

Small bowel endoscopy in children:

The mean length of the small bowel is almost the same as in adults, being approximately 450 cm at five years of age, 500 cm at ten years of age and 575 cm at 20 years of age.

INDICATIONS OF SMALL BOWEL ENDOSCOPY:

1. Obscure gastrointestinal bleeding (OGIB),
2. Evaluation of small bowel involvement in children with (suspicion of) Crohn's disease,
3. Hereditary polyposis syndromes.

Video capsule endoscopy

Video capsule endoscopy (VCE) or wireless video endoscopy enables direct visualization of the small bowel mucosa without radiation. It is a painless procedure and provides detailed images from areas not accessible utilizing other radiographic or endoscopic methods. The youngest child undergoing VCE reported so far was eight-months-old.

The capsule is 11 BY 26 mm in size and weights 3.7 g. It contains a camera acquiring images at a rate of two frames per second, a light source, a transmitter and a separate battery that provides eight operational hours. Sensors are taped to the child on the anterior abdominal wall which sends all images to the data recorder. Children wear the data recorder around their waist, in a custom-made rucksack or, in the smallest children, the data recorder is placed beside them on their cots. More than 50,000 pictures will be generated during the eight-hour procedure. At the end of the study, images can be downloaded to a workstation and give an endoscopic view of its journey through the small bowel. The single-use capsule is passively propelled through the intestine by peristalsis and excreted naturally, usually within 24–48 h. Although the optimal bowel preparation for VCE has not been determined yet in a paediatric trial, standard colonoscopic bowel preparation seems to be a good strategy. European multicentre study including only children under the age of eight years, 20 of 83 participants (24%, aged 4–7.9 years), swallowed the capsule without any difficulty. The young children need general anaesthesia for introducing the capsule safely in the duodenum while using a device during upper gastrointestinal endoscopy.

It is known that the diagnostic yield of VCE is the highest when the investigation will be performed as close as possible to the bleeding episode in patient's with obscure GI bleed. The World Organisation of Digestive Endoscopy (OMED) and the European Crohn's and Colitis Organisation (ECCO) recommend since 2009 that VCE should be performed in all children with a high suspicion of CD when conventional endoscopy and small bowel imaging are normal. However, due to a lack of well designed studies, it is still not clear where to put VCE in the diagnostic work-up of children with OGIB.

VCE appeared more accurate in detecting polyps than small bowel follow-through and VCE detected smaller polyps than MRI but larger polyps may be missed. large well designed studies are needed to assess the surveillance role of VCE for this specific group.

The first and most important potential complication of VCE, is capsule retention defined as remaining in the digestive tract for two weeks or more. A paediatric study showed a risk of 1.4%. One of the main limitations is the inability to control the movement of the capsule and the inability to take biopsies. Therapeutic interventions are not possible. Furthermore, it detects nonspecific lesions which could be difficult to interpret and potentially misses single-mass lesions. Most of the children under the age of eight years, need general anaesthesia to put the capsule in the duodenum.

The relative frequency of indications in the pediatric reports (50% for CD, 17% for OGIB, 13% for abdominal pain/diarrhea, and 11% for polyposis) differs from those in adults, wherein 66.0% of use has been for OGIB including IDA; 10.6% for clinical symptoms only such as pain, diarrhea, and weight loss without OGIB; 10.4% for CD; and the balance (13.0%) for other indications.

Clinical indications for capsule endoscopy in children:

First author	Publication year	Patients enrolled, n	Clinical indications									Comments	
			Suspected Crohn's	Known Crohn's	Colitis	Indeterminate colitis	OGIB	IDA	Abdominal pain/diarrhea	Polyposis	Malabsorption/protein-losing		
Atay ⁹	2009	207 (8–21 years old)	73	41		17	15		58	2	1	1 patient with protein-losing enteropathy 3 studies indicated for persistent vomiting/possible stricture; 2 studies indicated for evaluation of PTLD 1 patient with malabsorption	
Jensen ⁹	2010	117 (10 months to 22.4 years old)	68	17		3	18			6			
de' Angelis ⁹	2007	87 (18 months to 18 years old; 28 months to ≤10 years old)	10	21		1	21				33	1	
Fritscher-Ravens ¹⁷	2009	83 (1.5–7.9 years old)	20					30	12			21	Youngest patient was 1.5 years old. Minimum weight of 10 kg required 5 patients with growth failure; 1 patient with protein-losing enteropathy
Moy ¹¹	2007	45		16	3		1	7	1		11	6	
Antao ⁶	2007	37 (16 months to 16 years old)	18				7		2		5	5	
Guilhon de Araujo-Sant'Anna ⁸	2005	30 (10–18 years old)	20				4					6	
Cohen ⁷	2008	28 (2–18 years old)		21	5	2							All prior conventional studies (average 4.2/patient) were negative
Urbain ¹⁴	2007	17 (5–18 years old)					10		7				
Ge ¹²	2006	16 (6 to <10 years old)	16										
Tokuhara ³	2010	12 (10–17 years old)	5	1			2		4				Study compares CE with barium enterography in PJS Study of endoscopic placement of capsule in pediatrics, all using general anesthesia to facilitate optimizing a new technique Study compares CE vs EGD to evaluate functional abdominal pain
Arguelles-Arias ¹³	2004	12	12										
Postgate ¹⁸	2009	11 PJS only (6–16 years old)									11		
Barth ¹⁵	2004	11 (3–18 years old)					10				1		
Shamir ¹⁶	2007	10							10				
Total		723	242	117	8	23	118	7	94	75	34		

