

The impact of age and sex on the occurrence of pathology in the wall of the upper gastrointestinal tract

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Abstract

Introduction: The growing incidence of gastrointestinal diseases forces to improve both imaging techniques and the identification of the population with a greater risk of a disease. Identification of lesions located inside the wall of intestinal tract or in close proximity often was not possible using endoscopy or computed tomography.

Aim: The study was a retrospective evaluation of the occurrence of submucosal lesions (SML) and thickened wall (TW) of the upper gastrointestinal tract (UGIT) depending on age and sex.

Material and methods: Out of 20012 gastroscopies during the 4-year follow-up study, we enrolled 199 patients with pathological lesions in the wall of the UGIT. All patients underwent computed tomography and endoscopic ultrasound (EUS).

Results: We analysed a total of 122 (78 males, 44 females, age: 64.0 ± 12.9 years) out of 187 patients. 23.91% of SML in the oesophagus, 56.52% in the stomach, and 19.57% in the duodenum. A higher number of SMLs was found in men than in women (57.14% vs. 40.45%, $p = 0.023$), and the difference was greater over 50 years of age (85.71% vs. 40.00%, $p = 0.031$). We found less malignant SMLs compared to benign (35.87% vs. 64.13%, $p = 0.026$), especially in women (22.86% vs. 47.46%, $p = 0.006$). 26.67% of TW were in the oesophagus, 66.67% in the stomach, and 6.67% in the duodenum. There was a tendency towards increased incidence of TW over 50 years of age (8.58% vs. 18.30%, $p = 0.074$), which concerned men in particular (24.10% vs. 11.43%, $p = 0.043$). Until 65 years of age, these differences were significant for the oesophagus (27.27% vs. 0.00%, $p = 0.044$) and the stomach (25.93% vs. 4.00%, $p = 0.029$). As many as 70% of TW pathologies were malignant.

Conclusions: Submucosal lesions and TW of the upper gastrointestinal tract account for 0.61% of performed gastroscopies. They occur in men and usually over 50 years of age.

Introduction

The growing incidence of gastrointestinal diseases demands for the improvement of old imaging techniques and the development of new ones. An accurate diagnosis is made possible by appropriately selected methods, and knowledge of the age and sex of the population exposed to disorders of the upper gastrointestinal tract. It is particularly difficult to interpret submucosal lesions and pathologies distinguished by flat lesions with a thickened and irregular contour of the walls of the gastrointestinal tract. Generally, the reason

for these lesions is pathological processes located in the wall of the gastrointestinal tract, but they can also be caused by the compression of normal or pathologically altered organ.

In the oesophagus submucosal lesions (SML) can be the result of aortic arch compression or an enlarged left atrium. Moreover, it can be the effect of the presence of lymph nodes, spine, proliferative disorders of the respiratory system, as well as mediastinal tumours and pancreatic pseudocyst in the mediastinum [1, 2]. A compression in the stomach can be the result of car-

diac hypertrophy, normal pancreatic parenchyma, left lobe of the liver, spleen, and gallbladder. In the duodenum the tumour effect can be caused by the pathology of the head of the pancreas. In the wall of the upper gastrointestinal tract we can distinguish benign, potentially malignant, and malignant lesions. Benign lesions include leiomyoma, lipoma, intramural cyst, varicose veins, granular cell tumour, ectopic pancreas, and inflammatory polyp [1–10]. Malignant and potentially malignant lesions include oesophageal cancer, gastric cancer, gastric lymphoma, neuroendocrine tumour, stromal tumour, and metastases [11–15].

Aim

The aim of the study was a retrospective evaluation of the occurrence of submucosal lesions and thickened wall (TW) of the upper gastrointestinal tract (UGIT) depending on age and sex.

Material and methods

Study population

During the 4-year follow-up conducted in the Endoscopy Laboratory of the Department of Gastroenterology, 20012 gastroscopies were registered. In total 210 patients were enrolled for further investigation due to 4 pathological changes found in the wall of the upper gastrointestinal tract.

Due to the lack of consent or cooperation and systemic disease requiring another urgent procedure 11 (0.05%) patients were excluded from further investigation. All patients underwent computed tomography and endoscopic ultrasound with fine-needle aspiration obtaining cytologic, and in some cases also histopathological material.

