Measurement of colonic transit time with the Transit-Pellets™ method

Measurement of colonic transit time is an important investigation in clinical gastroenterology. The measurement is indicated particularly in patients with bothersome constipation that does not respond to conventional treatment. The result can help the physician to understand the patient's problem and support in further decisions on treatment. The method is a simple and cost-effective way to measure rapid, normal and slow colonic transit. Both total transit and segmental transit dysfunction in colon can be evaluated.

Constipation – a common symptom often difficult to evaluate

About 20% of the population suffer from constipation. For the common types of functional constipation, idiopathic and IBS-related constipation, the proportion of women is about 80-90%. It is important to structure the management of this large patient group. The duration of symptoms is of relevance. In general, a long history allows for more restricted investigations, and the management can be focused on the patient's symptoms. It may be very difficult to assess from the patient's description whether the colonic transit time is normal or delayed. If the initial management with diet modification, bulking agents and common laxatives is not successful, further investigations, including evaluation of colonic transit time with radiopaque markers, should be considered. (Törnblom 2011; Simrén)

Advantages of Transit-Pellets™

- High availability and affordable
- A cost-effective alternative to expensive methods like smart pills and scintigraphy
- Takes women's slower digestion into consideration
- Provides information about total and segmental transit times
- Provides a mean value for several days' marker boluses
- Suitable for therapy studies
- Can measure rapid colonic transit
- The method has been validated and has been used on several thousand patients
- Only one X-ray is needed
- The gelatin capsules with radiopaque markers are easy to swallow
- Helps the physician understand the patient's problem and make further decisions on treatment options

- Requires good patient compliance

Törnblom H. Motilitetsstörningar i tunntarm och tjocktarm. *I Gastroenterologi och hepatologi.* 2011:325-37 Simrén M - http://www.internetmedicin.se/page.aspx?id=884

Transport in colon

The transit investigation reflects the physiologic transport of intestinal contents and what happens when transit is disturbed. Colonic transit time measurements yield information about the propulsive activity and elucidate physiology as well as pathophysiology in the colon.

When assessing colonic transit time, a method using radiopaque markers (Transit-Pellets™) is usually applied. The markers represent the passage of solid and semi-solid contents. The most common reason to do this investigation is suspicion of so-called slow-transit constipation. With the new modification of marker intake on the sixth day, it is also possible to easily measure rapid passage, which could be of interest in the investigation of patients with chronic diarrhoea.

The patient swallows radiopaque markers for six consecutive days. On day seven, an abdominal radiograph is taken. Based on the number of retained markers and their position in the colon, the colonic transit time is calculated and compared to reference values. Because only one radiograph is needed, the radiation dose is limited, and the cost for the test kept at a minimum.

Key scientific studies with the Transit-Pellets™ method

The Transit-Pellets™ method was developed at Sahlgrenska University Hospital in Sweden and is documented in some twenty scientific reports (examples shown below). Reference values are now based on measurement in 199 adults (114 women and 85 men).

1. Abrahamsson H, Antov S, Bosaeus I. Gastrointestinal and colonic segmental transit time evaluated by a single abdominal x-ray in healthy subjects and constipated patients. *Scand J Gastroenterol. Suppl* 1988;152:72-80.

   This original study showed the usefulness of the Transit-Pellets™ method with intake of 10 markers daily for six days followed by an abdominal X-ray on day seven. Based on the principle that an equilibrium between ingested and excreted markers has been attained at X-ray.

2. Abrahamsson H, Antov S. Accuracy in assessment of colonic transit time with particles: how many markers should be used? *Neurogastroenterol Motil.* 2010;22:1164-69.

   Showed that measurement of colonic transit time with ten markers daily yields an accuracy very similar to 15-20 markers daily but a significantly higher accuracy than five markers daily.

3. Sadik R, Abrahamsson H, Stotzer PO. Gender differences in gut transit shown with a newly developed radiological procedure. *Scand J Gastroenterol.* 2003;38:36-42.

   This study showed that modification of the Transit-Pellets™ method by dividing the marker dose on day six into one morning dose and one evening dose is a simple and safe principle to measure rapid, normal and slow colonic transit.

4. Törnblom H, Van Oudenhove L, Sadik R, et al. Colonic transit time and IBS symptoms: what's the link? *Am J Gastroenterol.* 2012;107:754-60.

