whether this relation is genuine or due to coexistent factors. The presence of urinary tract anomalies or dysfunction was not initially a variable of interest in our study, thus it was not included in our analysis. Levitt and Pena believe that complete stool diversion will prevent the development of megarectum, UTI, and perineal wound infection after anorectoplasty[21,24].

Although a colostomy established in the mid and lower sigmoid may interferes with the mobilization of the rectum during the pull-through[25], all of our sigmoidostomy didn't interfere with the pull-through of the rectum during definitive surgical repair.

We reported a stoma related mortality rate of 5.3% and it appeared to be not influenced by the type or location of stoma. Lohfa et al found no difference in the mortality rate when colostomy type was considered[10]. Stoma related mortality rate in a developing country may increase up to 44% especially if the baby is small, sick and septic[8].

The wound problems like infection, dehiscence, evisceration, reversed direction and stenosis were more frequent

in separated stoma; we noticed that there was a tendency to separation of the skin bridge between the two stomas or around the proximal ones because of infection in the suture line between two orifices. While problems of prolapse, retraction, UTI and megarectum were more prevalent in loop type. However, according to the location, the stoma in the sigmoid colon was prone to prolapse and reversed direction more than those in descending colon while the later were having more problems of retraction, stenosis and incisional hernia. Pena et al reported 0% of complications such as mislocation, prolapse, stenosis and retraction in patients operated by same experienced surgeon with same technique[21].

Recently, in the study of Gardikis et al[26], the patients whose posterior sagittal anorectoplasty (PSARP) operation was completed under 4 months old were shown to have less complication related to stoma than those of older age, and there was no meaningful difference between loop and separated stomas in this period, especially for prolapse. In our study more than 60% of stoma complication developed at age older than 4 month. Performing the definitive repair including closure of stoma at earlier age has fewer complication and important advantages for the patient[27], including shorter time with an abdominal stoma, less discrepancy in diameter between proximal and distal bowel at the time of stoma closure, simpler anal dilatation, and no recognizable psychological sequelae from painful perineal maneuver in addition at least theoretically placement of rectum in the right position early in life may have an advantage in terms of acquired local sensation[4].

Loop stomas are prone to prolapse in frequent and may cause malnutrition as well as fecal impaction and hence, refractory constipation later in life[21,28]. In the presence of a large rectourethral fistula, the patients frequently voids into the colon and a more distal stoma will permit the urine to get- away through the distal stoma without serious absorption while with a more proximal stoma the urine is absorbed in the colon rising the incidence of metabolic acidosis[29].

In conclusion; the results of our study confirm that loop stoma have a higher rate of complications than separated stomas. Stoma in the descending colon carry less morbidity in addition to the advantages when compared to the stoma located in the proximal colon. Lastly, the earlier age of complete surgical repair with closure of stoma the less devastating complications.

The formation of stoma should not be taken as minor surgical procedure and should be done by surgeon having good experience with attention have to be paid to the technical details. An aggressive and diligent postoperative care is needed. A stoma care center should be established under pediatric enterostomal therapist and nurse specialist. The ongoing patient/family education is of paramount importance to prevent problems of skin excoriation.

References

1. Nixon HH. Anorectal anomalies: with an international proposed classification. Postgrad Med J 1972; 48:465-70.
2. Santulli TV, Kiesewetter WB, Bill AH Jr. Anorectal anomalies: A suggested international classification. J Pediatr Surg 1970; 5:281-7.
3. Holschneider A, Hutson J, Peña A, et al. Preliminary report on the International Conference for the Development of Standards for the Treatment of Anorectal Malformations. J Pediatr Surg 2005;40 (10):1521–6.
4. Marc A Levitt, Alberto Pena. Anorectal malformation. In Arnold G. Coran (ed.), Pediatric Surgery Textbook, Elsevier (7th ed.), 2012. p 1295- 6.
5. Gupta DK, Sharma S. Congenital pouch colon - Then and now. J Indian Assoc Pediatr Surg 2007;12:5-12.
6. Sinha SK, Kanojia RP, Wakhlu A, Rawat JD, Kureel SN, Tandon RK. Delayed presentation of anorectal malformations. J Indian Assoc Pediatr Surg 2008;13:64-8.
7. Demirogullari B, Yilmaz Y, Yildiz GE, et al. Ostomy complicatıons in patients with anorectal malformations. Pediatr Surg Int 2011;27 (10):1075–8.
8. Chowdhary SK, Chalapathi G, Narasimhan KL, Samujh R, Mahajan JK, Menon P, Rao KLN An audit of neonatal colostomy for high anorectal malformation: the developing world perspective. Pediatr Surg Int 2004; 20:111–3.
9. Al Saleem AH, Grant C, Khawaja S. Colostomy complications in infants and children. Int Surg 1992; 77:164-6.