Endoscopy

All gastroscopies (Olympus GIF Q 180, GIF Q 165, GIF Q 145) were performed by endoscopists in the Endoscopy Laboratory of the Department of Gastroenterology. All procedures were performed by an endosonographer with formal training and expertise in endoscopic ultrasound. Standards for EUS examination were followed. Examinations were performed in planned mode. Patients remained in the fasting state before the examinations. The examinations were performed in the left lateral recumbent position. The patients who tolerated gastroscopy poorly underwent EUS with intravenous anaesthesia. A radial echoendoscope, a linear echoendoscope, or both (Olympus GF-UCT 160, Olympus GF-UM 20, Pentax EG-3870 UTK) were used for the examination as needed.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the institu-

tional review board as well by the Local Ethics Committees when required. All the patients provided informed consent.

Computed tomography

Computed tomography (CT) scans of the abdomen and chest with a contrast agent were performed in planned mode using the same GE VCT 64-Slice CT Scanner. Patients were in the fasting state and prior to the examination of the stomach or duodenum were obliged to drink 1.5–2 l of water.

The examinations were conducted in the supine position.

Statistical analysis

Nonparametric Spearman test was used to find out correlation between the analysed data. To investigate age cut-off point for SML and TW occurrence, receiver operating characteristic (ROC) analysis was performed. Due to the qualitative nature of the data Pearson's χ^2 test was used for determining the relationships between the variables of this type. As a threshold of significance a value of 0.05 was taken; positive test results at this level were assumed to be statistically relevant. Statistical analyses were performed using Statistica 6.0 software.

Results

In the 199 performed gastroscopies pathologies occurred in 56% in the stomach ($n = 111$), 24% in the oesophagus ($n = 47$), and in 21% of the duodenum ($n = 41$). During the endoscopic diagnosis 134 cases were verified positively. Based on EUS-FNA, 12 pathologies proved to be the infiltration of pancreatic cancer, which was the reason for exclusion from the study. In the remaining 65 (32.7%) patients, the compression on the wall of UGIT was caused by another organ. A total of 187 patients were analysed (0.609% of all gastroscopies), of which in 122 cases we found pathologies

Table I. The occurrence of benign and malignant pathologies depending on age and sex

Parameter	Benign	Malignant	P-value
Female	28/44	16/44	0.138
Male	40/78	38/78	0.853
P-value	0.486	0.406	–
Age ≤ 50 years	12/17	5/17	0.162
Age > 50 years	56/105	49/105	0.577
P-value	0.495	0.387	–

Table II. The occurrence of SML and TW depending on location and age

Variable	All [%] (n)	Age [years]		P-value
		≤ 50 [%] (n)	> 50 [%] (n)	
SML	49.20 (92/187)	40.12 (15/34)	50.33 (77/153)	0.512
Oesophagus	46.81 [23.91] (22/47)	44.44 [26.67] (4/9)	47.37 [23.38] (18/38)	0.815
Stomach	46.85 [56.52] (52/111)	23.53 [26.67] (4/17)	51.06 [62.34] (48/94)	0.176
Duodenum	62.07 [19.57] (18/29)	87.50 [46.67] (7/8)	52.38 [14.29] (11/21)	0.629
P-value	0.321	0.011	0.910	–
TW	16.04 (30/187)	5.88 (2/34)	18.30 (28/153)	0.074
Oesophagus	17.02 [26.67] (8/47)	11.11 [50.00] (1/9)	18.42 [25.00] (7/38)	0.849
Stomach	18.02 [66.67] (20/111)	5.88 [50.00] (1/17)	20.21 [67.86] (19/94)	0.217
Duodenum	6.90 [6.67] (2/29)	0.00 [0.00] (0/8)	9.52 [7.14] (2/21)	0.388
P-value	0.340	0.624	0.519	–

Data in brackets show percentage in the column.

