Our ten-year clinical experience with Meckel's diverticulum scintigraphy

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Summary. Ectopic gastric mucosa may be present in the Meckel's diverticulum and associated with peptic ulcer and lower gastrointestinal bleeding. Scintigraphy by means of ^{99m}Tc-pertechnetate can help to make diagnosis of ectopic gastric mucosa. Eighty patients (11 adult men, 33 boys, 4 adult women and 32 girls aged 1 – 78, mean 11 years) underwent Meckel's diverticulum scintigraphy at our department within the last ten years. All patients were presented with melaena or haematochezia and anaemia. In children, scintigraphy was the examination of first choice. In adults, previous gastroscopy, colonoscopy and enteroclysis were done with negative results. Three patients, two boys (a two- and a ten-year-old) and one girl (a four-year-old) had positive scintigraphy. All children underwent surgery and Meckel's diverticulum with ectopic gastric mucosa were detected and confirmed by histology. Meckel's diverticulum scintigraphy can help to detect ectopic gastric mucosa and improve management of the disease.

Key words: ectopic gastric mucosa, gastrointestinal bleeding, Meckel's diverticulum scintigraphy

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Souhrn. Meckelův divertikl vzniká perzistencí části ductus omphaloentericus a je uložen proximálně od Bauhinské chlopně. Divertikl je někdy vystlán ektopickou žaludeční sliznicí, což může vést ke vzniku peptického vředu a krvácení. Diagnostika tohoto krvácení je obtížná a významně se může uplatnit scintigrafie Meckelova divertiklu. V letech 1994 – 2004 jsme scintigraficky vyšetřili 80 pacientů (11 mužů, 33 chlapců, 4 ženy, 32 dívek, věkový rozsah 1 rok – 78 let, medián 11 let). Všichni pacienti měli časově aktuální anamnézu krvácení do trávicího ústrojí z neznámého zdroje (meléna, enteroragie, odezva v krevním obraze). Scintigrafie byla metodou první volby u dětí. U dospělých ostatní zobrazovací modality, jako endoskopie (gastroskopie, koloskopie), enteroklýza a event. angiografie neodhalily zdroj krvácení. Celkem u tří dětí (2 chlapci – ve věku 2 a 10 let, 1 dívka ve věku 4 let) jsme na scintigrafii zjistili ložisko ektopické žaludeční sliznice. Všichni tři pacienti podstoupili operaci a byl potvrzen Meckelův divertikl, ve kterém se podle histologie nacházela ektopická žaludeční sliznice.

Klíčová slova: ektopická žaludeční sliznice, krvácení do trávicího traktu, scintigrafie Meckelova divertiklu

Meckel's diverticulum is one of the most common congenital anomalies of the gastrointestinal tract (31). It occurs in 1 % to 3 % of the population, more frequently in boys (26). Diverticulum arises from persistent ductus omphaloentericus and is located 20 – 60 cm from the ileocoecal valve. About 50 % of diverticuli contains ectopic gastric mucosa (4). Its secretion can cause peptic ulceration, resulting in pain, bleeding and/or perforation (3,18,19). Bleeding from the Meckel's diverticulum over the age of 40 is unusual (8,29). About 60 % of patients with complications of Meckel's diverticulum are under 2 years of age. Bleeding accounts for most cases (1,3,10-12,14,16,17,19,20,25,31).

The indication for abdominal scintigraphy by means of ^{99m}Tc-pertechnetate (Meckel's scintigraphy) is to identify ectopic gastric mucosa in the Meckel's diverticulum as the source of unexplained gastrointestinal bleeding (6,7,9,13).

The aim of this retrospective study was to evaluate our ten-year experience with Meckel's diverticulum scintigraphy.

