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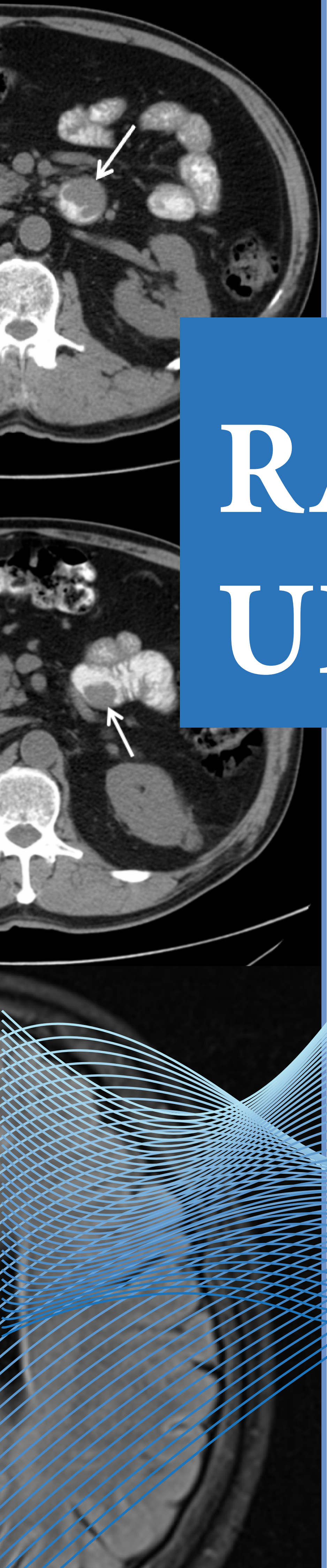

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LETTER FROM EDITOR-IN-CHIEF

The first number of electronic "Radiology Update" journal is in front of you. The journal appeared due to wonderful initiative of young radiologists from Kaunas, supported by radiologists of Radiology department of Lithuanian University of Health Sciences and Lithuanian Radiologists' Association, as well as strong backing from the side of administration of Lithuanian University of Health Sciences.

The birth of the journal was inspired by the lack of similar projects not only in Lithuania, but also in the Baltic states. Thus we will warmly welcome publications submitted by radiologists not only from Lithuania, Latvia, Estonia, other countries across Europe and may be even further, but also by representatives and colleagues of other specialities, dealing with medical imaging – cardiologists, oncologists, gynecologists, etc. Papers from representatives of technical and technological specialities are also absolutely welcome. This is the reason why the Editorial Board is completed of experienced and well known specialists from Lithuania and other countries, working not only in the field of Radiology.

Me personally – I want to guarantee, that the peer review will be carried out by professionals of different respective fields. Also I would like to believe that the level of the journal will constantly increase and it will find it's place between other medical journals. If we will succeed in growth of the ratings of the journal and if demanded – the Editorial Board will put a question of a printed version of the journal in the agenda.

I am very happy with the first number of the journal "Radiology Update" and wish productive work to the Editorial Board, objectivity and precision to the reviewers, and much useful information to the readers.

Later on if the journal will gain stronger status and more impact – the Editorial Board will expand, enrolling new experienced and well known researchers and physicians.

In the name of "Radiology Update",

Yours
Algidas Basevicius

RARE CLINICAL CASE OF JEJUNAL ANGIOMATOID FIBROUS HISTIOCYTOMA AND A LITERATURE REVIEW OF RADIOLOGICAL FINDINGS IN MALIGNANT AND NON-MALIGNANT TUMORS OF THE SMALL INTESTINE

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ABSTRACT

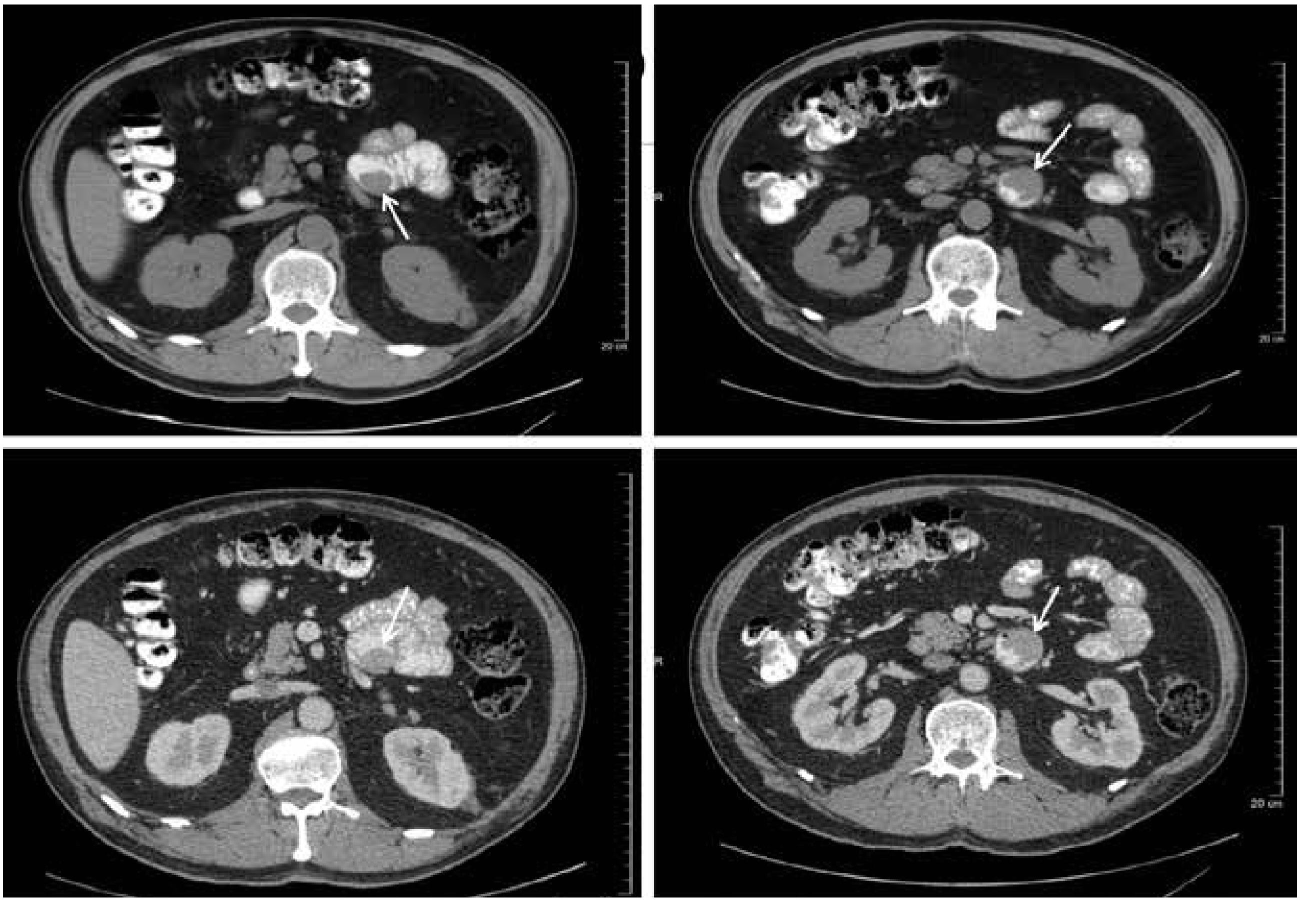
Background: Tumors of the small intestine represent a small fraction of gastrointestinal tract neoplasms and might be missed if the referring physician and radiologist are not actively looking for a tumor. The choice of an optimal imaging protocol for detecting tumors in the jejunum and ileum is crucial. The differential diagnosis should include both benign (GIST, lipoma, hemangioma, neural tumors) and malignant (adenocarcinoma, carcinoid, lymphoma and metastases) tumors. Angiomatoid fibrous histiocytoma (AFH) is a rare soft tissue tumor, and is never on the initial differential diagnosis of a small intestine tumor. In this article we present a case of jejunal AFH and a literature review of radiological findings in malignant and non-malignant tumors of the small intestine.
Clinical case: A 68-year-old male presented with a 1 month history of weight loss, lack of appetite, and pain in the right iliac and lumbar regions. Past medical history was significant for an adrenal tumor of unspecified origin and adrenalectomy in 2005. CT showed a non-homogenous infiltration located posterior to the ligament of Treitz and a polypoid exophytic mass. A biopsy was obtained during enteroscopy. Histological and immunohistochemical analysis confirmed an AFH. The adrenal tumor specimens were retrospectively re-analyzed and showed similar morphology and immunohistochemistry, therefore it was concluded that the neoplasm arose in the adrenal gland and metastasized to the jejunum.
Conclusions: In this report we presented to our knowledge the first case of an AFH of the adrenal gland which later metastasized to the jejunum.
AFH has several characteristic findings on MR imaging: a double-rim sign, fluid-fluid levels, and marginal infiltrating strings of tumor tissue.
To distinguish between benign and malignant tumors of the small intestine it is crucial to evaluate the number, location, vascularity, calcifications, growth and enhancement patterns, mesenteric and extra-intestinal involvement of the tumors.