Table III. The occurrence of SML depending on location, sex, and age

Variable	Male			Female			P-value
	All [%] (n)	≤ 50 years [%] (n)	> 50 years [%] (n)	All [%] (n)	≤ 50 years [%] (n)	> 50 years [%] (n)	
SML-UGIT	57.14 (56/98)			40.45 (36/89)			0.023
		46.67 [12.50] (7/15)			42.11 [22.22] (8/19)		0.935
			59.04 [87.50] (49/83)			40.00 [77.78] (28/70)	0.019
Oesophagus	57.17 [23.21] (13/24)			39.13 [25.00] (9/23)			0.302
		33.33 [14.29] (1/3)			50.00 [37.50] (3/6)		0.813
			57.14 [24.49] (12/21)			35.29 [21.43] (6/17)	0.310
Stomach	59.62 [55.36] (31/60)			41.18 [58.33] (21/51)			0.270
		25.00 [28.57] (2/8)			22.22 [25.00] (2/9)		0.661
			55.77 [59.18] (29/52)			45.24 [67.86] (19/42)	0.310
Duodenum	85.71 [21.43] (12/14)			40.00 [16.67] (6/15)			0.031
		100.00 [57.14] (4/4)			75.00 [37.5] (3/4)*		0.877
			80.00 [16.33] (8/10)			27.27 [10.71] (3/11)*	0.174
P-value	0.046	0.043	0.354	0.986	0.184	0.502	–

SML-UGIT – submucosal lesions in upper gastrointestinal tract, * $p < 0.1$ between age ≤ 50 or > 50. Data in brackets show percentage in the column.

within UGIT in the EUS (78 males, 44 females, age: 64.0 ± 12.9). The pathologies were most frequently observed in the stomach (59.02%; $n = 72$), then in the oesophagus (24.59%; $n = 30$), and in the duodenum (16.39%; $n = 20$).

No significant correlation of SML and TW with age was found, in contrast to malignancy of pathologies which significantly increased with age ($r = 0.183$). The ROC analysis failed to identify a threshold age for the greater occurrence of SML, WT, or malignant lesions. Given the epidemiological data, we arbitrarily decided to divide the patients into age groups ≤ 50 years and > 50 years of age. Here the incidence of benign and malignant lesions did not differ significantly as well (Table I).

23.91% of SMLs were located in the oesophagus, 56.52% in the stomach, and 19.57% in the duodenum (Table II). A significantly higher number of SMLs was found in men than in women (57.14% vs. 40.45%, $p = 0.023$), and the difference was greater over 50 years of age and concerned mainly the duodenum (85.71% vs. 40.00%, $p = 0.031$) (Table III). We found significantly fewer malignant SMLs compared to benign (35.87% vs. 64.13%, $p = 0.026$), especially in women (22.86% vs. 47.46%, $p = 0.006$), and in the area of the oesopha-

gus (81.82% vs. 18.15%; $p = 0.013$), with a tendency towards greater prevalence of malignant lesions in the duodenum (Tables IV, V).

26.67% of TW were located in the oesophagus, 66.67% in the stomach, and 6.67% in the duodenum (Table II). There was a tendency towards increased incidence of TW over 50 years of age (8.58% vs. 18.30%, $p = 0.074$), which concerned men in particular (24.10% vs. 11.43%, $p = 0.043$). Until 65 years of age, these differences were significant for the oesophagus (27.27% vs. 0.00%, $p = 0.044$) and the stomach (25.93% vs. 4.00%, $p = 0.029$) (Tables VI, VII). As many as 70% of TW pathologies were malignant (Table III). All TW pathologies occurred in women over 50 years of age and all were malignant. Histopathological characteristics of the observed SML and TW are shown in Table VIII.

Discussion

EUS allows for a visualisation of individual layers of the walls in the UGIT. The layers visible from the probe are, respectively: hypoechoic mucosa, hyperechoic submucosa, hypoechoic muscularis propria, and hyperechoic serosa. In the case of small focal lesions

Table IV. The occurrence of benign and malignant pathologies in SML and TW depending on location