   Study on a large number of patients showing that the modified Transit-Pellets™ method is very useful to characterise e.g. IBS patients with respect to normal, slow or rapid colonic transit.

5. Sadik R, Abrahamsson H, Ung KA, et al. Accelerated regional bowel transit and overweight shown in idiopathic bile acid malabsorption. *Am J Gastroenterol.* 2004;99:711-8.

   The Transit-Pellets™ method can be used to elucidate pathophysiology and diagnosis in patients with rapid colonic transit. Accelerated bowel transit and obesity are both implicated in idiopathic bile malabsorption.

Indications for transit measurement

The most common application of the colonic transit test is in investigations of severe constipation and to make decisions about treatment when there is a suspicion of slow-transit constipation or, alternatively, suspicion of so-called outlet obstruction. The test can verify whether there is a slow transit or some other type of transit disturbance.

In clinical practice, the most common reason for the test is when a patient with constipation does not respond to treatment. A low defecation frequency – less than three per week – combined with abdominal complaints may be a sign of disturbed motility with colonic transit. Constipation-related dysfunctions, i.e. transit disturbances, are specifically looked for with the test. The method is also suitable for repeated measurements, e.g. for documentation of effects of treatment.

In cases with diarrhoea, a rapid colonic transit can often be seen. In contrast, if a patient has so-called constipation-induced diarrhoea with liquid content passing faecal impaction, the test will show a slow transit despite the patient's report of loose stools.

Instructions for transit measurement

Step 1:	One capsule with ten markers is swallowed days 1-5. On day six, one capsule is swallowed in the morning (24 hours prior to the X-ray) and one in the evening (12 hours prior to X-ray). No laxatives or bulking agents shall be ingested.
Step 2:	Abdominal X-ray or fluoroscopy on day seven.
Step 3:	Calculation and Interpretation.

The patient swallows ten radiopaque ring-formed markers in a capsule in the morning for five days (Table 1). On day six, the marker dose is divided: one capsule with five tube-formed markers is taken in the morning and one similar capsule in the evening. On day seven, an abdominal radiograph or fluoroscopy is performed, and the number of retained markers is counted. During the test week, the patient continues with their ordinary diet but must avoid laxatives and bulking agents. It is important that the markers are taken every day exactly as prescribed. The interval between the first marker intake and the X-ray must be six days (approx. 144 hours).

From the abdominal radiograph on day seven, the total number of retained markers is counted, as well as their distribution in the various segments of the colon (Table 2).

The markers on day six have a different shape. If correctly taken, these markers should be located mainly proximal to the ring markers in the colon. If transit is slow, these markers are located in caecum ascendens and help to delineate this segment. The tube markers can also provide important information in case of rapid transit.

Note that the earlier used 'extra dose' of twenty rod-shaped markers on day six (Abrahamsson et al 1988) is no longer used: it is not needed with the new design of the Transit-Pellets™ test.

Laxatives

Note that if the patient takes laxatives leading to defecation, the test will give an erroneous value and it may be impossible to verify a slow transit. If the patient absolutely cannot avoid laxatives for seven days, one possibility can be to take markers for a shorter period (as long as possible) but minimally for two days, with the X-ray twenty-four hours after the last marker intake. If more than fifteen ring markers are located in caecum ascendens, the transit is slow in at least this segment.

If the marker count shows that at least five markers have been excreted, i.e. an equilibrium has been reached, the calculation of transit time and interpretation can be done as described below. Thus, if a patient contacts the laboratory saying that laxatives cannot be avoided, it can be of value to have an X-ray and marker count earlier than day seven, provided practitioners are informed exactly how the markers have been taken.

Table 1. Schedule for marker intake with the Transit-Pellets™ method.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Ring markers	10	10	10	10	10		
Tube markers						5+5	
Abdominal X-ray							X

Table 2. Upper reference values in days (percentile 95) for segmental colonic transit time in men and women with the Transit-Pellets™ method (Abrahamsson et al 1988). The total OATT-values are based on measurements in 114 women and 85 men.