Keywords: angiomatoid fibrous histiocytoma, small intenstine, small bowel, neoplasms, tumors, imaging, radiology

CLINICAL CASE

A 68-year-old male was admitted to our hospital on August 20, 2014 and presented with a 1 month history of 8 kg weight loss, lack of appetite and abdominal pain in right iliac and lumbar regions. Past medical history was significant for an adrenal tumor and a left adrenalectomy in 2005, and the histopathological examination of the excised lesion revealed uncertain histogenesis and malignancy. There were no significant findings on physical examination, except for pain in the right iliac and lumbar regions. Laboratory studies showed a microcytic anemia with a hemoglobin of 88 g/l and a mean corpuscular volume (MCV) of 71 fL, thrombocytosis with platelets of 555x109/l. C-reactive protein was elevated to 47, 7 mg/l.
Upper gastrointestinal tract (GI) barium contrast study showed two filling defects near the ligament of Treitz. Computed tomography (CT) of the chest, abdomen and pelvis revealed a mass located in the small intestine (Figure. 1).

Figure 1. CT of the abdomen with oral contrast showing a mass in the intestinal lumen producing a filling defect.



It was a non-homogenous infiltration up to 1.5 cm in depth with moderate contrast enhancement located posterior to the ligament of Treitz. In addition, just above this infiltration, a polypoid mass of about 1.7x1.4 cm growing exophytically directly into intestinal lumen, and a 4x0.9 cm possibly pathological lymph node in the mesentery were described. Based on this CT appearance, a small bowel neoplasm was suspected. Following the CT scan, the patient underwent enteroscopy to visually inspect the lesions. The procedure revealed two ulcerous lesions: one was near the ligament of Treitz and occupied a third of the lumen circularly, while the second was 4 cm below the ligament of Treitz and occupied two thirds of the lumen circularly.

Both lesions were biopsied during the procedure. Histological examination of the specimens revealed infiltration of the lamina propria by tumor cells. The cells had oval, polymorphic nuclei, indistinct cell borders and an eosinophilic cytoplasm. Mitosis was infrequent. Immunohistochemistry demonstrated expression of desmin and epithelial membrane antigen (EMA). Aktin and CD56 were negative. Ki67 proliferative index was 30%. In addition, histological samples from 2005 were re-evaluated and the cells exhibited positive reactions with desmin, EMA and negative reactions with aktin, CD56, CK18. Ki67 proliferative index was 10%. Given the identical morphology and immunophenotyping, it was suspected that the primary adrenal tumor had spread into the small intestine. The diagnosis of angiomatoid fibrous histiocytoma was made based on studies of both specimens.

The patient underwent surgery to excise the duodenal and jejunal masses. Two pieces of material were removed. The first piece was composed of normal adipose tissue with a few fibrous tissue insertions.

The second piece consisted of two components. Macroscopically both excised components showed a circular serosa that was not overgrown. One component consisted of a firm mass with

atypical cells of moderate size with oval nuclei and various amounts of eosinophilic. Mitosis was infrequent. The Ki67 proliferative index was 70%.
Second component consisted of similar tumor cells, except that their nuclei were polymorphic and cells had a moderate amount of eosinophilic cytoplasm with indistinct borders. Blood-filled pseudoangiomatous spaces of variable size were prominent in the lesion. Ki67 proliferative index was 30%. The immunohistochemical stains were as follows: desmin - positive, aktin - negative, vimentin - positive, CD68 - negative, S100 protein – negative, CD56 - negative. All other markers were negative. Two lymph nodes with a diameter of 0,8 cm and 0,9 cm were also removed and demonstrated reactive changes.

DISCUSSION

ANGIOMATOID FIBROUS HISTIOCYTOMA (AFH)

Angiomatoid fibrous histiocytoma (AFH) is a particularly rare tumor of soft tissues which usually occurs in the dermis and subcutis of the extremities [1]. Most commonly, AFH arises in children and young adults and accounts for less than 1% of total soft tissue tumors [1-3]. AFH was first described by Enzinger in 1979 as a variant of malignant fibrous histiocytoma (MFH) with a tendency to occur in superficial tissues of the extremities and young age group, contrary to MFH which occurs in deep soft tissues of older individuals [1-3]. Today, AFH is classified as a distinct neoplasm due to its more favorable prognosis and benign clinical course [3-5].
Although most patients present with AFH in childhood, the age range is quite wide [6]. However, the mean age is approximately 20 years [4] and in most patients AFH occurs in the first 30 years of life [1, 6]. The most common site for AFH is superficial tissues of the extremities but rarely the tumor can arise in the trunk, head and neck [4]. There were several reported cases of AFH presenting in nonsomatic soft tissues which included the cranium, mediastinum, lungs, vulva, ovary, retroperitoneum, omentum and bone [7-8]. It is worth mentioning that our case reports the occurrence of AFH in the adrenal gland and small bowel for the first time.
Presentation of AFH is related to its location. Since the tumor tends to grow in superficial tissues, it mostly appears like a superficial nodular slowly growing mass. Pain and tenderness are possible but rather unusual symptoms of AFH. Typically, masses are found in those areas where lymph nodes are localized. Patients with AFH in other locations can present with symptoms related to affected organ or anatomical site. Patients with nonsomatic AFH are more likely to present with systemic symptoms than patients with somatic AFH. Fever, weight loss, general malaise, and anemia suggest that production of cytokines by the tumor is occurring. Also, the mean age of patients with nonsomatic AFH is higher by approximately 20 years [1-9].
The diagnosis of AFH is established after careful histopathological, immunohistochemical and cytogenetic examination because pre-operative diagnosis of AFH is hardly possible due to there being no specific clinical or imaging findings [9]. Macroscopically, AFH is usually a small tumor, the median size is just 2 cm, although tumor can grow to 10-12 cm [4]. The lesion is usually circumscribed, has a firm consistency and grey appearance. Microscopic examination often shows lesions with an incomplete pseudocapsule and in most cases surrounded by a "lymphoplasmacytic" infiltrate. AFH consists of sheets or short fascicles of round epithelioid or spindle cells. It is the only histological feature of AFH that remains constant in most cases [1]. The proportions of differently shaped cells may vary. Common features usually present in all tumor cells are bland, vesicular nuclei and a moderate amount of eosinophilic cytoplasm. Round cells have uniform nuclei and infrequent mitoses. Spindle cells can show nuclear polymorphism. This cellular morphology does not predict a worse outcome [10]. One more common finding is multifocal intralesional hemorrhage which contains blood-filled spaces of different sizes. Approximately two-thirds of lesions have this feature [1]. Hemosiderin deposits, accumulation of siderophages and sometimes giant cell formations can be prominent in the pseudoangiomatous spaces [10].
For the diagnosis of AFH immunohistochemistry provides only a supportive role because AFH

lacks a specific immunoprofile. Positivity for desmin, CD68 and CD99 can be demonstrated in approximately half of the cases. Three genetic abnormalities are related with angiomatoid fibrous histiocytoma: EWSR1–CREB1 fusion gene resulting from t(2;22)(q34;q12), FUS–ATF1 fusion gene resulting from t(12;16)(q13;p11) and EWSR1–ATF1 fusion gene resulting from t(12;22)(q13;q12) [10]. EWSR1–CREB1 is the most often discovered gene fusion in patients with AFH [11] and EWSR1–ATF1 is more often related to nonsomatic cases of AFH [7].

