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Original Article

Evaluation of Rectal Pouch Level in Anorectal Malformations : Comparison between Invertogram and Prone Lateral Cross-table Radiograph

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Abstract

Background: **Invertogram has been used to evaluate the level of blind rectal pouch in neonates with anorectal malformations (ARM) for over 80 years. In recent years, prone lateral cross-table radiograph (PLCTR) has been recommended for demonstrating these anomalies, providing equivalent information as the traditional procedure.**

Objective: **The aim of this study was to compare the effectiveness in evaluation of rectal pouch level in ARM between invertogram and PLCTR.**

Materials and Methods: **During January 2009 to June 2012, all of the neonates with ARM who had no evidence of cutaneous, urinary or genital fistula underwent both invertogram and PLCTR for demonstration of the blind rectal pouches. Demographic data and radiographic findings of the patients were collected and analyzed.**

Results: **Fifty -two neonates with ARM (46 males and 6 females) were available for the study. Thirty-nine patients (75%) were full term babies, whereas 13 patients (25%) were premature. Invertogram and PLCTR were done within 13 to 36 hours after birth. Radiographic findings of the two methods in 46 patients (89%) were not different. In the remaining 6 cases (11%), the findings of PLCTR were more accurate, with confirmation by colostomy study (loopogram) or operative findings, while the evidence of rectal gas shadow in the invertogram revealed higher than the actual levels.**

Conclusion: **PLCTR is much easier to position, less time consuming and more accurate in some cases than invertogram regarding interpretation of the level of rectal pouch in ARM. PLCTR should be routinely used instead of invertogram for evaluation in ARM.**

Key words: **Anorectal malformations, invertogram, prone lateral cross-table radiograph, rectal pouch level**

INTRODUCTION

Anorectal malformations (ARM) are one of the commonest anomalies in the neonates. The reported incidence is between 1:1500 and 1:5000 live births[1-5]. Major advances have been made in the last decade in operative techniques to correct this abnormality[6]. The initial surgical management of an infant with ARM depends on the level of anomaly as well as the presence or absence of fistula between the rectal pouch and adjacent organs[7,8]. Radiographic investigation is used to evaluate the blind rectal pouch for determining the level of anomalies. Anoplasty is the surgical method of

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choice for patients whose rectal pouch terminates close to the perineal skin, whereas the colostomy is usually chosen for patients with intermediate to high-lying rectum and/or internal fistula[9]. The level of anomalies in the majority of cases can be determined by a careful clinical examination. However, radiologic investigations are necessary in 10% to 20% of patients when clinical data is not sufficient[10]. In the radiologic evaluation of the neonates with ARM, the invertogram, first described by Wangensteen and Rice in 1930[11] has withstood the test of time. Precautions in the technique and pitfalls in its interpretation have been well documented[12,13]. In 1983, the prone lateral cross-table radiograph (PLCTR) was recommended by Narasimharao[14]. PLCRT was claimed to be an easy procedure, providing equivalent or better evaluation compared with the invertogram. The aim of this study was to compare the accuracy in the evaluation of rectal pouch level of ARM between invertogram and PLCTR.

Materials and Methods

The study was approved by the Institutional Review Board of Queen Sirikit National Institute of Child Health (QSNICH). A prospective study of neonates with ARM treated at our institute between January 2009 and June 2012 was carried out. Neonates with ARM who had no evidence of cutaneous, urinary and genital fistula underwent both invertogram and PCTLR for demonstration of the blind rectal pouches at the same time. Details of the radiological procedure were explained to, and informed consent was obtained from, the parents. Most of the patients were planned to undergo radiological examination approximately 24 hours after birth, but was done earlier in some cases with rapid abdominal distension or delayed passage of intestinal gas to the rectum during the examination. However, all radiologic examinations were performed at least 12 hours after birth in order to allow enough time for the air to reach the rectum. Skin markers were not used. Nasogastric tube was passed through to the stomach before the radiological investigation to rule out esophageal atresia.