10. Lohfa B. Chirdan, Francis A. Uba, mmanuel A. Ameh , Philip M. Mshelbwala. Colostomy for high anorectal malformation: an evaluation of morbidity and mortality in a developing country. Pediatr Surg Int 2008; 24:407–10.
11. Donald E Meier, Afua AJ Hesse. Anorectal malformation. In: Emmanuel A Ameh (ed.) Pediatric Surgery: A Comprehensive Text for Africa, global help org. 2011. vol.(2). p 455-60.
12. Marc A Levitt, Alberto Peña. Review of Anorectal malformations, Orphanet Journal of Rare Diseases 2007; 2:33.
13. Vick LR, Gosche JR, Boulanger SC, et al. Primary laparascopic repair of high imperforate anus in neonatal males. J Pediatr Surg 2007;42:1877–81.
14. Iwai N, Fumino S: Surgical treatment of anorectal malformations. Surg Today 2012 Nov 30 [Epub ahead of print].
15. Chirdan LB, Uba FA, Ameh EA, et al. Colostomy for high anorectal malformation: an evaluation of morbidity in a developing country. Pediatr Surg Int 2008;24:407–10.
16. Desiree van den Hondel, Cornelius Sloots, Conny Meeussen, Rene Wijnen, To Split or Not to Split: Colostomy Complications for Anorectal Malformations or Hirschsprung Disease: A Single Center Experience and a Systematic Review of the Literature. Eur J Pediatr Surg 2013; DOI http://dx.doi.org/ 10.1055/s-0033-1351663. ISSN 0939-7248.
17. Chandramouli B, Srinivasan K, Jagdish S, Ananthakrishnan N.Morbidity and mortality of colostomy and its closure in children. J Pediatr Surg 2004; 39:596-9.
18. Sheikh MA, Akhtar J, Ahmed S. Complications/problems of colostomy in infants and children. J Coll Physicians Surg Pak 2006; 16:509–13.
19. Ekenze SO, Agugua-Obianyo NE, Amah CC. Colostomy for large bowel anomalies in children: a case controlled study. Int J Surg 2007;5:273–77.
20. Tay E, Tay J, Subramaniam R, Joseph VT. Acute retention of urine due to prolapsing stoma in a case of anorectal malformation with bladder neck fistula. Pediatr Surg Int 2004; 20:809–10.
21. Pena A, Migotto-Krieger M, Lewitt MA. Colostomy in anorectal malformations: a procedure with serious but preventable complications. J Pediatr Surg 2006; 41:748–56.
22. Sathyaprasad Burjonrappa, Sami Youssef, Stephanie Lapierre, Arie Bensoussan, Sarah Bouchard, Megarectum after surgery for anorectal malformations. J Pediatr Surg. 2010; 45(4): 762–68.
23. Omar Oda, Dafydd Davies, Kimberly Colapinto, J Ted Gerstle, Loop versus divided colostomy for the management of anorectal malformations. J Pediatr Surg 2014; 49: 87–90.
24. Levitt MA, Kant A, Pena A. The morbidity of constipation in patients with anorectal malformations. J Pediatr Surg 2010;45(6):1228–33.
25. Andrea Bischof, Marc A. Levitt, Alberto Pena. Reoperative surgery for the complicated pediatric stoma. In: Andrew P. Zbar, Robert D. Madoff, Steven Wexner, Reconstructive surgery for the rectum, anus and perineum. Springer 2013. PP 487 -92.
26. Gardikis S, Antypas S, Mamoulakis C, Demetriades D, Dolatzas T, Tsalkidis A, Chatzimicael A, Polychronidis A, Simopoulos C. Colostomy type in anorectal malformations: 10-years experience. Minerva Pediatr 2004; 56:425–429.
27. Lewis Spitz, Arnold G, Coran. Operative pediatric surgery: Hodder Arnold sixth edition. 2006. P. 487 – 8.
28. Singal AK, Bhatnagar V. Colostomy prolapse and hernia following window colostomy in congenital pouch colon Pediatr Surg Int 2006;22:459–61.
29. SN Kureel, RK Tandon Anorectal Malformation: Diagnosis and Management. In: Devendra K Gupta (ed.), Pediatric Surgery Diagnosis and Management. Jaypee Brothers Medical Publishers 1st ed. 2009. p 788-815.

IMJ 2017;63(1):29-38.