The Management of Urological Manifestations Associating Functional Defecation Disorders in Children

Thesis

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Mohamad Al-Sayed Nader Soliman

List of Contents

List of Abbreviations

ACE	:	Antegrade continent enema
ADHDs	:	Attention deficit hyperactivity disorder
AUA	:	The American Urological Association
BBD	:	Bowel bladder dysfunction
BMI	:	Body mass index
CFU	:	Colony forming unit
CIC	:	Clean Intermittent Catheterization
CNS	:	Central nervous system
CTT	:	Colonic transit time
DES	:	Dysfunctional elimination syndromes
DUI	:	Daytime urinary incontinence
DV	:	Dysfunctional voiding
DVSS	:	The Dysfunctional Voiding Symptom Score
EAS	:	External anal sphincter
EBC	:	Expected bladder capacity
EFB	:	Electromyography feedback
EMG	:	Electromyography
ESPGHAN	:	The European Society of Pediatric Gastroenterology, Hepatology and Nutrition
FC	:	Functional constipation
FDA	:	The Food and Drug Administration
FDDs	:	Childhood functional defecation disorders
FFI	:	Functional fecal incontinence
FGIDs	:	Functional gastrointestinal disorders
FNRFI	:	Functional non retentive fecal incontinence
HAPC	:	High amplitude propagated contractions
HPF	:	High power field
IAS	:	Internal anal sphincter
ICCS	:	The International Children’s Continence Society
LAPC	:	Low amplitude propagated contractions

LUTSs	:	Lower urinary tract symptoms
MEN	:	Multiple endocrine neoplasia
MRI	:	Magnetic resonance imaging
MT	:	Manometry
NASPGHAN	:	The North American Society for Pediatric Gastroenterology, Hepatology and Nutrition
NE	:	Nocturnal enuresis
NICE	:	The National Institute for Health and Clinical Excellence
OAB	:	Overactive bladder
ODDs	:	Oppositional defiant disorders
ORSI	:	Overflow retentive stool incontinence
PACCT	:	The Paris Consensus on Childhood Constipation Terminology
PEG	:	Polyethylene glycol
PFMs	:	Pelvic floor muscles
PVR	:	Posvoid residual
RAIR	:	Rectoanal inhibitory reflex
RBCs	:	Red blood corpuscles
RBT	:	Rectal balloon training
RTC	:	Rapid transit constipation
SBLs	:	Senna based laxatives
SD	:	Standard deviation
SNS	:	Sacral nerve stimulation
STC	:	Slow transit constipation
UB	:	Underactive bladder
US	:	Ultrasound
UTI	:	Urinary tract infection
VCUG	:	Voiding cystourethrogram
VIP	:	Vasoactive intestinal polypeptide
VUR	:	Vesicoureteric reflux
WHO	:	World health organization

List of Figures

List of Tables

Introduction

Being a healthy child does not mean the absence of diseases but it resembles a state of physical, mental and social wellbeing, which helps to reach proper childhood growth and development according to the genetic, cultural and socioeconomic factors ***(Devanarayana et al., 2015)***.

During the last few decades, childhood health has achieved many targets as controlling of major communicable diseases by immunization, worthy reduction in neonatal and children mortality and getting the required developmental goals ***(Wallace et al., 2014).***

However, new sets of challenges have been emerging. They mostly consist of diseases of multifactorial causes as bronchial asthma, obesity, substance abuse and functional gastrointestinal disorders (FGIDs) mainly functional defecation disorders (FDDs) ***(Mugie et al., 2011).***

Many systems have been created for clarifying standard definition and helping in diagnosis of functional defecation disorders, for example, the Rome III criteria. According to these criteria, the child must fulfill at least one of the following symptom per week for at least two months: two or fewer defecation in toilet, at least an episode of fecal incontinence, volitional stool retention, painful defecation, large diameter stools, or a large fecal mass in the rectum ***(Russell et al., 2015)***.

The association of bowel dysfunction in combination with lower urinary tract symptoms (LUTS) has become

recognized. These conditions in children with absence of neurogenic abnormalities represent an increasingly common problem for primary and subsequent care providers including gastroenterologists, pediatric surgeons, pediatric urologists and mental health providers ***(Lee and Koyle, 2014)***.