The patients were held in inverted position for five minutes in routine invertogram. In the PLCTR, the patients were held face down with their hip flexed and were kept in this genupectoral position for five minutes with the centre of radiographs at the greater trochanter, as in the invertogram. The radiographs were evaluated by a pediatric radiologist. The levels of blind rectal gas shadow were classified as being due to low, intermediate, or high anomalies, based upon the bony landmarks of the pubococcygeal (PC) line and the ischial (I) point[12]. A blind rectal gas shadow seen above the PC line was interpreted as due to a high anomaly, that seen between the PC and I-line as due to an intermediate anomaly, and below the I-line as due to a low anomaly. Accuracy of the blind rectal gas levels were proven during anoplasty for low anomaly, and by barium examination of the distal loop of the colon (distal loopogram) after colostomy for intermediate and high anomalies.

Exclusion criteria included ARM patients with clinical findings of cutaneous, urinary and genital fistula, those with esophageal atresia, and those with clinical instability requiring endotracheal intubation and respiratory support.

Statistical analysis of radiological evaluation comparing invertogoram and PLCTR were performed using the exact McNemar test, as implemented in Stata v. 12 (Stata Corp, College Station, TX, USA). A two-tailed p-value of less than 0.05 was considered statically significant.

Results

During the study period, 171 neonates with ARM were referred to the Institute. One hundred and twelve cases had cutaneous or genitourinary fistula and seven cases had a combination of ARM with esophageal atresia. Only 52 neonates (46 males and 6 females) were enrolled for radiograpraphic investigations (invertogram and PLCTR). Thirty-nine patients (75%) were full term babies and 13 patients (25%) were premature (Table 1).

The age of patients at the time radiography was performed ranged from 13 to 39 hours. In 26 patients invertogram was done before PLCTR, the remaining 26 underwent PLCTR first. There was no difference in the interpretation of the distal rectal pouch level in 46 sets of radiographs (89%): high, intermediate and low anomaly in 10, 26 and 10 cases, respectively (Figure 1 and Table 2). In 6 cases (11%) the interpretation differed between radiography techniques. Four cases were interpreted as having a high anomaly on the invertogram, but PLCTR showed intermediate anomaly (Figure 2). These patients underwent sigmoid colostomy. The definitive diagnosis was established by

Table 1 Demographic data of the 52 patients with anorectal malformations

Clinical data	No. of patients (%)
Sex	
male : female	46:6 (77:23)
Gestational age (weeks)	
less than 33	2 (4)
33-36	11 (21)
37-40	39 (75)
Age at radiological evaluation (hours)	
13-18	6 (12)
19-24	22 (42)
25-30	18 (35)
31-36	4 (8)
over 36	2 (4)

loopogram which showed intermediate anomaly in all of the 4 cases (Figure 3). The remaining 2 cases were interpreted as having intermediate anomaly on the invertogram, but as a low anomaly on PLCTR (Figure. 4). These 2 cases were diagnosed as low anomaly and successfully underwent anoplasty. There was no statistically significant difference ($p > 0.05$) in the comparison between invertogram and PLCTR for each anomaly, but a significant difference ($P < 0.05$) was seen in the comparison for all ARM patients (Table 2). In addition, 33 of the 46 patients (72%) with no difference in the interpretation of the rectal pouch level, had terminating rectal gas shadows seen in the PLCTR lower than those seen in the invertogram.

