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Upper gastrointestinal tract scintigraphy and ultrasonography in diagnosis of gastroesophageal reflux in children

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Summary

Background:

Gastroesophageal reflux (GER) is one of the most common gastrointestinal tract disorders both in adults and children. The study was undertaken to assess the usefulness of gastrointestinal upper tract (GUT) scintigraphy and GUT ultrasonography in detection of GER in children.

Material/Methods:

The investigated group comprised of 76 children, aged 1-204 months (mean 74 months) with clinical signs and symptoms of GER. All of them underwent GUT scintigraphy, and 42 children had also GUT ultrasonography.

Results:

GUT scintigraphy confirmed reflux in 60/76 children (78.9%), GUT ultrasonography - in 17/42 children (40.5%). Airways tract aspiration was detected in one child.

Conclusions:

Scintigraphy was found to be a very useful method in detection of GER, as it confirmed the presence of GER in most of the children with signs and symptoms suggestive of GER. It also allows for the detection of airways tract aspiration. GUT ultrasonography showed a lower sensitivity. Both investigations are simple, noninvasive, not changing the physiology of the gastrointestinal tract and can be performed in out-patient conditions.

Key words:

gastroesophageal reflux • gastrointestinal tract scintigraphy • gastrointestinal tract ultrasonography • children

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Background

Gastroesopageal reflux is one of the most common diseases of the gastrointestinal tract in the whole general population and one of the most common pediatric problems at the same time [1–3]. A high rate of newborns experience spitting or vomiting that do not inhibit normal development of the baby, and that subside spontaneously before the end of the first year (so called physiological reflux). However, sometimes, reflux symptoms do not subside but increase, leading to possible complications connected with effects of the acid content of the stomach on the esophageal mucus.

Diagnostics of the gastrointestinal reflux is not always required. Very often, the diagnosis can be based on typical clinical symptoms. Only after introducing a proper treatment, if there is no therapeutic effect, the patient should be referred for diagnostic tests. Diagnostics is required in cases with symptoms suggestive of esophageal inflammation, children with impaired physical development, patients suspected of atypical reflux disease, and especially those with symptoms referable to the respiratory tract, e.g. recurrent infections of the lower respiratory tract, refractory asthma, apnea [1,3–6].

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Methods used in the diagnostics of the gastrointestinal reflux include: 24-hour pH test, esophageal motility study, endoscopy of the gastrointestinal upper tract (GUT) with histopathological examination of the sampled material (visualizing not the reflux itself, but its consequences connected with the effects of the acid gastric content on the esophageal mucous membrane), scintigraphy, ultrasonography. The previously used barium-enhanced X-ray examinations belong to the past.

Scintigraphy and ultrasonography of the GUT are noninvasive diagnostic methods, and as such, are especially useful in the diagnostics of children. Authors of this report aimed to evaluate the usefulness of both these noninvasive options in diagnosing gastroesopageal reflux in children.

Aim of the work

- To investigate the usefulness of scintigraphy and ultrasonography of the GUT in the diagnostics of the gastroesopageal reflux in children
- To investigate the usefulness of radioisotopic examinations in the detection of the gastric content aspirated to the airway tract.

Material and Methods

The study group included 76 children, 38 boys and 38 girls, aged 1–204 months (mean age of 74 months). The children were referred from the Department of Pediatrics, Hematology and Oncology of the Pomeranian Medical University in Szczecin and from the Gastrological Outpatient Clinic.

All the children revealed clinical symptoms of pathological gastroesopageal reflux. In newborn children, these included spitting, anxiety, intense crying; in older children: heartburn, chest pain, stomach pain and distention. Irrespective of age, there were regurgitations, vomiting of different intensity, sometimes with blood in the regurgitated gastric content, lack of appetite, choking during eating, insufficient weight gain or loss of weight. In 14 patients, there were episodes of apnea.

Scintigraphic examinations of the GUT were performed in the Department of Nuclear Medicine of the Pomeranian Medical University in Szczecin. GUT scintigraphy with the use of gamma camera was carried out in all 76 children. Radiopharmaceutical, Tc-99m-antimony sulphide colloid in the dose of 40 MBq was administered orally. Right after its administration, the patient drank 100–330 ml of a fluid (milk, gruel, thick fruit juice). Dynamic registering in supine position was carried out for 40 minutes in AP projection or, in case of an anxious child, in PA. No sedatives were used in children. No massage or pressing of the abdomen was introduced.

GUT scintigraphy included the following phases:

- Esophageal phase: registered dynamically, one image per second, for one minute, passage of the radiopharmaceutical from the oral cavity, through the esophagus, to the abdomen
- Gastric phase: dynamic registering was continued, i.e. one image per 30 seconds, for 40 minutes.