Patients and methods

Eighty patients (11 men, 33 boys, 4 women, 32 girls, aged 1 – 78, mean 11 years) underwent Meckel's diverticulum scintigraphy from 1994 to 2004. All patients had timely anamnesis of bleeding in the gastrointestinal tract from an uncertain source (melaena, enterorrhagia, acute haemorrhagic anaemia). In adults, gastroscopy, colonoscopy, enteroclysis or alternatively angiography did not detect the source of bleeding. In children, Meckel's diverticulum scintigraphy was the investigation of choice in the first instance. Patients fasted for 6 hours before the study to reduce the size of the stomach. Ranitidine pretreatment was administered (15 mg/kg i.v. or orally for 24 to 48 hours before study) (23,31) to reduce gastric secretion and thus increase gastric mucosa uptake of the radioisotope (9).

Dynamic scintigraphy of the abdomen in anterior and posterior views was started immediately after intravenous application of 370 MBq ^{99m}Tc-pertechnetate. The acquisition protocol was one-second frames for 120 seconds and twenty-second frames for 20 minutes. Static 1 000 count images of the abdomen were done after this. To improve sensitivity, specificity and better spatial specification we added abdomen single photon emission tomography (SPECT). We used a rotating, digital, double-head gamma camera, Helix or VariCam (Elscint), with infrared body contouring and large field of view. Images were evaluated by the conventional processing system, Xpert-Pro (Elscint)

Results

Scintigraphy by means of ^{99m}Tc-pertechnetate detected ectopic gastric mucosa in three children (two boys – 2- and 10-year-old and one 4-year-old girl). All children underwent surgery and Meckel's diverticulum with ectopic gastric mucosa (by histology) was detected. Fig. 1 shows sequential anterior

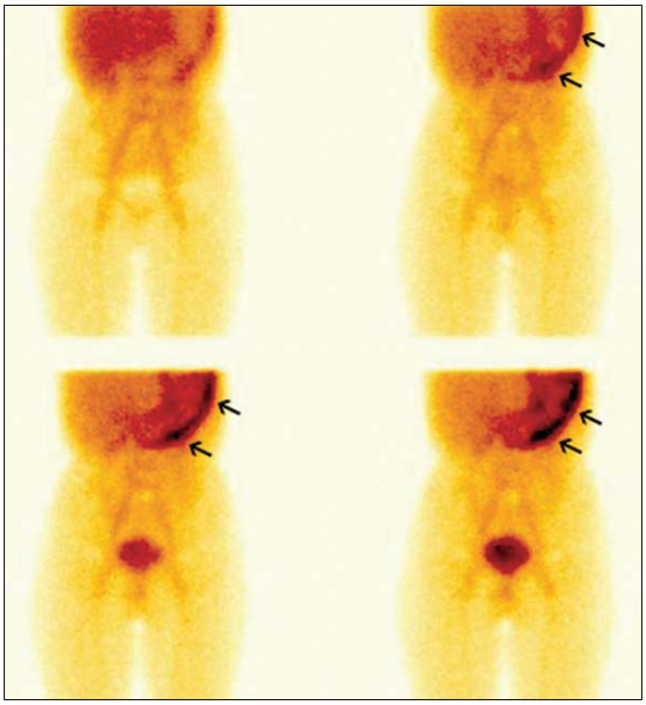

Figure 1 / Obr. 1
Normal abdominal ^{99m}Tc-pertechnetate scintigraphy in a 9-year-old boy. Sequential anterior views of the abdomen obtained for 20 minutes after injection. There is normal accumulation of ^{99m}Tc-pertechnetate in gastric mucosa (arrows).
Dynamická scintigrafie dutiny břišní u 9letého dítěte. Sumace dynamických scintigramů po 4 minutách. Normální nález. Fyziologická akumulace ^{99m}Tc-pertechnetátu v žaludeční sliznici *(šipky)*.