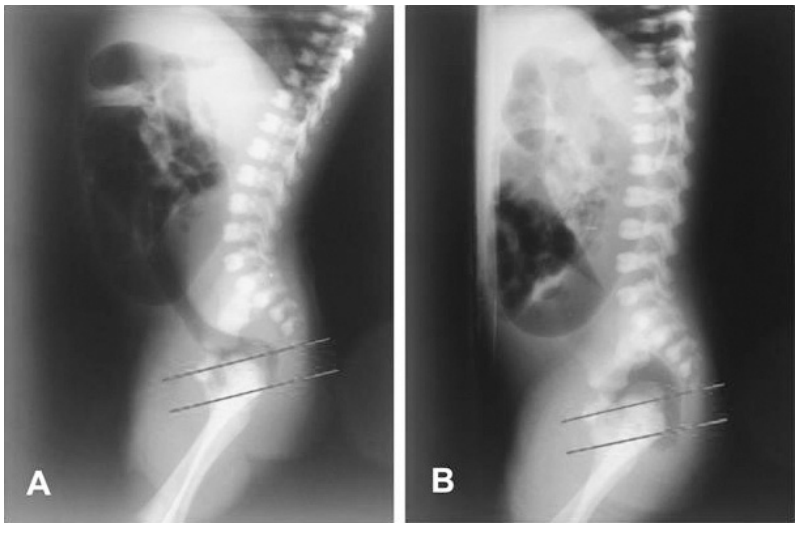

Figure 1 A. Invertogram showed low type A RM with rectal gas shadow at the I-line
B. PLCTR also showed low type. but level of rectal gas shadow is more caudal than the invertogram

Table 2 Comparison of radiological evaluation between invertogram and prone lateral cross-table radiograph (PLCTR)

Type of Anorectal Malformation Radiological procedures	Correct Diagnosis No.(%)	Incorrect Diagnosis No.(%)	p-value[a]
Lowb[b] (n = 12)			
Invertogram	10 (83)	2 (17)	0.500
PLCTR	12 (100)	0	
Intermediate[c] (n = 30)			
Invertogram	26 (87)	4 (13)	0.125
PLCTR	30 (100)	0	
High[c] (n = 30)			
Invertogram	10 (100)	0	0.999
PLCTR	10 (100)	0	
Total no. of patients (n = 52)			
Invertogram	46 (89)	6 (12)	0.031
PLCTR	52 (100)	0	

[a]p-value by exact McNemar test; [b]proven by anoplasty; [c]proven by colostomy study (distal loopogram)

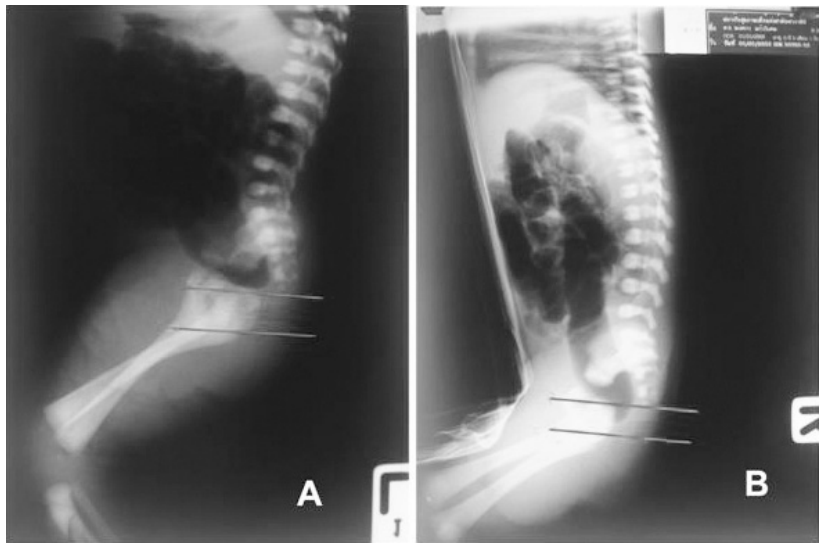

Figure 2 A. Invertogram showed rectal gas shadow above the PC-line PC-line (high type)
B. PLCTR showed level of rectal gas shadow between PC and I-line (intermediate type)

