Measurement of colonic transit time with Transit-Pellets™

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 decision 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 15-20% in 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 food modification, bulking agents and common laxatives are not successful further investigations including evaluation of colonic transit with radiopaque markers should be considered. (Törnblom 2011; Simrén)

**Advantages**

- High availability and affordable
- A cost effective alternative to expensive methods like wireless capsules and scintigraphy
- Gives information about total and segmental transit time
- Gives a mean value for several days’ marker boluses
- Suitable for therapy studies
- Can measure rapid colonic transit
- The method is validated and have been used in several thousand patients
- Only one X-ray needed
- The gelatin capsules with markers are easy to swallow
- Helps the physician to understand the patient’s problem and to make further decision on treatment

**Disadvantage**

- Requires good patient compliance

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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 semisolid 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 diarrhea.

The patient swallows radiopaque markers for 6 consecutive days. On day 7 an abdominal radiograph is taken. Based on the number of retained markers and their position in colon a 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 studies with the Transit-Pellet™ method

The Transit-Pellet™ method was developed at Sahlgrenska University Hospital 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.

   This original study showed the usefulness of the Transit-Pellet™ method with intake of 10 markers daily for 6 days followed by an abdominal X-ray on day 7. Based on the principle that an equilibrium between ingested and excreted markers has been attained at X-ray.

   Showed that measurement of colonic transit time with 10 markers daily yields an accuracy very similar to 15-20 markers daily but a significantly higher accuracy than 5 markers daily

   This study showed that modification of the Transit-Pellet™ method by dividing the marker dose on day 6 into one morning dose and one evening dose is a simple and safe principle to measure rapid, normal and slow colonic transit.

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

   Transit-Pellet™ method can be used to elucidate pathophysiology and diagnosis in patients with rapid colonic transit. In this study demonstrated in the diarrheal disease bile acid malabsorption.
Indications for transit measurement

The most common application of the colonic transit test is in investigations for severe constipation and to make decision on therapy 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 practise the most common reason for the test is when a patient with constipation does not respond to the therapy. A low defecation frequency, <3 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 therapy.

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 fecal impaction the test will show a slow transit despite the patient’s report of loose stools.

Instructions for transit measurement

Step 1: One capsule is swallowed day 1-5. On day 6 one capsule is swallowed in the morning and one in the evening.
Step 2: Abdominal X-ray or fluoroscopy on day 7.
Step 3: Calculation & Interpretation.

The patient swallows 10 radiopaque ring formed markers in a capsule in the morning for 5 days (Table 1). On day 6 the marker dose is divided: one capsule with 5 tube formed markers is taken in the morning and one similar capsule in the evening. On day 7 an abdominal radiograph or fluoroscopy is done and the number of retained markers is counted. During the test week the patient continues with the ordinary food, often also bulking agents but must avoid motility stimulating laxatives and enemas. 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 6 days (about 144 hours).

From the abdominal radiograph on day 7 the total number of retained markers is counted as well as their distribution in the various segments, see Table 2.

The markers on day 6 have another appearance. 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 cecum-ascendens and help to delineate this segment. The tube markers can also give important information in case of rapid transit.

Note that the earlier used ‘extra dose’ of 20 rod shaped markers on day 6 (Abrahamsson et al 1988) is no longer used: it is not needed with the new design of the Transit-Pellet™ 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 7 days one possibility can be to take markers for a shorter period (but as long as possible) but minimally for two days with the X-ray 24 hour after the last marker intake. If more than 15 ring markers are located in cecum-ascendens the transit is slow in at least this segment.

If the marker count shows that at least 5 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 7 provided the medical staff is informed exactly how the markers have been taken.

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring markers</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Tube markers</td>
<td></td>
<td></td>
<td></td>
<td>5+5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal X-ray</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Segment</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cecum-ascend.</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Transv.</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Descend.</td>
<td>1.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Rectosigm.</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>2.2</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Medifactia
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 10 markers the transit time is:

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\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 to 55 markers. Thus, at least half a daily dose should be excreted and at least half of the evening dose on day 6 must be retained. If the number of retained markers are only 0-2 the transit time is <0.3 days. If 56-60 markers are retained the transit time is >5.5 days (an equilibrium has not been reached).

Interpretation

The total number of markers in colon determines if the colonic transit is delayed or not. The upper reference value (‘normal value’ = percentile 95) is sex 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 give 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 cecum-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 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 cecum 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 cecum can help to solve the location problem. In rare patients it may be a problem to differ between the sigmoid and the transverse colon. If so, the problem can be solved by inflation of some air 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 cecum-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.