Treatment for angiomatoid fibrous histiocytoma is surgical resection. Wide local excision with adequate follow-up allow for successful management of the disease in a majority of patients. Local recurrence of AFH can occur in up to 15%, while AFH tends to metastasize in less than 5% of cases. AFH can recur due to either incomplete resection or the tumor being localized in the head and neck [1]. Both metastases and local recurrence in somatic AFH correlate with invasion into the deep fascia or muscle [4]. Nonsomatic AFH have higher local recurrence rate compared to somatic AFH. This may be due anatomical location which leads to difficulties in obtaining complete excision [7].

TUMORS OF THE SMALL BOWEL

Tumors of the small intestine represent a small fraction of gastrointestinal tract neoplasms and might be missed if the referring physician and radiologist are not actively looking for a tumor due to asymptomatic and non-specific nature of the disease or poorly taken medical history. Given these factors, it is likely that the small bowel will not be investigated with an optimal imaging modality and protocol for detecting neoplasms in jejunum and ileum. The situation is made even more challenging when physicians are faced with an unusual case as the one presented in this article. Thus, maintaining a high index of suspicion, devising an appropriate imaging protocol and knowing the differential diagnosis of small intestine neoplasms is crucial.

The small intestine makes up over 70% of the total length and 90% of the absorptive surface of the gastrointestinal tract. Despite its size, neoplasms in the small bowel have an incidence of only 1 per 100,000 people worldwide [12], which is about 3% of all gastrointestinal tract neoplasms [13]. Incidence is higher in Western countries than in Asia [14]. Over the past several decades the incidence of small bowel cancer has increased, with rates depending on the histological origin of the tumor: carcinoid tumors showed the highest increases in incidence compared with adenocarcinomas and lymphomas, while the incidence of sarcomas remained stable [15]. Currently about 30-40 % of small intestine tumors are adenocarcinomas, 35-40% are carcinoid tumors, 15-20% are lymphomas and 10-15% are sarcomas (gastrointestinal stromal tumors – GIST) [15-17]. The increase might be due to improved diagnosis with radiological and endoscopic techniques and the spread of not yet conclusively proven lifestyle or environmental factors [18]. Non-malignant tumors of the small intestine, which make up about 5% of all non-malignant gastrointestinal tumors, can be lipomas, adenomas, gastrointestinal stromal tumors (GIST), leiomyomas, hemangiomas, various neural tumors and hereditary polyposis syndromes, Peutz-Jeghers syndrome in particular [18-19]. Metastases to the small bowel are most common in metastatic melanoma [19, 24], but various other cancers may also involve the small bowel, most notably lung and breast from distal sites, ovarian and other GI primary tumors by intraperitoneal spread [19].

Possible radiological modalities used to investigate the small intestine include follow-through barium studies, fluoroscopy-guided enteroclysis, computed tomography (CT) or magnetic resonance imaging (MRI) with intravenous (IV) contrast, CT or MR enterography (bowel distention with oral contrast agents) and CT or MR enteroclysis (bowel distention with oral contrast agents delivered via naso-jejunal intubation). Capsule endoscopy is useful in evaluating the mucosal surface and detecting early tumors, but does not allow for visualization of the submucosa, outer wall of the bowel and adjacent structures like the mesentery [18-19]. After first line investigations of the gastrointestinal tract (ultrasound, endoscopy and barium studies), the most utilized modality is CT, which has an 80% sensitivity in detecting small bowel tumors, and CT enterography with a sensitivity of 85-95% [20-22]. Evaluation of the small intestine on CT is best when the bowel is properly cleansed, adequate doses of intravenous contrast are used, multi-planar reconstructions are available, both arterial and venous phases are acquired to assess for tumor vascularity and washout, and oral contrast is administered to allow for both proper distention of all bowel loops and accurate delineation of the mucosa with appreciation of the pattern of mucosal enhancement [23]. While both positive and neutral oral contrast materials are used, neutral oral agents are sometimes preferred over positive barium contrast because the latter can obscure subtle hyperenhancement close to the lumen.

When creating a differential diagnosis of a detected small intestine mass on CT or MRI it is important to keep in mind certain characteristics which help to form an initial impression and determine the most likely origin of the tumor. These include location in the small intestine (jejunal or ileal, more proximal or distal), number of masses, exophytic or intramural growth, enhancement pattern and vascularity, tissue properties based on Hounsfield units in CT and signal intensity in various MRI sequences, calcifications, mesenteric involvement (masses, lymph nodes, stellate pattern), extra-intestinal involvement (known history of or imaging findings indicating primary tumor or evident hepatic and splenic findings) [19]. We will highlight how various small intestine tumors tend to present with respect to these characteristics. Finally, we will briefly discuss the imaging findings in AFH.

ADENOCARCINOMA

The majority of small bowel adenocarcinomas involve the duodenum, while the rest are mostly located in the proximal jejunum near the ligament of Treitz [25]. Appearance on CT varies, but in a typical scenario this tumor will present as a single local asymmetrical annular thickening of a short segment of bowel wall with elevated shoulder-like borders or a distinct exophytic mass; in both cases the lumen is asymmetrically narrowed, the tumor density is closest to soft tissue and enhancement is only moderate due to hypovascularity [19, 26-28]. The tumor itself is rigid and therefore can cause intussusception or bowel obstruction [26]. Invasion into the mesentery or vessels and regional lymph node enlargement may be present, distant metastases may be noted [19]. Fluoroscopic imaging with barium contrast may reveal a typical “apple core” sign and mucosal ulceration [19, 28].

CARCINOID

In contrast to adenocarcinomas, carcinoid tumors are most common in the distal ileum, often within 60 cm of the ileocecal valve; recently an increasing number of carcinoids in the duodenum is observed [28]. These tumors are among the smallest to involve the GI tract, often just a few centimeters in size [28]. Typically on CT carcinoids are recognized as solitary or multiple, intramural or exophytic soft tissue masses with marked enhancement during the arterial phase due to hypervascularity (best seen with oral water contrast) and calcifications; most specific finding associated with carcinoid is a desmoplastic reaction of the mesentery due to local spread, which involves fat stranding, a visible stellate pattern and angulation or tethering of small bowel loops. Clinical and radiological signs of small bowel obstruction may be present, although less often than in adenocarcinomas, due to growth into the lumen and deformation of small bowel loops [19]. Often the primary tumor is hard to visualize and diagnosis is first suspected based on mesenteric involvement or hypervascular hepatic metastases [19, 26-28]. Suggestive clinical history of serotonin overproduction (flushing, diarrhea, palpitations) can guide the radiologist to look more closely for typical features of carcinoid with the tools of nuclear medicine (somatostatin receptor scintigraphy, I-131 labeled MIBG or whole-body F18 dopa PET) [19].

LYMPHOMA

This tumor affects the small bowel with no predilection to either proximal or distal parts, but it is more common in the stomach [26]. Lymphoma in the small bowel can be primary, limited to small bowel and mesentery, or secondary, with involvement of extraintestinal organs (liver, spleen) and other lymph nodes [19]. The key feature differentiating lymphoma from both adenocarcinomas and carcinoids is the absence of obstruction [19]. Several different patterns of presentation on CT are common in lymphoma: most common is a single infiltrating bulky circumferential thickening of a relatively large segment of small bowel wall with no obstruction due to the pliability of tumor tissue. Other presentations include multiple intramural or mesenteric masses, aneurysmal dilation due to replacement of smooth muscles with lymphoid tissue and damage to the myenteric plexus and exophytic, sometimes ulcerated mass (can be mistaken for adenocarcinoma or GIST) [19, 26-28]. Lymphomas as a rule are less enhancing than other gastrointestinal tumors, and if enhancement is present it is usually homogenous [28]. Characteristic sign of lymphomas is bulky retroperitoneal or mesenteric adenopathy. Due to markedly enlarged lymph nodes, subsequent surrounding of adjacent vessels can develop and so called “sandwich” sign can be observed after injection of IV contrast [19, 27].