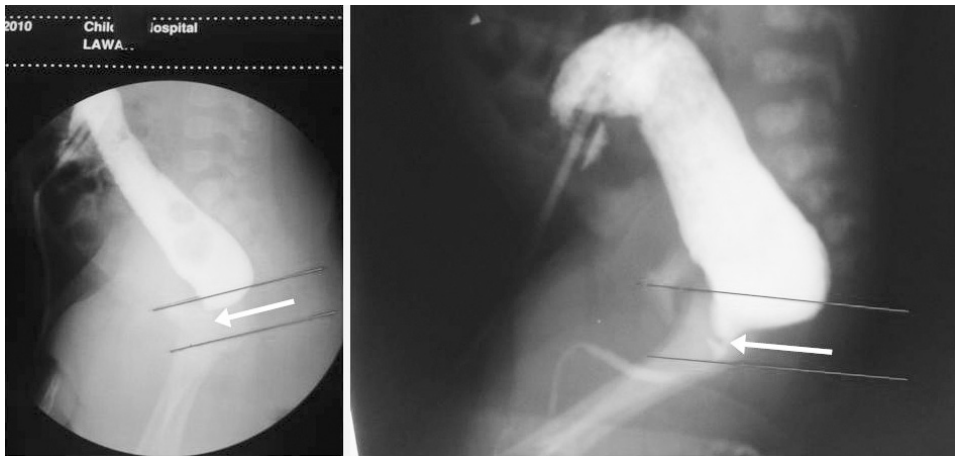

Figure 3 The colostomy study revealed intermediate type imperforate anus with rectourethral fistula (arrow)

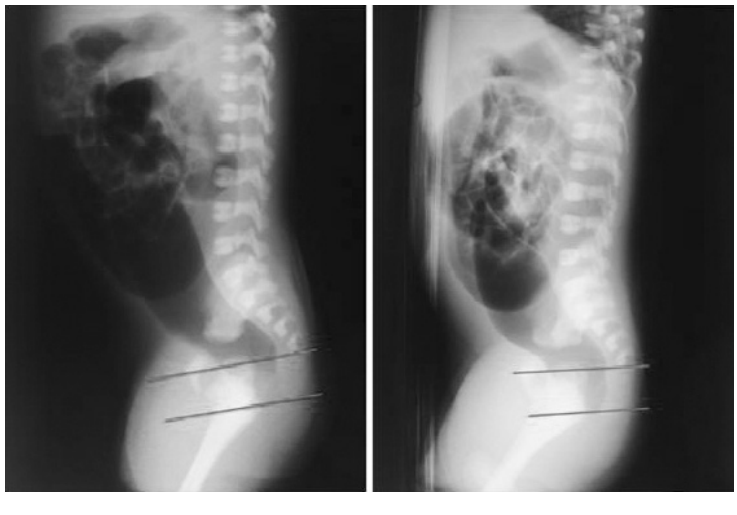

Figure 4 A. Invertogram showed rectal gas shadow between the PC and I-line (intermediate type)
B. PLCTR showed level of rectal gas shadow at the I-line (low type). Low type ARM was proven by the operative procedure (anoplasty)

Discussion

Anorectal malformations comprise a spectrum of anatomical defects. Some of these are minor, and can be surgically treated early on with an excellent functional prognosis. Others are complex and difficult to manage and have uncertain prognosis[15-20]. Most infants with low anomalies undergo a definitive anoplasty within a few days after birth. Higher anomalies have poor sphincteric development and have higher chances of an associated internal fistula. A temporary colostomy is essential, and helps in the detailed investigations of the anomaly by allowing the performance of a contrast study called a distal loopogram[9].

The upside-down x-ray (invertogram) originally described by Wangensteen and Rice[11] in 1930 has been considered the classic method for determining the level of the blind rectal pouch. In this method, the patient must be carefully held upside down. A modification of a prone lateral cross-table radiography (PLCTR) as described by Narasimharao[14] was reported in 1983. Patients were held face down with their hips flexed and were kept in this genupectoral position. The evaluation of the rectal gas shadow was based on bony landmarks (pubococcygeal line and ischial point) in both the invertogram and the PLCTR. Narasimharao[14] recommended the routine use of PLCTR instead of invertogram because the former provided equivalent or sometimes better information than the invertogram.

The results of our study are similar to, and support, the previous study of Narasimharao[14]. PLCTR offers certain advantages such as easy positioning, better distension or delineation of rectal gas, and is less time consuming. The patient is usually calm and relaxed in the genupectoral position. The full extent of the rectal gas shadow could be well demonstrated on the radiograph. The patient usually cry during invertogram positioning, which causes contraction of puborectalis sling and a deceptive obliteration of the lower rectum[6]. In addition, we found evidence that the blind rectal pouch seen on invertogram is higher than the actual levels in some cases.

In conclusion, the present study revealed that PLCTR was more accurate than the invertogram regarding interpretation of rectal pouch level in ARM. Thus, we advocate the routine use of PLCTR instead of the invertogram in the evaluation of ARM because it is easier to perform and is more accurate.

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