Variable	Benign [%] (n)			Malignant [%] (n)			P-value
	All	SML	TW	All	SML	TW	
P-UGIT	55.74 (68/122)			28.88 (54/122)			0.300
	64.13* (59/92)			35.87 (33/92)			0.026
	30.00* (9/30)			70.00 (21/30)			0.071
Oesophagus	66.67 [29.41] (20/30)			33.33 [18.52] (10/30)			0.134
	81.82 [30.51] (18/22)			18.15 [12.12] (4/22)			0.013
	25.00 [22.22] (2/8)			75.00 [28.57] (6/8)			0.242
Stomach	51.39 [54.41] (37/72)			48.61 [64.81] (35/72)			0.847
	61.54 [54.24] (32/52)			38.46 [60.61] (20/52)			0.173
	25.00 [55.56] (5/20)			75.00 [71.43] (15/20)			0.064
Duodenum	55.00 [16.18] (11/20)			45.00 [16.67] (9/20)			0.715
	50.00 [15.25] (9/18)			50.00 [27.27] (9/18)			1.00
	100.00 [22.22] (2/2)			0.00 [0.00] (0/2)			0.221
P-value#	0.366	0.095	0.082	0.366	0.095	0.082	–

P-UGIT – submucosal and thickened wall pathologies in upper gastrointestinal tract, * $p < 0.05$ between SML and TW in the same malignancy, #comparison to opposite malignancy. Data in brackets show percentage in the column.

Table V. The occurrence of benign and malignant pathologies in SML and TW depending on sex and age

Variable	Male, % (n)			Female, % (n)			P-value
	All	≤ 50 years	> 50 years	All	≤ 50 years	> 50 years	
SML-B	52.54 (31/56)			47.46 (28/36)			0.312
		57.14 (4/7)			75.00 (6/8)		0.742
			55.10 (27/49)			78.57 (22/28)	0.340
SML-M	77.14 (25/56)			22.86 (8/36)			0.124
		42.86 (3/7)			25.00 (2/8)		0.606
			44.90 (22/49)			21.43 (6/28)	0.148
P-value	0.512	0.757	0.559	0.006	0.242	0.012	
TW-B	40.91 (9/22)			0.00 (0/8)			0.082
		100.00 (2/2)			0.00 (0/0)		NA
			35.00 (7/20)			0.00 (0/8)	0.107
TW-M	59.09 (13/22)			100.00 (8/8)			0.387
		0.00 (0/2)			0.00 (0/0)		NA
			59.09 (13/20)			100.00 (8/8)	0.482
P-value	0.485	0.221	0.271	0.014	NA	0.014	

B – benign, M – malignant. Data in brackets show percentage in the column. NA – not available.

Table VI. The occurrence of TW pathologies depending on sex and threshold age of 50 years

Variable	Male [%] (n)			Female [%] (n)			P-value
	All	≤ 50 years	> 50 years	All	≤ 50 years	> 50 years	
TW-UGIT	22.45 (22/98)			8.99 (8/89)			0.122
		13.33 [9.10] (2/15)			0.00 [0.00] (0/19)		0.101
			24.10 [90.90] (20/83)			11.43 [100.00] (8/70)	0.043
Oesophagus	25.00 [27.27] (6/24)			8.70 [25.00] (2/23)			0.137
		33.33 [50.00] (1/3)			0.00 [0.00] (0/6)		0.134
			23.81 [25.00] (5/21)			11.76 [25.00] (2/17)	0.341
Stomach	23.33 [63.64] (14/60)			11.76 [75.00] (6/51)			0.114
		12.50 [50.00] (1/8)			0.00 [0.00] (0/9)		0.274
			25.00 [65.00] (13/52)			14.29 [75.00] (6/42)	0.198
Duodenum	14.29 [9.09] (2/14)			0.00 [0.00] (0/15)			0.129
		0.00 [0.00] (0/4)			0.00 [0.00] (0/4)		1.00
			20.00 [10.00] (2/10)			0.00 [0.00] (0/11)	0.119
P-value	0.722	0.436	0.944	0.374	1.00	0.415	–

TW-UGIT – thickened wall pathologies in upper gastrointestinal tract. Data in brackets show percentage in the column.

