



## Original Research Article

## 3D high-definition manometry in evaluation of children after surgery for Hirschsprung's disease: A pilot study



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## ABSTRACT

**Purpose:** Anorectal 3-dimensional high definition manometry (3D HRM) could be the best tool for postoperative assessment of restorative surgical procedures for Hirschsprung's disease. The aim of our study was to evaluate patients after surgery for Hirschsprung's disease using 3D HRM.

**Materials and methods:** Anorectal function was evaluated using solid state 3D HRM. We measured the length of the anal canal, mean resting squeeze pressures, the presence of rectoanal inhibitory reflex, cough reflex, ano-anal reflex and the bear down manoeuvre.

**Results:** We studied 14 children operated on for Hirschsprung's disease. The mean values of pressure asymmetry were higher in patients after the Duhamel procedure than after the TEPT procedure (29.58% vs. 22.26% during resting and 26.1% vs. 14.01% during squeeze, respectively). No difference between the groups was observed in the measurement of all the manometric parameters except the presence of rectoanal inhibitory reflex (87.5% after TEPT vs. 33% after Duhamel).

**Conclusions:** Anorectal 3D HRM evaluation of patients with Hirschsprung's disease demonstrated that the asymmetry of the anal canal occurred in a similar percentage after both procedures.

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## 1. Introduction

Hirschsprung's disease is one of the most common congenital disorders of the gastrointestinal tract. This disease is characterised by the lack of ganglion cells in the intestinal wall, which results in the permanent contraction of its lumen and a lack of motility [1]. The only treatment for the disease is surgery. One of the most popular surgical methods is the Duhamel procedure [2,3], which is gradually being replaced by the newest method, the transanal endorectal pull through (TEPT) procedure [4]. To assess the postoperative function of the anorectal area, a manometric study should be performed [5].

Anorectal manometry measures pressures of the distal part of the gastrointestinal tract. This method is non-invasive, simple to use and quick; however, this procedure is not readily available in paediatric clinics. The most widely used method is the conventional water-perfused system using a 4 channel-catheter. A new

high-resolution manometry (HRM) system using circumferential sensing solid state transducers allows for the evaluation of the anal sphincteric complex in a more detailed manner. The catheter consists of at least 12 sensors located longitudinally and circumferentially and records average pressures every 0.5–1 cm. Anorectal 3D high-resolution manometry (3D HRM) is an advanced version of the HRM system and has been recently introduced into clinical practice. Currently, 3D HRM is the most precise method to assess the anal sphincter function and may be crucial for planning and controlling surgical procedures of the anorectal area. Until now, only a few studies have evaluated patients after surgery for Hirschsprung's disease [6–8]. None of the studies were based on high resolution manometry. The aim of our study was to evaluate patients after surgery with the Duhamel and TEPT procedures for Hirschsprung's disease using anorectal 3D HRM.

## 2. Materials and methods

## 2.1. Patients

Patients after surgery for Hirschsprung's disease underwent manometric evaluation in the Department of Paediatric Gastroenterology and Nutrition, Warsaw Medical University, Poland. The

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diagnosis of Hirschsprung's disease was confirmed by rectal biopsies in all patients. All operations (Duhamel procedure or TEPT) were performed by the same surgical team in the Department of Children's Surgery between 2007 and 2010. For each patient clinical characteristics including age, age at surgery, number of stools per day were collected. Functional outcomes were evaluated. Constipation and soiling were defined using the III Rome criteria [9].

## 2.2. Study protocol

All subjects received a physical examination and auxologic assessment. Manometry was performed with a high definition manometry catheter (ManoScan 360 HD; Sierra Scientific Instruments Inc., Los Angeles, California) that was attached to an amplifier and recorder system and further connected to the computer. The catheter measures 6.4 cm in length and has an outer diameter of 10.75 mm. The instrument consists of 256 solid state pressure sensors in 16 rows; every row is composed of 16 circumferentially oriented sensors. The pressure is measured every 4 mm longitudinally and every 2.1 mm circumferentially. The 3D HRM catheter is shown in Fig. 1. The protective sheath with the balloon located at the top is placed onto the catheter. The plastic syringe is connected with the catheter to inflate air into the balloon when necessary.