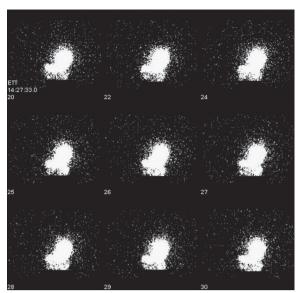


Figure 1. Normal results of the study. Radioactive content in the

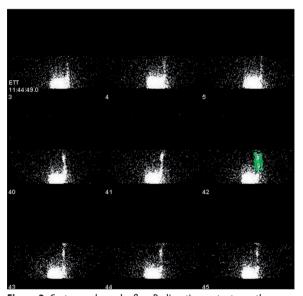


Figure 2. Gastroesophageal reflux. Radioactive content over the esophageal region.

 Late phase: two acquisitions of the chest: AP and PA, in lying position, with an aim to visualize a possible aspiration of the gastric content to the respiratory airways, carried out right after the gastric phase, and then after 2 hours. Time of every acquisition amounted to 10 minutes.

In the examined material, we evaluated the presence of gastroesophageal reflux and aspiration of the gastric content to the airways in all 76 children, esophageal motility in 74 children, and gastric emptying in 73 children. The gastroesophageal reflux was evaluated qualitatively on subsequent dynamic images of the second phase (Figures 1, 2) and on the basis of time-activity curve from the region over the esophagus (Figure 3). Increase in activity in this region by at least 5% per image, as compared to the background, was interpreted as the presence of reflux.

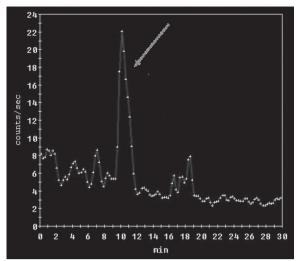


Figure 3. Time-activity curve from the esophageal region — GER is marked by an arrow.

Esophageal motility was considered normal if within 10 second after contrast administration, radioactivity of the esophagus decreased below 90% of the baseline value. Gastric emptying was evaluated with the number of counts in the region over the stomach, at the beginning and at the end of the gastric phase. Loss of activity below 65% of the baseline value within 40 minutes was considered a normal gastric emptying. Normal ranges for the passage of the radiotracer through the esophagus are clearly defined in the literature and commonly used. Definition of such ranges for gastric emptying is more complicated and depends on the type and volume of the ingested food, patient's age, and examination position. According to the literature data for fluid meals, the appropriate value of the residual gastric content ranges from 36 to 70% after 1 hour [7]. We accepted a medial value as a normal one, after considering a shorter examination time. We gave the patients fluid or semi-fluid meals, but not standardized ones.

Abdominal ultrasonography with evaluation of the gastroesophageal reflux was performed in 42 children at USG laboratory of the Department of Diagnostic Imaging and Interventional Radiology, Pomeranian Medical University. Two scanners were used: ATL Ultrasound model HDI 3500 and Logiq 500MD. The results were considered to be positive if within 10 minutes of examination, there were at least 7 episodes of gastroesophageal reflux.

Results

Scintigraphic features of the gastroesophageal reflux were found in 60 out of 76 children (78.9%). Features of aspiration of the gastric content to airways were found in 1 case. Esophageal motility was normal in 60 out of 74 children (81.1%). Disturbances of radiotracer passage through the esophagus were found in 9 out of 74 children (12.2%). In 5 children out of 74 (6.7%), the result of the examination was non-diagnostic, due to incomplete swallowing of the tracer or child moving during acquisition. Stomach emptying was evaluated in 73 patients. In 45 cases out of 73 (61.6%), gastric emptying was normal, while in 17 out of 73 (23.3%), slower. In 11 children out of 73 (15.1%), the

result was non-diagnostic due to child's movements during acquisition.

Ultrasonography for gastroesophageal reflux was performed in 42 children. Gastroesophageal reflux was confirmed in 17 of them, which accounts for 40.5% of study population. The result seems to be too low if we take into account the fact that the study group included children with obvious clinical symptoms of gastroesophageal reflux.

Discussion

Gastroesophageal reflux is not always a clinical problem. In most of the infants, there is spitting or regurgitation not influencing the general health state or psychophysical development of the child. The symptoms subside spontaneously with age and do not need to be diagnosed. The problem is the pathological gastroesophageal reflux, manifesting itself with recurrent vomiting, disturbed weight gain, loss of appetite, anxiety, abdominal pain and chest pain. It may cause apnea that may become life-threatening in extreme cases [3,5-10]. Some authors believe that in typical clinical symptoms, an alternative for the diagnostic process is the introduction of treatment, 'just for a try', and evaluation clinical improvement [6,11,12]. However, according to most of the authors, suspicion of the pathological gastroesophageal reflux requires diagnostic tests in order to confirm the diagnosis, reveal complications, and exclude anatomical malformations of the gastrointestinal tract. Atypical forms of the gastroesophageal reflux (e.g. giving only respiratory symptoms) require diagnostics as well [4,13,14].