METASTASIS

Radiological signs of metastases in part depend on their origin. Malignant melanoma metastases are single or multiple masses in the submucosa without small bowel obstruction, sometimes with aneurysmal dilation due to a similar mechanism as in lymphoma; “target” sign may be appreciated when a clearly demarcated mass enhances and protrudes into the lumen [19]. Metastases from breast and lung cancer are rigid soft tissue masses and can cause luminal narrowing and small bowel obstruction, often looking very similar to primary small bowel adenocarcinoma [19]. Metastases from intraperitoneal organs (primary gastrointestinal, ovarian tumors) tend to diffusely involve the bowel loops and adhere them together, show signs of mesenteric involvement and stellate pattern similar, but not identical to, the desmoplastic reaction of carcinoid tumors [19]. Thus, when a mass suggestive of primary adenocarcinoma, carcinoid tumor or lymphoma is discovered, particular care must be taken to determine whether the mass is primary or secondary in origin with further imaging and other investigations.

GIST (FORMERLY LEIOMYOSARCOMA)

This tumor arises from the interstitial cells of Cajal and can involve the duodenum, jejunum or ileum, however the most common location is the stomach [19]. Typically it presents in patients over 50 years old [27]. GIST can be benign and malignant, but radiological appearance does not allow for precise differentiation between these possibilities [27]. It is noted however that malignant GIST is usually over 5 cm in size [19]. On CT examination the tumor is most often an exophytic relatively large soft tissue mass with a smooth outline, ulceration, and heterogenous, mostly peripheral, enhancement with central necrosis or cystic component [19, 26-28]. In some cases, aneurysmal dilation due to cavitation (not muscle or nerve damage like in lymphomas or metastases) [19], small hemorrhages and calcifications are evident [28]. Metastasis is mostly by direct invasion, but hematogenous spread to the liver is also typical with metastases being hypovascular or cystic in their appearance [26, 28].

LIPOMA

This common benign tumor is easily distinguished on CT by its characteristic fat density in appearance and Hounsfield units [19].

HEMANGIOMA

It is most common in the jejunum; due to its vascular nature hemangioma can present with almost insignificant or profuse gastrointestinal bleeding and/or corresponding anemia [29]. Hemangioma is usually small, often contains phleboliths [19]. On CT small bowel hemangiomas behave similarly to liver hemangiomas: there is a slow rim-like heterogenous peripheral contrast uptake in the early phases, progressing centrally and ending in complete or almost complete homogenous enhancement of the mass in later phases [30].

NEURAL TUMORS

Typically present as smooth or lobulated, well-defined masses; calcification is common in all types of neural tumors; additional lesions might suggest that the tumor is malignant, but no specific radiological findings exist for determining malignant potential [31].

HEREDITARY POLYPOSIS SYNDROMES

Small bowel is most often affected by Peutz-Jeghers syndrome, which presents with a large number of small filling defects on barium studies or discrete masses on CT. Typical mucocutaneous involvement (pigmentation) of the perioral area, palms and soles is seen clinically [19].

RADIOLOGICAL APPEARANCE OF ANGIOMATOID FIBROUS HISTIOCYTOMAS

CT findings are nonspecific, as it was in our case, and they may show only a heterogenous mass with both solid and cystic components and possibly some irregular enhancement [9]. To better visualize the tumor it is necessary to perform an MRI.

A recent study on MR imaging in AFH revealed several new findings characteristic of AFH: first, the lesions exhibited a “double-rim sign” on T2-weighed and contrast-enhanced images, which consisted of both a high and low signal intensity components (the outer component being of high signal intensity); second, there were marginal strings of infiltrative neoplastic tissue spreading into the surrounding fat and muscle [32].

AFH on MR usually has both cystic and solid components, contains fluid-fluid levels, is predominantly heterogenously hyperintense on T2-weighed images with some regions of local hypointensity, isointense or hypointense to muscle on T1-weighed images, may display surrounding edema, usually exhibits variable contrast enhancement or an enhancing pseudocapsule [9, 32-33]. Interestingly, authors of an article describing 7 AFH cases noted that all of those cases were initially misdiagnosed based on MRI, and erroneous diagnoses included hemangiomas, arteriovenous malformations, hematomas and sarcomas [33].

CONCLUSION

In this report we presented to our knowledge the first case of an angiomatoid fibrous histiocytoma of the adrenal gland which later metastasized to the jejunum. AFH presented with no specific clinical or radiological findings, therefore the diagnosis had to be confirmed by histological and immunohistochemical analysis after resection of the tumor.

Angiomatoid fibrous histiocytoma has several characteristic findings on MR imaging, including a double-rim sign, fluid-fluid levels, and marginal infiltrating strings of tumor tissue.

Tumors of small intestine are rare, and careful protocol selection is necessary to detect and classify the tumor. In order to distinguish between benign and malignant tumors of the small intestine it is crucial to evaluate the number, location, vascularity, calcifications, growth and enhancement patterns, mesenteric and extra-intestinal involvement of the tumors.

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USE OF ULTRASONOGRAPHIC TESTING IN DIAGNOSIS OF CARPAL TUNNEL SYNDROME

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is among the most common disorders of the upper extremity. At the moment electrodiagnostic testing (EDX) is often identified as a gold standard for CTS diagnosis. Recent studies show that ultrasonographic testing may become an alternative confirmatory tool for the disorder.
Aim: To compare the cross sectional area (CSA), wrist-to-forearm ratio (WFR) and the elasticity of the median nerve (MN) between patients with CTS and healthy subjects and to evaluate diagnostic usefulness of these measurements in diagnosis of CTS.
Materials and Methods: Patients diagnosed with CTS as well as healthy volunteers were examined by two observers, experienced radiologist and medical resident with 1 year of experience. Both were blinded to the diagnosis. Standard measurements of CSA of the MN were performed. Elasticity of the nerve was measured using strain ratio elastography. In order to evaluate the diagnostic utility of ultrasound, recently proposed diagnostic algorithm was tested (Goldberg G, 2016). QuickDASH questionnaire was used to evaluate the ability of ultrasound and EDX to assess symptom severity of CTS patients.
Results: 27 wrists with CTS and 25 healthy wrists were analyzed. CSA and WFR were significantly higher in CTS patients than in healthy volunteers. However, there was no significant difference in elasticity of the MN in our sample. There was no correlation between the MN conduction velocity, clinical symptoms and ultrasound measurements. Logistic regression revealed that ultrasound measurements had weak relationship between prediction and grouping. Diagnostic algorithm had specificity of 81.5% and sensitivity of 24%.
Conclusion: Currently there is no reliable ultrasonographic diagnostic algorithm. Further ultrasound studies are needed for the development of better diagnostic tools combining various diagnostic techniques.

Keywords**:** carpal tunnel syndrome, cross sectional area, elastosonography, strain ratio, quickDASH

INTRODUCTION

Carpal tunnel syndrome (CTS) is among the most common disorders of the upper extremity. One of the recent studies show that it affects around 8% active workers with higher rates in females and older age people [1]. Main symptoms of CTS are numbness, tingling, weakness and pain that in severe cases can cause disability of the arm and interfere with person's daily living activities and result in decreased quality of life.
At the moment electrodiagnostic testing (EDX) is often identified as a gold standard for CTS diagnosis [2] together with clinical symptoms and is widely used if surgical treatment is planned. EDX confirms a clinical diagnosis of CTS with a high degree of sensitivity (56% to 85%) and specificity (at least 94%) [3]. Another useful technique in examining CTS is ultrasound. Enlargement of the median nerve (MN) at the distal wrist crease is sensitive (65% to 97%) and specific (73% to 98%) [4], however pathological size of the cross sectional area (CSA) is still debated. Combining measurements of strain elastography

and CSA of the MN may improve diagnostic accuracy [5]. Novel ultrasonography techniques such as shear wave elastography shows promising results in CTS diagnostics with high sensitivity and specificity as well (93%, 89% respectively) [6]. Elastography may be usefull not only for establishing the diagnosis, it also allows to evaluate severity of CTS [7].