The term 'Bladder and Bowel Dysfunction (BBD)' is created to describe children with a combination of functional bladder and bowel disorders ***(Austin et al., 2014)***. It is recommended to evaluate bowel habits as part of the initial assessment of any child presenting with urological manifestation ***(Burgers et al., 2013)***.

There are several theories suggested for explanation of coexistence of bowel and urinary dysfunctions ***(Burgers et al., 2010).***

Overall, the loaded rectum with stools compresses the bladder and reducing its capacity, ultimately leading to urgency and frequency. Furthermore, the rectal fecal mass may cause pelvic muscles spasms which will likely result in incomplete bladder emptying and significant post void residual volumes. Additionally, children who voluntary hold defecation for longer periods will gradually present decreased sensation to evacuate leading to establishment of the bowel bladder cycle pattern ***(Santos et al., 2014).***

Aim of the work

This study aimed to evaluate the incidence of urological manifestations in children with functional defecation disorders and the effect of management of defecation disorders on these urological manifestations.

Defecation and Continence

Defecation and Continence are two sides of the same coin, they share common anatomical, physiological, and neurological pathways ***(Cook et al., 2009).***

The rectum is the terminal part of the colon with normally collapsed but distensible walls. It is not straight, but contains the valves of Houston, which make a series of kinks. Distally, at the level of the levator ani muscles it joins the anal canal which ranges from 2.5 to 4 cm in length.The puborectalis muscle forms a sling around the anorectal junction, pulling it forward, creating the anorectal angle, which is usually 80° to 90° at rest, during defecation it becomes more obtuse at 100° to 105°. The lining mucosa changes from columnar to cuboidal to squamous epithelium at the anal verge ***(Griffiths, 2002).***

The rectum acts both as a reservoir for the storage, and a pump for the evacuation of stools, it plays a basic role in defecation with the anal canal and pelvic floor muscles ***(Brookes et al., 2009).***

For proper defecation and continence, basic needs should be available. Firstly, both the internal and external anal sphincters must have intact function. Secondly, normal sensation as the sensation of a full rectum and well differentiation between gas and feces. Thirdly, intact colon motility, and finally, there must be no anatomical obstruction to the way of stool ***(Brisseau, and Langer, 2000).***

Normal defecation patterns in children:

Considerable variation in 'normal' bowel habit in children is accepted ***(Afzal et al., 2011)***. Infants have a mean of 4 stools per day during the first week of life. This frequency gradually drops to a mean average of 1.7 stools per day at 2 years of age and 1.2 stools per day at 4 years of age. After 4 years, the frequency of bowel movements remains unchanged, over this interval, stool volume increases more than tenfold, while maintaining a consistent water content (75%) ***(Kehar et al., 2012) (Halachmi and Farhat, 2008).***

Normal colonic motility:

The colon is neurologically under control of:

(1) *The Sympathetic motor activity* is mediated by α 2-adrenergic receptors and is generally stimulatory to the sphincters and inhibitory to the wall, it is supplied by the superior and inferior mesenteric (T9–T12) and hypogastric (T12–L2) plexuses

(2) *The Parasympathetic motor activity* is excitatory to the wall, arises from the vagus nerve up to the splenic flexure and the pelvic nerves to the rest of the colon and rectum.

(3) *The enteric nervous system* is a complex and highly coordinated neurons that involves two major ganglionic plexuses. The submucosal (Meissner's) plexus primarily regulates mucosal functions, whereas the myenteric (Auerbach's) plexus, present between the inner circular and outer longitudinal muscle layers, is responsible for motor activity ***(Beery and Chokshi, 2014) (Benevento and Sipski, 2002).***