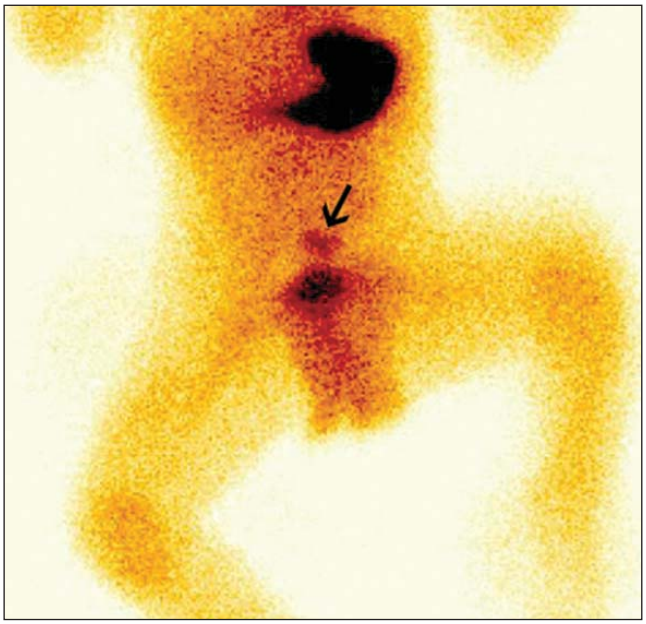

Figure 2 / Obr. 2
Meckel's diverticulum in a 2-year-old boy with enterorrhagia. Anterior view of the abdomen obtained 30 minutes after ^{99m}Tc-pertechnetate injection. There is a focus of pathological accumulation of ^{99m}Tc-pertechnetate in ectopic gastric mucosa in the Meckel's diverticulum, located on the border of the lower-right and mid-abdomen (arrow).
Statický scintigram dutiny břišní za 20 minut po i. v. aplikaci radiofarmaka u 2letého chlapce s enteroragií. Akumulace ^{99m}Tc-pertechnetátu v ektopické žaludeční sliznici v Meckelově divertiklu na rozhranní hypo- a mezogastria *(šipka)*.

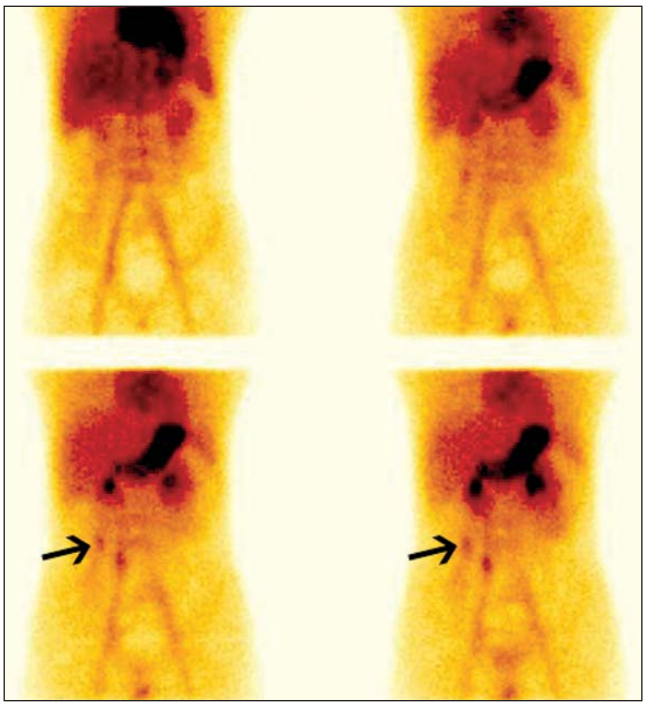

Figure 3 / Obr. 3
Meckel's diverticulum in a 10-year-old boy with melaena. Sequential anterior views of the abdomen obtained for 20 minutes injection. There is a focus of pathological accumulation of ^{99m}Tc-pertechnetate in ectopic gastric mucosa in the Meckel's diverticulum, located to the right mid-abdomen (arrows).
Statický scintigram dutiny břišní za 20 minut po i. v. aplikaci radiofarmaka u 10letého chlapce s melénou. Akumulace ^{99m}Tc-pertechnetátu v ektopické žaludeční sliznici v Meckelově divertiklu v mezogastriu vpravo *(šipka)*.