These results shows that ultrasound may be a good alternative to EDX because it is less expensive, causes no pain and requires shorter waiting time for the patients to be examined. As about 60% of patients at diagnosis show objective clinical deficit and 80% slowing of distal motor latency of the MN [8], more easily available ultrasonographic testing may shorten the waiting time and help to diagnose CTS earlier.

The goal of this study is to compare the CSA, wrist-to-forearm ratio (WFR) and the elasticity of the MN between patients with CTS and healthy subjects and to evaluate diagnostic usefulness of these measurements in diagnosis of CTS.

MATERIALS AND METHOD

Study protocol was approved by local institutional ethics committee. Written informed consent was obtained from all participants.

Population and procedure

Between December 2015 and March 2016 we examined 26 subjects (27 wrists with CTS and 25 healthy hands). As one participant had one hand with CTS and the other without, he was assigned to both control and patients groups. Table 1 shows the main characteristics of patient and control group included in this study. All patients were symptomatic and had electrodiagnostically proven CTS. Subjects meeting electrophysiological criteria for polyneuropathy were excluded. Other exclusion criteria for both groups were prior wrist trauma, operation, diabetes mellitus and rheumatic diseases.

Table 1. Demographic data of healthy volunteers and patients with CTS

Characteristic	Control group (n=13)	CTS group (n=14)	P Value
Sex (n)[1]			0.385
Female	9 (69.2)	12 (85.7)	
Male	4 (30.8)	2 (14.3)	
Age (y)[2]	59.2 9.7	57.7 9.8	0.867
Height (cm)	166.9 7.1	162.4 8.1	0.128
Weight (kg)	75.2 13.8	78.3 20.5	0.720
BMI[3]	27.1 5.2	29.6 6.8	0.449

1Data are numbers of patients or volunteers with percentages.
2 Data are means ± standard deviations.
3 Body mass index (kg/m2).

ULTRASONOGRAPHIC MEASUREMENTS ACQUISITION

Experiment was conducted by two observers. First observer was a radiologist with 30 years of experience and the second was a medical resident with 1 year of experience. Both were blinded to the diagnosis of CTS and measurements of each other.

All subjects were comfortably seated and asked to rest their arm on the table with elbow flexed 90° and fingers kept relaxed. A slight flexion of the wrist was maintained during the measurement. First, CSA of the MN was measured at the distal wrist crease (CSA-D) which corresponds to the proximal inlet of the carpal tunnel at the scaphoid-pisiform level. Next, it was measured in the forearm by tracing the MN 12 cm proximally (CSA-P). While scanning in the transverse plane, using conventional B-mode ultrasonography, the hyperechoic boundary of the nerve was traced by a continuous line and the CSA was acquired.

Representative ultrasonographic image is shown in Figure 1. WFR was calculated dividing the CSA-D by CSA-P value. All ultrasound images were acquired using Phillips EPIQ 7 ultrasound system and L12-5 linear array transducer.
Elasticity of the MN was measured using strain elastography. Measurements were taken at the distal wrist crease. Low-frequency compression of the tissues was applied manually by the hand-held ultrasound transducer. Ellipse located on CSA of the MN was used as a region of interest (ROI), the adjacent tissue to the right of the MN at the same depth was used as the reference. Representative ultrasonographic image is shown in Figure 2. Relative strain was measured and strain ratio was calculated using Philips QLAB software's Q-App Elastography Quantification (EQ) application, which compares the strain values between two user-defined areas of tissue in the elastrogram. Because manual compression was used and some differences in tissue displacement depending on different levels of pressure may occur, the strain ratio was measured three times and mean value was used for data analysis and comparison, with higher strain ratio number meaning higher stiffness.

ULTRASONOGRAPHIC DIAGNOSTIC ALGORITHM

As ultrasonographic screening is potential time and health care costs saving method, we decided

Figure 1. Transverse image. CSA-D measurement using continuous trace.

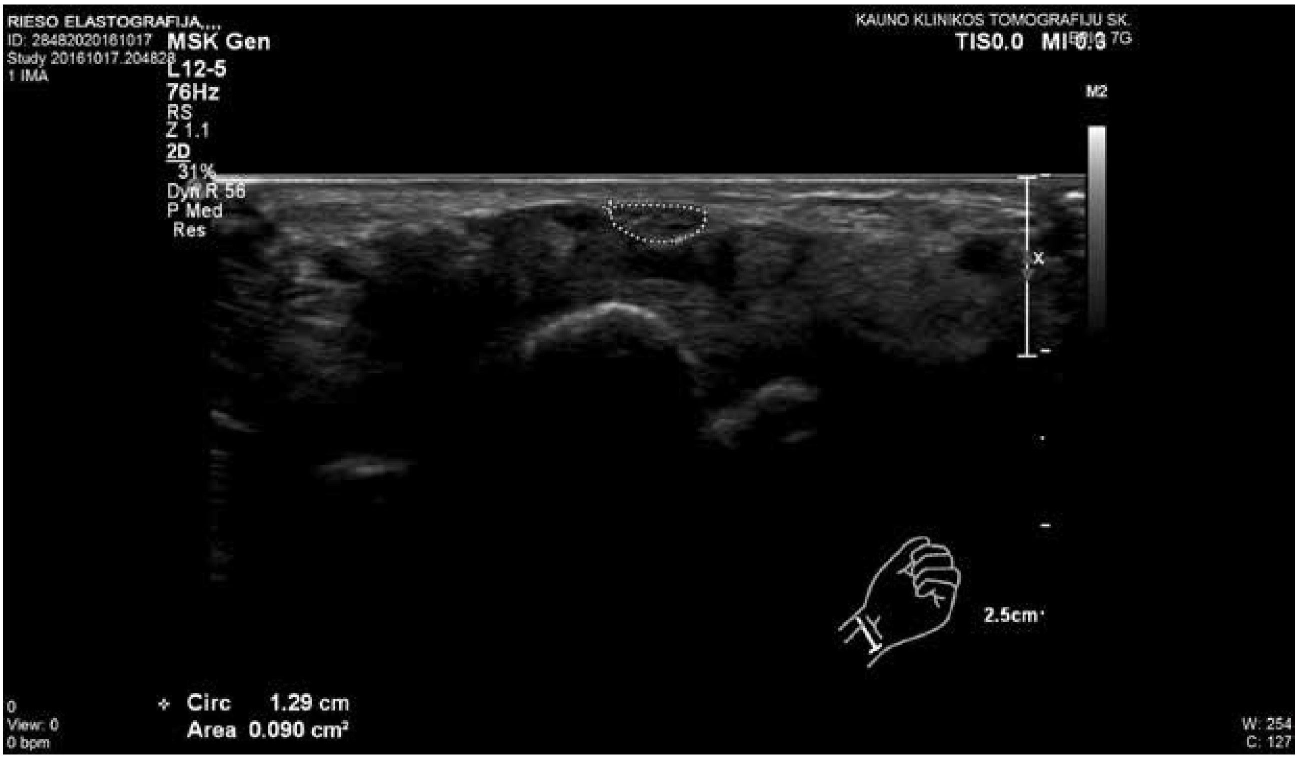
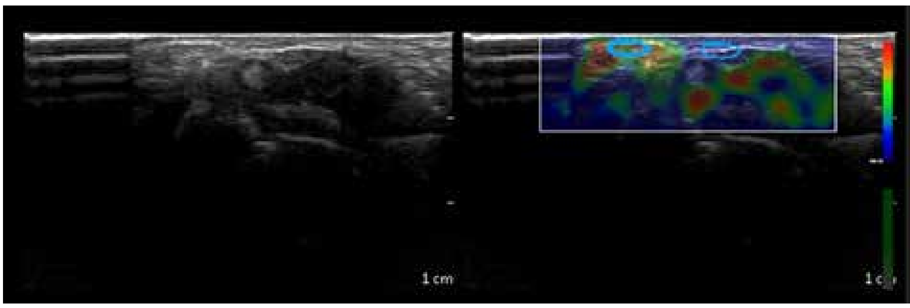


Figure 2. Transverse image. Strain ratio measurement.



to test one of the recently proposed ultrasonographic diagnostic algorithms for CTS (Goldberg G, 2016). It was based on analytic literature review and suggests that patients who present with typical or atypical symptoms without clinical signs of motor axon deficiency should be first examined by ultrasound and if their CSA is larger or equal 9 mm^2 and/or WRF is higher or equal than 1.4 should be tested eletrodiagnostically. The goal of the test is to assess potential of the algorithm in clinical practice by evaluating its sensitivity and specificity.