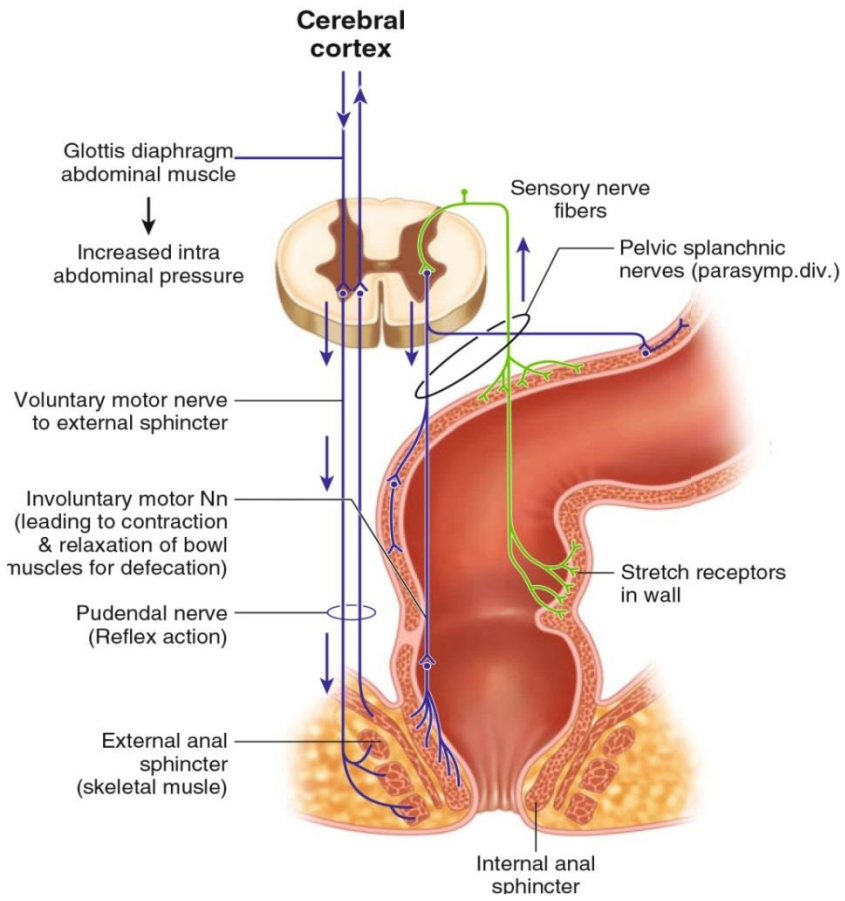

Figure (1): Neurological control of defecation
(Wani and Thakur, 2016)

The interstitial cells of Cajal present throughout the gastrointestinal tract from esophagus to anus and are located diffusely in the submucosal, intramuscular, and intermuscular regions. These cells are considered to function as intestinal pacemaker, initiating slow wave activity and signal transduction from neurons to smooth muscle cells ***(Takaki, 2003).***

Hormones have fundamental role in regulation of colonic motility. Some hormones are directly released from the central nervous system (such as corticotrophin releasing

hormone) and others directly from the gut (like gastrin and cholecystokinin) which stimulate motility and (glucagon and vasoactive intestinal polypeptide 'VIP') which have inhibitory effect ***(Thiruppathy and Emmanuel, 2010).***

The patterns of colonic motor activity include:

1) Segmental activity which may be either single or bursts of contractions, rhythmic or erratic. They are more frequent (2-4 cycles /min), creating compression pressure (5-50mmHg) and lasts (15-60 seconds) helping in mixing of contents ***(Scott, 2003) (Rao et al., 2001).***
2) Propagated activity which may be either low amplitude propagated contractions (LAPC) or high amplitude propagated contractions (HAPC). LAPCs occur nearly 100 times / day, making pressure changes in the colon < 50 mmHg. The main function of these contractions is the transport of contents ***(Rao et al., 2001)***. HAPCs are infrequently contractions occurring approximately 6 times / day generating pressures > 100 mmHg. The main function of these contractions is to transport large amounts of content through a long segments of the colon. Greater than 95% of propulsion occurs in an aboral direction. The propulsion of large volumes of contents in the aboral direction can be a stimulus for defecation ***(Cook et al., 2000).***

The anal sphincters:

The internal anal sphincter (IAS) is a direct distal continuation of the circular muscle layer of the rectum (not