In the diagnostics of the gastroesophageal reflux [4,6], 24-hour pH tests belong to so called golden standard. Its sensitivity in diagnosing this ailment is assessed for 87–96%, while its specificity for 93–97% [4,9,13,15–17]. Sensitivity of pH tests may be reduced by alkalization of the gastric content, e.g. in infants due the fact that the diet is based on milk [9]. Also medicines from the group of H2-blokers and proton pump inhibitors increase pH of the gastric content. Disadvantage of pH tests is their invasiveness and unphysiological character [18].

Scintigraphy of the GUT is noninvasive, does not disturb physiology of the gastric tract, and is well tolerated by most of the children. The risk from radiation exposure is minimal and this method does not require hospitalization [7,17,19–26]. Some authors define the scintigraphic examination of the GUT as insufficiently sensitive or useful in diagnosing gastroesophageal reflux [1,4,5,27]. Others recommend it as a first-line method in reflux diagnostics [9,18,21,28]. Authors' own experiences show that this method has many advantages and deserves a wider acceptance. Apart from detecting gastroesophageal reflux, it allows for evaluation of esophageal motility and stomach emptying, and sometimes also visualization of aspiration of the gastric content to the respiratory tract.

Stomach emptying may be assessed with registration of the number of impulses in the region of interest above the stomach, at the beginning and at the end of the gastric phase. There are no established, commonly applying Original Article © Pol J Radiol, 2011; 76(1): 63-67

normal values of stomach emptying, as it depends on the type and volume of ingested food. Moreover, different authors use different food (of different composition and consistency) [7,23,29]. Centers using scintigraphy in evaluation of gastric emptying tend to define their own normal ranges.

In order to reveal aspiration of radioactive gastric content to the respiratory airways, static acquisitions of the chest are performed in supine position, in AP and PA projections. The acquisitions can be repeated, at different time intervals, but within up to 24 hours after the administration of radiopharmaceutical.

Interpretation of the study results does not depend on subjective assessment of the operator. Caglar et al. studied the differences in the evaluation of scintigraphy and revealed a high repeatability of results of the same study obtained by the same observer at different time intervals, and by different observers, with a different degree of experience [30]. One of the limitations of this method is the examination time, normally amounting to 30-60 minutes, depending on the center [18,20,21,24,30,31,32]. Episodes of gastroesophageal reflux may appear later than 1 hour after meal, and thus remain undetected during scintigraphy. In our center, registration of the gastric phase was conducted for 40 minutes, which allowed for the detection of the gastroesophageal reflux in 79% of our patients. Our results do not differ from the results obtained in other centers. According to the literature, the sensitivity of this examination method in detecting gastroesophageal reflux amounts to 69-89% [20-22,24,30,33-35].

Most of the authors recommend scintigraphy of the GUT in AP projection [7,18,23,36] due to a smaller distance between the examined structures and the collimator. This position of the camera was used in our center as well. PA projection was carried out only in exceptional cases, when the collimator located above the child caused a severe anxiety.

Literature data on scintigraphic detection of the gastric content aspirated to airways reveal a low incidence. This can be confirmed with a report by Wynchank et al. who performed 1217 scintigraphies and found aspiration in 48 cases only [18]. In our material, only one child had features of aspiration. It seems that the volume of radioactive gastric content which could enter bronchi is too low to be detected with gamma camera [31,37]. An important role can be played by rapid clearing of the bronchi with the help of ciliary epithelium [18]. Scintigraphy may not reveal small volumes of the aspirated gastric content. However, there is no alternative method. There exists a method of analysis of lipid content in alveolar macrophages. However, this examination is not too specific and relatively inconvenient [7,38].

Ultrasonography tends to be described as a study of low sensitivity (of 35%), although some authors report a sensitivity of over 90%. Such a divergence of results may follow from a subjective assessment of the operator and no clear ultrasonographic criteria for reflux diagnosis [3,18,39]. In the presented material, ultrasound features of gastroesophageal reflux were found in as little as 40% of the patients, in spite of the fact that all those children had shown clear clinical symptoms of reflux. Short examination time has a negative influence on ultrasound sensitivity. Advantage of ultrasonography is no exposure to radiation, noninvasiveness, and wide availability.

Conclusions

- Scintigraphy of the upper gastrointestinal tract is a sensitive method used in preliminary diagnostics of gastroesophageal reflux, especially recommended in children (it is noninvasive, does not disturb the physiology of the gastrointestinal tract, and is not connected with a high risk from radiation exposure; it does not require hospitalization either).
- At further stages of clinical diagnostics, scintigraphy of the GUT is very useful in monitoring of the disease course and treatment results.
- An additional advantage of GUT scintigraphy is the possibility of evaluation of the esophageal motility, gastric emptying and visualization of gastric content aspiration to airways.
- 4. Ultrasonography is less sensitive in diagnosing gastroesophageal reflux than scintigraphy.

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