ULTRASOUND AND EDX RELATIONS WITH DISABILITY OF THE ARM IN CTS GROUP

Each CTS patient was asked to fill QuickDASH, one of a hand-specific questionnaires that may help to determine functionality in patients with CTS. We decided to use validated lithuanian version of QuickDASH questionnaire because its results well correlates with Boston Carpal Tunnel Questionnaire which is most widely used for evaluating CTS severity [9]. QuickDASH questionnaire was used in order to compare ultrasonographic and EDX results with the disability of the arm in CTS group.

STATISTICAL ANALYSIS

All data analysis was performed using SPSS Statistics Version 23 (IBM). First of all, the ultrasonographic measurements were compared between groups to check the hypothesis that strain ratio of the MN, WFR and CSA-D are significantly higher in patient group than in control group. Independent samples Mann-Whitney U test was used for this. As majority of the patient group had mild CTS, it was not possible to compare ultrasonographic measurements between different degrees of CTS. To evaluate the relation between EDX and ultrasonographic measurements in patient group Spearman's rank order correlation was used. MN conduction velocity (MNCV) from wrist to second digit (as it is one of the first indicators of CTS), CSA-D, WFR and strain ratio index were compared. To test how well would MNCV and ultrasound measurements predict diagnosis on their own, without the use of algorithm, logistic regression was used. Algorithm was tested by counting true positives and negatives, false positives and negatives and calculating specificity and sensitivity. Results between examiners were compared using related samples Wilcoxon signed rank test.

RESULTS

According to radiologist, patient group had statistically higher CSA-D with the mean of 9.8 mm^2 versus control group 8.4 mm^2 ($p=0.016$). WFR was statistically higher in patient group as well with the mean of 3.3 versus control group 1.6 ($p=0.047$). There was no significant difference in elasticity of the MN in our sample, with mean strain ratio 1.6 in patient group and 1.4 in control group ($p=0.109$). We found no correlation between MNCV and ultrasonographic measurements ($p>0.05$).

There was no statistically significant difference between experienced radiologist's and resident's CSD-D ($p=0.935$), but there was statistically significant difference between doctor's and resident's CSA-P measurements ($p=0.045$), followed by statistically significant difference between WFR ($p=0.03$). There was no statistically significant difference between strain ratio measured by the doctor and by the resident ($p=0.437$).

A logistic regression analysis was conducted to predict diagnosis of CTS using only CSA-D and WFR measurements. A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between patient and control groups (chi square = 11.588, $p<0.003$ with df= 2). Nagelkerke's R^2 of 0.266 indicated a weak relationship between prediction and grouping. Prediction success overall was 67.3% (72% for control group and 63% for CTS group) compared to constant only model's 51.9%. Adding strain ratio to the model didn't make a significant improvement in prediction making overall prediction success just a little higher 69.2% (76% for control group and 63% for CTS group, chi square = 11.643, $p<0.009$ with df = 3, Nagelkerke's $R^2 = 0.268$).

According to radiologist, in patient group there were 22 hands whom would be correctly send to the EDX using proposed algorithm (indications for EDX is CSA-D ≥ 9 mm^2 and WFR ≥ 1.4 mm^2), and 5 hands would have been falsely declared as healthy. That gave the algorithm specificity of 81.5%. In control group there were 19 false positive hands and 6 true negative hands, which gave the algorithm sensitivity of 24%. Resident doctor also showed similar specificity (100%) and sensitivity (40%) as a radiologist.

QuickDASH results varied from 13.6 to 65.9, the higher result meaning the greater disability. In CTS group disability of the arm was significantly higher in subjects with slower nerve conduction velocity. However, CSA-D, WFR and nerve stiffness were not significantly higher in people with greater disability of the arm.

DISCUSSION

In our study we got similar results when comparing CSA and WFR between patient and control group like other studies [6,14-16] as there was a statistical difference between the groups, despite higher CSA values in our control group when compared to other studies 6.3-7.9 mm^2 [6,14].

Table 2. Mean CSA-D, CSA-P, WFR and elastographic values for patients and control group by both examiners

Diagnostic Test	Radiologist		P Value	Resident		P Value
	Control group (n=13)	CTS group (n=14)		Control group (n=13)	CTS group (n=14)	
CSA-D	8.4 ± 2.2	9.8 ± 2.1	0.016	8.1 ± 1.7	11.0 ± 3.5	0.001
CSA-P	5.3 ± 1.8	4.6 ± 2.0	0.608	5.0 ± 1.0	4.1 ± 2.6	0.016
WFR	1.6 ± 0.4	3.3 ± 3.7	0.047	1.7 ± 0.7	3.7 ± 2.8	0.000
Strain ratio	1.4 ± 0.6	1.6 ± 0.6	0.109	1.5 ± 0.6	3.3 ± 0.4	0.410

Previous studies have shown that stiffness of the MN in CTS patients is significantly higher than in healthy subjects [5,12,13]. However, we didn‘t find difference in nerve stiffness between the groups. It could be due to different methods applied by other authors in measuring elasticity of the MN, for example, using acoustic coupler with a standardized elasticity. The fact that most of our CTS cases have mild CTS also could have influenced the results. However, one of the recent studies that used similar technique as ours shows that strain elastography do not exclude patients with mild CTS [10]. Also, anthropometric factors such as body mass index may affect the results [11].

Findings about ability of ultrasound to distinguish between different degrees of CTS are controversial. According to some authors, ultrasound should be able to distinguish between different degrees of CTS [7], some concludes that it cannot categorize disease severity [10]. Limited number of studies using same methods exists, so it is not yet possible to evaluate true diagnostic value of strain ratio elastography.

We found no relations between sensory MN conduction velocity and ultrasound measurements despite other authors findings [17,18,19]. Disability of the arm is related to nerve conduction changes but not with ultrasonographic measurements. Other studies had similar results [20,21]. It appears that changes in nerve physiology have more effect on function than changes in anatomy which is represented in these findings.

When testing the ability of CTS diagnosis prediction, we found that in our model CSA and WFR of the MN had a poor value of prediction. And we didn‘t achieve good results with elasticity of the MN too, in our sample there was no correlation between elasticity and CTS as reported by other authors [5,6]. We found that the proposed algorithm for diagnosing CTS lacked sensitivity. These results fall behind greatly when compared to sensitivity of clinical provocative tests such as Phalen's test (57%-91%) [22] and conventional EDX (56% to 85%) [3]. Though some other studies found that ultrasound measurements had a good sensitivity [6] it seems that EDX would still be a first choice for diagnosing CTS as it has a potential to diagnose between diseases that could imitate CTS.

Ultrasound still holds its potential as easy to master technique when compared to EDX. Resident doctor in our study performed similarly to experienced radiologist. This could aid greatly in the accessibility for diagnosing CTS. This and other advantages like relatively low cost of examination, provision of anatomic images of the MN and surrounding structures, makes ultrasound a valuable technique, but further improvements of the method are needed, as at the moment ultrasonographic algorithm lacks sensitivity for a screening test. Further studies are needed for the development of better diagnostic tools combining various diagnostic modalities.