views of the abdomen obtained for 20 minutes after injection in the case of the 9-year-old boy (with negative result). There is normal accumulation of ^{99m}Tc-pertechnetate in gastric mucosa. The 2-year-old boy with enterorrhagia is shown in Fig. 2. There is an anterior view of the abdomen obtained 30 minutes after ^{99m}Tc-pertechnetate injection with a focus on pathological accumulation of ^{99m}Tc-pertechnetate in ectopic gastric mucosa in Meckel's diverticulum, located on the border of the lower-right and mid-abdomen. Fig. 3 shows scintiscans in a 10-year-old boy referred for melaena. There are sequential anterior views of the abdomen obtained from a 20-minute injection with a focus of pathological accumulation of ^{99m}Tc-pertechnetate in ectopic gastric mucosa in Meckel's diverticulum, located to the right mid-abdomen.

Discussion

Our findings on Meckel's diverticulum scintigraphy are similar to those found in literature. Poulsen at al. (21) retrospectively evaluated a total of 55 ^{99m}Tc-pertechnetate scintigraphies in 53 patients in comparison with the results from surgery and other diagnostic procedures and available section reports during the period from 1981 to 1996. Four children had positive scintigraphy. Three patients underwent a laparotomy and the Meckel's diverticulum was found. Ectopic gastric mucosa was demonstrated in only two of these Meckel's diverticuli at histological examination. In the fourth patient, a nine-year-old girl with rectal bleeding, a contrast study of the small intestine revealed normal findings. Rebleeding occurred and the scintigraphic examination was repeated with negative results. The patient was not operated on and no rebleeding was observed after the observation period of 4 years. In a study of a total of 51 scintigraphy examinations, 49 patients were negative, in two cases Meckel's diverticulum was found on later laparotomy for other reasons. The diverticulum was removed in one patient, and the histological examination revealed ectopic gastric mucosa (21).

Sfakianakis et al. (28) in retrospective analysis of 57 rectilinear scans found 5 true positive, 46 true negative, 2 false positive and 4 false negative. Of 86 camera studies 10 were true positive, 74 true negative, one false negative and one patient showed bowel activity (28).

In an animal study using dogs, the smallest scintigraphically detectable gastric patch was 1.8 cm^2 (22). Available data suggest that ^{99m}Tc-pertechnetate uptake is localized to the mucin cell rather than the parietal cell (31).

Positive scintigraphy should fulfil the following interpretation criteria:

1) activity in the ectopic gastric mucosa should appear at the same time as activity in the normal mucosa of the stomach (9);

2) a Meckel's diverticulum may appear anywhere within the abdomen, although it is typically seen in the right lower quadrant (9);

3) activity at Meckel's diverticulum must not be mistaken for activity in the kidneys, ureter or urinary bladder (activity in the urinary tract usually first appears after activity is seen in the normal gastric mucosa) (5,9);

4) small Meckel's diverticulum may seem to appear at a later time than within the stomach (9).

Radiation absorbed dose for ^{99m}Tc-pertechnetate in the stomach wall (target organ) is 1.25 cGy/185 MBq (31). An effective dose for Meckel's diverticulum

scintigraphy is 0.012 mSv/MBq (15). In our study the average applied activity was 370 MBq, patients received an effective dose of 4.44 mSv.

In children, sensitivity and specificity for Meckel's diverticulum scintigraphy is 85 % and 95 % (27) but in adults, scintigraphy reveals a decrease in both sensitivity (63 %) and specificity (9 %) (24). One must be aware of possible false negative results of scintigraphy (2,32). The relatively low negative predictive value of the Meckel's scintigraphy may result in need for operative evaluation despite the scan data (30). We have had no false negative scintigraphy with subsequent finding of Meckel's diverticulum at surgery.

Conclusion

Scintigraphy of the abdomen by means of ^{99m}Tc-pertechnetate is a suitable non-invasive method for detection of ectopic gastric mucosa, especially in the Meckel's diverticulum.

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