Manometric data were analysed using ManoView analysis software (Sierra Scientific Instruments, Los Angeles, California). The software interpolates pressures between the sensors, and maps of the pressure are depicted on the screen. The real time spatiotemporal plots of the anorectum are recorded and presented in 2D and 3D display on the computer monitor using specialised software.

No routine bowel preparation was used. All patients were investigated in the supine position. Before each examination, the probe was calibrated and then inserted into the anorectum. After the 5-minute accommodation period, the following standard manometric measurements were obtained: resting pressure, squeeze pressure, rectoanal inhibitory reflex (RAIR), ano-anal reflex and cough reflex. RAIR was defined as 25% decrease in mean resting pressure of anal canal and was evaluated by progressively distending the rectal balloon in 10 mL increments from 0 to 60 mL. In cooperating children, the bear down manoeuvre was also recorded. Subsequent measurements were separated by 2-minute intervals.

It was shown in healthy adults that the spatiotemporal plot of the left half of the anal canal tube is the mirror image of the right half [10]. There is no such correlation between the anterior and

posterior parts of the anal canal. We hypothesised that if there was any lesion of the sphincter area, the difference in the mean pressure between the left and right part of the anal canal would be recorded. An example of a large difference between both halves that resulted in an asymmetrical sphincter is shown in Fig. 2. For the statistical analyses, we used raw measurements from each sensor to calculate the mean pressure of each half of the anal canal tube.

The pressure asymmetry measurement was obtained while the patient was resting and again during a squeeze of the anal sphincter. We evaluated the pressures of the anorectal area during 10–20 s; the time of the evaluation depended on the level of cooperation from the child. The percentage difference between the left and right part of the anal canal was termed pressure asymmetry and was calculated using the Hodges-Lehman's estimator, which allowed the parameter to be independent of the age of the patient.

## 2.3. Statistical analysis

The Hodges-Lehman estimator was used as the pressure location parameter measured at each point of the 20 or 10 s investigation. The global asymmetry [%] between the left and right side was computed. Differences between the two groups of patients were tested with the permutation test using 10,000 Monte Carlo steps. To determine whether manometry parameters could differentiate between the two types of surgery, the Pillai-Bartlett statistic was used. Because of the small sample size, the distribution of the Pillai-Bartlett statistic was estimated exactly. The Spearman coefficient was used to measure the correlation between two variables.

The study was approved by the Ethics Committee of the Medical University of Warsaw, Poland (KB81/2011).

## 3. Results

Fourteen patients (12 males; mean age of 51 months; range 14–168) were studied, 6 after the Duhamel procedure and 8 after the TEPT procedure. The mean age at surgery and mean time after surgery was shorter in the TEPT group than in the Duhamel group. The level of anastomosis in the Duhamel and the TEPT groups was located as follows: at the ileum 0 vs. 1, at the transverse colon 2 vs.



Fig. 1. 3D HRM catheter.

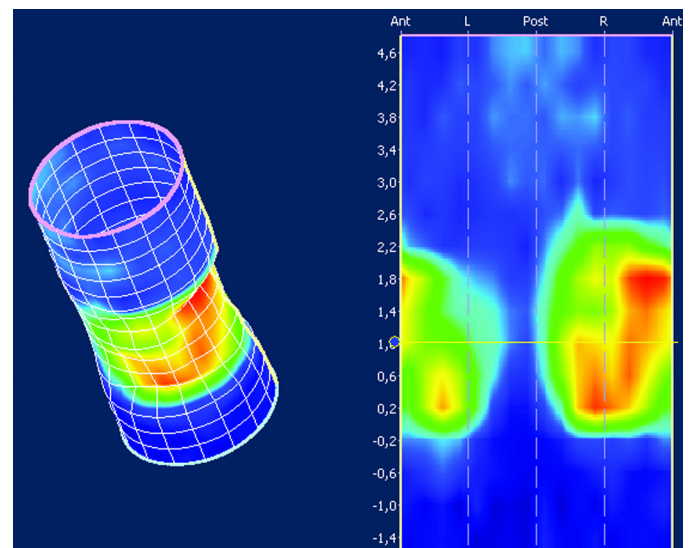


Fig. 2. The 3D and 2D spatiotemporal plots of the asymmetrical high pressure zone of the anorectum.

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