	Caecum ascend.	Transv.	Descend.	Rectosigm.	Total
Män	1.0	0.5	1.2	1.3	2.2
Kvinnor	1.3	0.7	2.3	1.3	4.0

Calculation and Interpretation

Calculation

Colonic transit time is calculated as the mean oro-anal transit time (OATT, mouth-to-anus) for the daily marker doses swallowed. Because the colonic transit constitutes the main part of the mouth-to-anus transit time, OATT is used as a measure of colonic transit. The transit time is equivalent to the number of daily marker doses retained. With a daily dose of ten markers, the transit time is:

$$\text{Oro-anal transit time in days (OATT)} = \frac{M}{10}$$

i.e., the number of markers counted from the X-ray film (M) divided by the daily dose. If, for example, 35 markers are retained, the OATT is 3.5 days according to the formula M/10. A numerical transit time value can be given if the number of retained markers is in the range 3–55 markers. Thus, at least half a daily dose should be excreted and at least half of the evening dose on day six must be retained. If the number of retained markers is only 0–2, the transit time is less than 0.3 days. If 56–60 markers are retained, the transit time is more than 5.5 days (an equilibrium has not been reached).

Interpretation

The total number of markers in the colon determines if the colonic transit is delayed or not. The upper reference value ('normal value' = percentile 95) is gender dependent and is 4.0 days (40 markers) for women. A guideline for the referring physician can be for women: 4.1 to 5.0 days is a slight to moderate delay and >5.0 days is a definite delay in transit.

Healthy men have a more rapid mean transit time than healthy women. The upper reference value for men is 2.2 days (22 markers). If a patient has abnormally rapid colonic transit, the OATT is lower than the lower reference value (percentile 5). This means <0.6 days (<6 markers) for women and <0.5 days (<5 markers) for men.

The distribution of markers in the various colonic segments can provide information about the type of delay (see Table 2). Note that healthy men and women may have a transit value in a few segments close to the upper reference value but not in all segments at the same time, as indicated by the reference value for the total transit time.

Patients with a severe form of slow-transit constipation – so-called colonic inertia – have slow transit in the whole colon and have a high retention of markers in the caecum-ascendent part (>15 markers). Many patients with slow transit constipation have a delay only in the left colon. If the test shows a very high number of markers in the recto-sigmoid area but normal retention in the middle and proximal parts of the colon, this is a finding compatible with outlet obstruction.

When analysing the abdominal radiograph, it is usually easy to calculate exactly the total number of retained markers. A few patients may have the caecum located more medially so that some overlap with the sigmoid must be considered. If the patient has a slow colonic transit, the tube-formed markers located in the caecum can help to solve the location problem. In rare patients, it may be a problem to differentiate between the sigmoid and the transverse colon. If so, the problem can be solved by inflation via a rectal tube to delineate the sigmoid.

Applications

- If the colonic transit is delayed, intensified constipation therapy should be considered with alteration of laxative treatment, motility stimulating drugs etc.
- If the patient has severe complaints of constipation but the transit time is completely normal, there is a high possibility of altered sensitivity like IBS, and the therapy should be directed accordingly.
- In a very small number of patients with colonic inertia, surgical therapy may be considered (colectomy with ileorectal anastomosis) but if transit time is normal in the caecum-ascendent segment, this operation is not indicated.
- If transit through rectum and the sigmoid colon is delayed, the possibility of outlet obstruction, including pelvic-floor dysfunction, should be considered.

Ingredients

Capsule: Hypromellose methylcellulose E464
Markers: Elastosil® R401/60, Silicone rubber (88%) $BaSO_4$ powder EMPROVE (22%)

How to refer for a transit measurement

Referral for transit measurements may be sent to the radiology department. Most radiology departments have experience in determining whether colonic transit is slow, rapid or normal. The referral can be written by e.g. general practitioners or another doctor who has experience in gastroenterology patients. In difficult cases, consult a gastroenterologist or an interested gastro surgeon about the suitable way to process a potential referral.

Typically, the radiology department is in charge of instructions to and the markers for the patients. As indicated above, the instructions/information are a very important part of the process. The response to the examination is sent to the referring physician, noting the total number of markers in the colon, and thus, if the transit is slow, normal or rapid. Even the distribution of the markers in the different segments of the colon can be mentioned and – based on these values – segmental transit time can be calculated. Comparative values are shown in Table 2.

How to order Transit-Pellets™

Transit-Pellets™ are easily ordered from:
E-Mail: order@medifactia.com
Phone: +46-31-787 70 77
Web site: www.medifactia.com

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