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DIAGNOSTIC VALUE OF GRAY-SCALE ULTRASONOGRAPHY AND COLOR DOPPLER FLOW FOR THE DETECTION OF AXILLARY LYMPH NODE METASTASES IN BREAST CANCER PATIENTS

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ABSTRACT

Purpose: The aim of our study was to evaluate the diagnostic value of gray-scale ultrasonography and color Doppler flow for the detection of axillary lymph node metastases in breast cancer patients.
Materials and methods: This prospective study included 98 women (39 healthy women and 59 with approved diagnosis of breast cancer). All women underwent examination of gray-scale ultrasonography and color Doppler flow. Morphological lymph node findings, intranodal flow distribution and quantitative blood flow parameters were documented and analyzed. Patients were arranged by ultrasound examination findings in to two groups. First group (experimental (n=29)) – women, who was noticed with abnormal axillary lymph nodes during the ultrasound examination. Second group (control (n=69)) – women, who had normal axillary lymph nodes during the ultrasound examination. Healthy women were repeatedly examined after 3 and 6 months. Women who were diagnosed with breast cancer underwent sentinel lymph node biopsy, ultrasound examination findings were compared with histological sample findings. Metastases in the axillary lymph nodes were diagnosed for 22 patients. The accuracy, sensitivity and specificity of ultrasound analysis were calculated.
Results: Cortical thickening was found in malignant lymph nodes – 4,3mm, in benign lymph nodes – 2,2mm ($p<0,001$). Benign lymph nodes had significantly greater central flow, while malignant lymph nodes had peripheral flow ($p<0,05$). Kinetic findings: benign axillary lymph nodes RI=0,59±0,2, PI=3,06±2,4, DSG=5,34±2,1, MDG=2,53±1,6; malignant lymph nodes RI=0,78±0,2, PI=7,91±4,2, DSG=5,89±1,5, MDG=2,24±1,4, but there was no significant meaning ($p>0,05$). Evaluating just morphological findings, ultrasound analysis' accuracy is 81,4%, sensitivity 90,9%, specificity 75,7%, but combined together with kinetic findings accuracy 88,1-89,8%, sensitivity 95,8-96%, specificity 82,9-85,3%.
Conclusion: Cortex thickness and peripheral flow was statistically significant findings in diagnosing metastasis in axillary lymph nodes. Malignant lymph nodes RI and PI usually have greater value than benign lymph nodes, but there was no significant meaning, therefore we cannot depend only on kinetic findings of a lymph node blood flow. Examining kinetic and morphological lymph node findings together gives us 7% more accurate ultrasound analysis.

Keywords: doppler ultrasonography (DUS), malignant axillary lymph nodes, peak systolic velocity (DSG), pulsatility index (PI), resistive index (RI).

INTRODUCTION

Ultrasound imaging (UI) is one of the most commonly used methods to assess the state of armpit (A) lymph nodes (LM) for women with the breast cancer (BC) (1). Precision of UI upon locating metastasis of the breast cancer in armpit lymph nodes is varies in different studies and depends of the experience of the specialist, size of metastasis and the histological type of the breast cancer (2). State of armpit lymph nodes and the amount of affected lymph nodes in the armpit is the irreplaceable factor, especially important for the planning of systemic chemotherapy as well as surgeries (3). Upon locating typical pathologic armpit lymph nodes (shape changes, absence of hilus, peripheral blood flow), neoadjuvant chemotherapy is recommended for the patient; in case of non-affected structure (oval shape, thin even cortical thickness, hyperechogenic hilus, hilar blood flow) or suspicious lymph nodes (uneven increased cortical thickness, dislocated hilus, mixed or peripheral blood flow) – surgery with sentinel lymph node biopsy. Removal of a large group of regional lymph nodes has a negative effect on the life quality of patients (lymphedema 15-40 percent, paraesthesia, lower amplitude of the hand movement) (3). More than in 60 percent of primary cases of the breast cancer, lymph nodes are unaffected. Such patients do not need the biopsy of the sentinel lymph node; therefore efforts are put to improve possibilities on non-invasive analysis upon identifying metastasis in armpit lymph nodes for the healthy tissues to remain unaffected (4). A healthy lymph node has oval shape, thin even hypoechogenic cortical thickness and hyperechogenic hilus due to walls of the connective tissue, trabeculae of lymphatic tissue and medullar sinuses. Cancerous cells reach the lymph node via lymphatic vessels and accumulate in periphery of the lymph node – it affects the increases cortical thickness and a rounded shape of the lymph node (5). In the majority of analysis the cortical thickness is considered to be increased when exceeds 3 mm; in some studies cytological or histological analysis is recommended with the cortical thickness >2,5 mm (6). In our survey the cortical thickness is considered as being increased after reaching 3 mm. The rounding shape of the lymph node is indicated by the proportion between diameters of long and short axes: in healthy lymph nodes it should be >2, in those affected by metastasis <2 (7, 8). Architecture and hemodynamics of blood vessels changes in lymph nodes affected by metastasis (9). The majority of studies analyse morphologic features of lymph nodes. Aim of our survey is to assess not only morphological, but also kinetic parameters of lymph nodes (type of the blood flow, resistance index (RI) and pulsatility index (PI), the maximum value of the systolic speed and the minimal value of diastolic speed upon predicting possible metastasis in lymph nodes.

AIM OF THE WORK

To define morphological features of healthy lymph nodes and lymph nodes, affected by metastasis as well as to compare the kinetic parameters of the blood flow. To assess statistical indicators of the ultrasound imaging.

MATERIAL AND METHODS OF THE SURVEY

Since 1 September 2015 to 1 September 2016 the prospective case – control survey was implemented in the diagnostic cabinet for breast diseases at the Radiology Clinics in Kaunas Clinics at the University Hospital of the Lithuanian Health Sciences. 98 women were included into the survey, 39 of them – healthy and 59 – with the confirmed diagnosis of the breast cancer. Criterions: 1) armpit lymph nodes were identified as without changes during the ultrasound imaging (even, ordinary cortical thickness and adipose hilus) with hilum or mixed-type blood flow registered; 2) affected/ suspicious armpit lymph nodes found during the ultrasound imaging (uneven, thickened cortical thickness, dislocated hilus) with hilum or mixed-type blood flow registered. The survey didn't include patients with typical pathological armpit lymph nodes (round shape, absence of hilus) and those women with no lymph node blood-flow registered during the ultrasound imaging.

Ultrasound imaging was done with Acuson S2000, Siemens equipment, with a linear sensor and frequency of 14,5 MHz. Two-dimensional B regime was used for the assessment and analysis of the number of lymph nodes as well as morphological features (size, shape, state of hilus, cortical thickness). Type of the blood flow (hilus of mixed-type) was assessed in the colour Doppler regime with a low-speed parameters (4,4 cm/s) as well as quantitative blood-flow parameters (resistance index (RI) and pulsatility index (PI) the maximum value of the systolic speed and the minimal value of diastolic speed). Under the data of the ultrasound imaging, patients were divided into two groups. The first group (exploratory (n=29)) – women with affected lymph nodes, identified during the ultrasound imaging. The second group – control group (n=69) – women with unaffected lymph nodes, identified during the ultrasound imaging. Healthy women were repeatedly examined after 3 and 6 months. Women with diagnosis of the breast cancer underwent the biopsy of sentinel lymph node and data from the ultrasound imaging was compared to results of the histological analysis. Metastases in lymph nodes were confirmed for 22 patients. The sensitivity and specificity of the ultrasound imaging were calculated.

Permission of bioethics for the survey implementation: No. BEC-MF-408.

STATISTICAL ANALYSIS

Statistical survey data analysis was done by aids of SPSS 17.0 and Excel 2010. Distribution of analysed features within the scope was assessed by the descriptive data statistics – absolute (n) and percentage frequencies (percent). Quantitative data is presented as arithmetic average (m) with a standard deviation (sn). Comparison of quantitative variables of two independent scopes, the distribution of which supports the principle of normality, average values were compared on Student's T-test; comparison of quantitative variables of two independent scopes, the distribution of which does not support the principle of normality, average values were compared on Mann-Whitney U-test. New tables of interrelating characteristics were composed for the assessment of links between features; dependence was identified on the criterion of chi-square ($\chi 2$). When data is described in the four-field (2x2) frequency table and when at least one expected number of observations is less than 5, the precise Fisher's criterion is calculated. When the significance level $p \leq 0,05$, the difference between features in groups of respondents was considered as statistically significant.