Outcome studies of capsule endoscopy in children:

First author	Publication year	Procedures, n (patient age)	Positive findings, n (%)	New diagnosis, n	Change in therapy, n	Diagnosis							Comments	
						Crohn's disease	Colitis	Indeterminate colitis	OGIB	Polyposis	Malabsorption/ celiac	Other		
Atay ⁹	2009	207 (8–21 years old)	77 (37)	Not stated	Not stated									77 patients had diagnostic findings. Quantity and type of findings are reported without resulting per-patient diagnosis or impact on therapy.
Jensen ⁹	2010	123 (10 months to 22.4 years old)	61 (52)	Not stated	Not stated	18	1	1	6	3	1	31		
de' Angelis ⁹	2007	87 (18 months to 18 years old; 28 months to ≤10 years old)	62 (71)	18	32	26			6	28			2	In 32 (37%) patients CE was fundamental to better planning of medical or surgical therapy
Fritscher-Ravens ¹⁷	2009	85 (1.5–7.9 years old)	45 (54)	36	Not stated	14			9	4	6	12		
Moy ¹¹	2007	46	28 (62)	19	9	18			1	8			1	Better than SBFT CE was found to be more sensitive than SBFT and conventional endoscopy
Antao ⁶	2007	37 (16 months to 16 years old)	28 (85)	Not stated	28 (85%)	13			7	3			5	
Guilhon de Araujo-Sant'Anna ⁸	2005	30 (10–18 years old)	21 (70)	15	Not stated	10			3	6			2	CE was found to be more sensitive than conventional studies 7/28 originally diagnosed as UC/IC, 5 of these were reclassified as CD
Cohen ⁷	2008	28 (2–18 years old)	28 (100)	5	18	26	1	1						
Urbain ¹⁴	2007	17 (5–18 years old)	10 (59)	9	7 (44%)	6			1				3	
Ge ¹²	2006	16	12 (75)	12	Not stated	4			4	1			3	No diagnosis findings in conventional procedures 7 CE procedures were performed in 2 OGIB patients to monitor therapy
Tokuhara ³	2010	19 (10–17 years old)	11 (58)	Not stated	Not stated	1			7				3	
Arguelles-Arias ¹³	2004	12	7 (58)	7	7	7								No diagnosis findings in conventional procedures 90% of patients preferred CE over barium enterography. CE more sensitive for polyps <10 mm
Postgate ¹⁸	2009	11 PJS only (6–16 years old)	10 (91)	0	1					10				
Barth ¹⁵	2004	12 (3–18 years old)	9 (82)	9	Not stated				9					
Shamir ¹⁶	2007	10	4 (40)	4	4	1							3	
Total		740	413	134	106	144	2	2	53	63	7	65		

GVHD, graft versus host disease; PJS, Peutz-Jeghers syndrome.

Capsule retention rates:

Indication	Pediatric			Adult
	Studies reporting, n	n	Combined percentage	Pooled rate, % (95% CI)
OGIB including IDA	10	2/125	1.6	1.2 (0.9–1.6)
Crohn's disease	11	9/359	2.5	2.6 (1.6–3.9)
Polyposis	8	1/75	1.3	2.1 (0.7–4.3)
Overall	15	18/740	2.6 (1.5–4.0)	1.4 (1.2–1.6)

Enteroscopy

DBE is performed with an enteroscope and an overtube, both of which have a latex balloon at the distal end; SBE is performed with an enteroscope and an overtube, with a silicon balloon only on the overtube. Length of 200 cm, an outer diameter of 9.4 mm, and an overtube length of 140 cm. general anesthesia is usually required. The procedure time, both antegrade and retrograde, varies from 40 min (mean procedure time approximately 100 min) but may be up to 200 min in case interventions.

BAE has a high diagnostic yield in diagnosing the cause of OGIB. A clear advantage of BAE versus VCE is the possibility for therapeutic intervention such as coagulation of a bleeding focus.

If a stricture in the small bowel is suspected at radiological imaging, BAE is preferred above VCE because of the risk of capsule retention. Moreover, BAE has been successful in dilating CD-related strictures, but the reported experience in paediatric IBD is still scarce

Well designed studies are needed to assess the surveillance role of BAE versus VCE for patients with hereditary polyposis syndromes. Once polyps in the small bowel are detected, BAE seems to be very useful for polypectomy, avoiding surgical procedures.

To date, BAE seems feasible in children as young as three years and as small as 13 kg.

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