Table VII. The occurrence of TW pathologies depending on sex and threshold age of 65 years

Variable	Male		Female		P-value
	≤ 65 years	> 65 years	≤ 65 years	> 65 years	
Oesophagus	27.27 [25.00] (3/11)		0.00 [0.00] (0/13)*		0.044
		23.08 [30.00] (3/13)		20.00 [28.57] (2/10)*	
Stomach	25.93 [58.33] (7/27)		4.00 [100.00] (1/25)*		0.029
		21.21 [70.00] (7/33)		19.23 [71.43] (5/26)*	
Duodenum	16.67 [16.67] (2/12)		0.00 [0.00] (0/9)		0.198
		0.00 [0.00] (0/2)		0.00 [0.00] (0/6)	
P-value	0.789	0.752	0.638	0.496	–

* $p < 0.1$. Data in brackets show percentage in the column.

Table VIII. Histopathological characteristics of SML and TW

Lesion	Benign		Malignant	
WT	Ectopic pancreas	7	Cancer	9
	Lipoma	1	Neuroendocrine tumour	5
	Granular cell tumours	1	GIST	4
			Lymphoma	3
SML	Lipoma	17	GIST	26
	Leiomyoma	13	Neuroendocrine tumour	5
	Ectopic pancreas	12	Cancer	2
	Intramural cyst	10		
	Granular cell tumours	5		
	Inflammatory polyp	1		
	Varicose veins	1		

EUS resolution is much higher than conventional CT. However, CT has a significant advantage in assessing the extent of the process and involvement of other organs.

In the available literature there are divergent opinions on the incidence of pathology in the wall of the upper gastrointestinal tract. Gastroenterology by Dabrowski contains information that submucosal tumours are diagnosed once in 100–300 endoscopies of the upper gastrointestinal tract [16]. In the retrospective material collected in the years 1976–1984 Hedenbro *et al.* analysed 15,104 endoscopies and found one submucosal lesion in 300 of all performed endoscopies of the upper gastrointestinal tract [17]. In a large Asian study, Lee *et al.* examined 104,159 gastroscopies, which showed 795 (0.76%) cases of submucosal lesions [18]. In another Korean study, 6683 endoscopies of the UGIT were analysed, in which the above-mentioned pathologies of the oesophagus was found in 0.6% [19]. In the work by Van Stolk, evaluating postoperative material and autopsy of the dead over 50 years of age, a significantly higher incidence of pathologies in the wall of the gastrointestinal tract was observed [20]. Submucosal lesions were found in the oesophagus in 8%, and in the stomach in 50% of

cases. *In vivo* tumours are diagnosed much less frequently, although the prevalent use of endoscopy increased their detection rate. In the current work analysing 20,012 gastroscopies, as a result of the endoscopic diagnosis, the pathology in the wall of UGIT was confirmed in 122 cases, which accounts for 0.61%. The studies by Polkowski show that submucosal lesions are most often observed in the stomach (68%), then in the oesophagus (25%), and least frequently in the duodenum (7%) [12, 21]. In another work submucosal lesions were in 60% found in the stomach, in 30% in the oesophagus, and in 10% in the duodenum [22]. The results of our work are partly convergent with previous studies only for the oesophagus (23.91%) and stomach (56.52%), while the percentage of SMLs in the duodenum in our study was higher (19.57%).

In the available literature, data on the diversity of lesions in submucosal membrane of UGIT depending on sex and age are scarce. The occurrence of individual SMLs depending on age and sex was the subject of the majority of previous analyses. Most studies report no differences between men and women, or possibly a slight prevalence of men [23, 24]. Reports regarding age are divergent and do not specify the age of the oc-

currence of the above-mentioned lesions [25–27]. In the current study we analysed pathologies in the wall of UGIT, specifying SML and TW on a large sample size of 20,012 gastroscopies.

A drawback of our study is the lack of ability to assess inter- and intraobserver variability in terms of performed gastroscopies and EUS. However, verification of pathologies in CT, FNA, and histopathology significantly reduces the number of possible overdiagnoses.

Our study demonstrated significant variability of SML location depending on age and sex. We have also shown that TW is characterised by significantly greater malignancy increasing with age and especially in women. In our opinion, the results of the present study can be the basis for identifying new UGIT cancer-risk groups.

Conclusions

Submucosal changes and thickened wall of the upper gastrointestinal tract account for 0.61% of performed gastroscopies. They are mostly located in the stomach, occur more frequently in men than in women and usually after 50 years of age. Thickened wall of the upper gastrointestinal tract in women is most likely to be malignant.

Conflict of interest

The authors declare no conflict of interest.

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