RESULTS

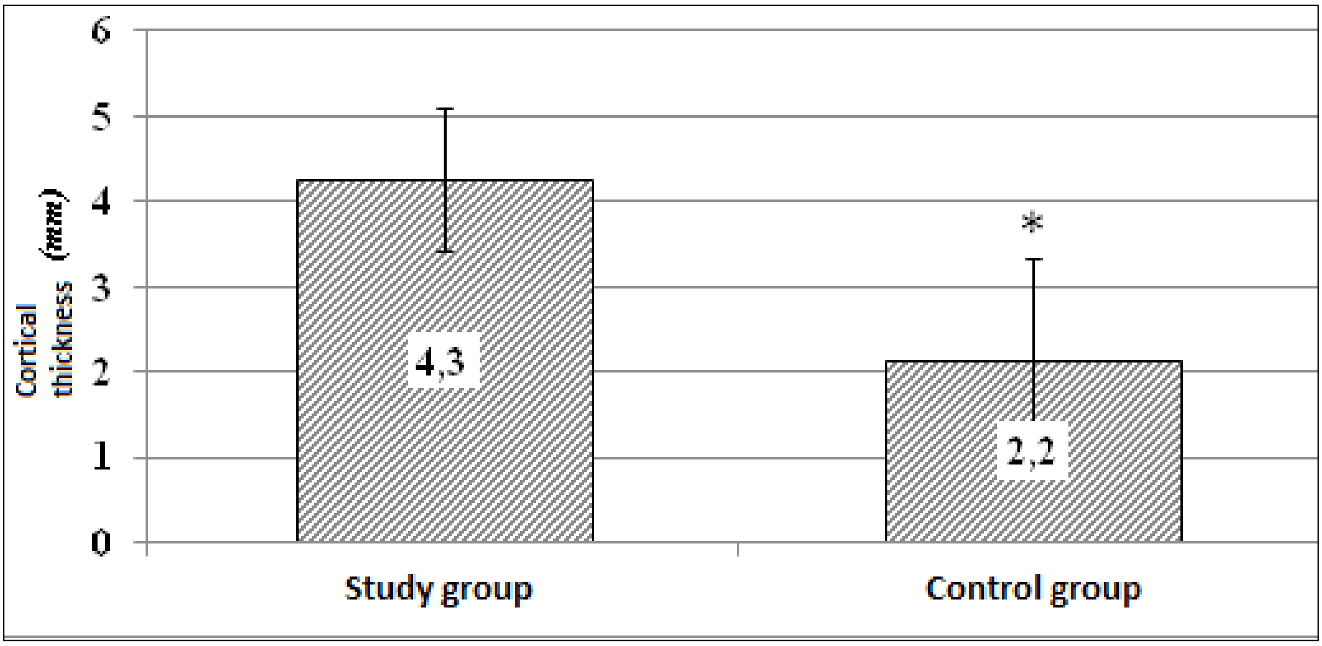
Age average of the women-respondents – 60,7 ($p>0,05$). Age of respondents in the exploratory group was not statistically significantly different from the age of women in the control group. Types of the breast cancer were identified: invasive ductal carcinoma – 25 cases (40,7 percent), invasive lobular carcinoma – 27 cases (44,1 percent), mucinous adenocarcinoma 6 cases (10,2 percent), intracystic carcinoma – 1 case (1,7 percent). The degree of differentiation of the tumour (G1, G2, G3) was analysed as well as the imunomarker expression (estrogen (ER), progesterone (PR) receptors, human epidermal growth factor receptor (HER2)), spread in blood vascular and lymphovascular (LV1) system. Tendency was observed that tumours with a more aggressive form G2, G3 and HER2+ tend to metastases to regional lymph nodes, but his data was not statistically significant. Patients with metastases in lymph nodes were identified with spread by blood vascular and lymphovascular systems.

Cortical thickness of lymph nodes, affected by metastases was higher – 4,3 mm, while in health lymph nodes – 2,2 mm ($p<0,001$) (Picture 1). Proportion between diameters of long and short axes in healthy and affected lymph nodes was similar (>2). Statistically significant difference was defined that the hilar blood flow was more often observed in healthy armpit lymph nodes, while in affected lymph nodes – mixed (Picture 2).

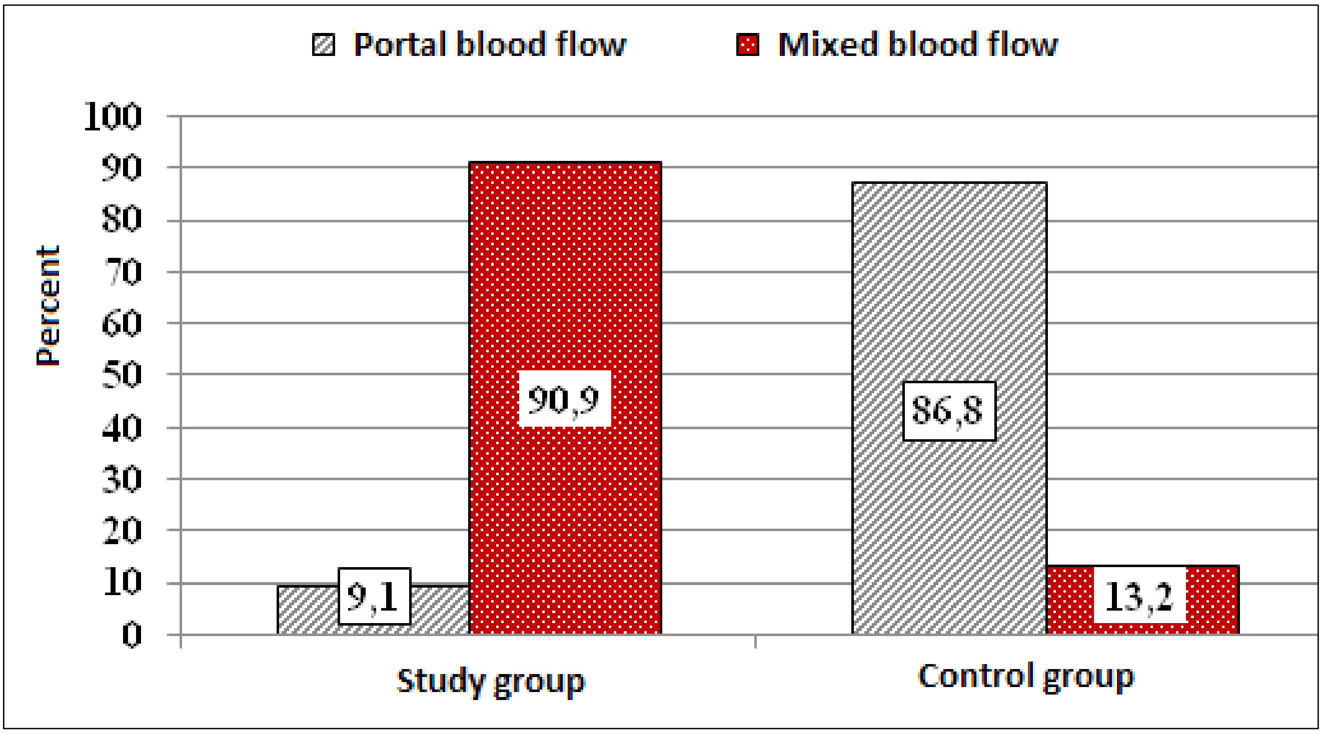
Kinetic features: in healthy armpit lymph nodes RI=0,59±0,2, PI=3,06±2,4, MSS=5,34±2,1, MDS=2,53±1,6; in lymph nodes affected by metastases RI=0,78±0,2, PI=7,91±4,2, MSS=5,89±1,5, MDS=2,24±1,4. It was defined that MSS in the exploratory group is statistically significantly higher ($p<0,05$) than in the control group (Picture 3). PI and RI in lymph nodes affected by metastases are also higher than in healthy lymph nodes, but this data was not statistically significant.

According to our data, the UI accuracy is 81,4 percent, sensitivity – 90,9 percent, specificity – 75,7 percent and if kinetic features are assessed together, accuracy – 88,1-89,8 percent, sensitivity – 95,8-96 percent, specificity – 82,9-85,3 percent. When assessing the state of the armpit lymph nodes for women with breast cancer, it is important to evaluate not only morphological, but also

1 Picture. Mean cortical thickness (*- p<0,001).

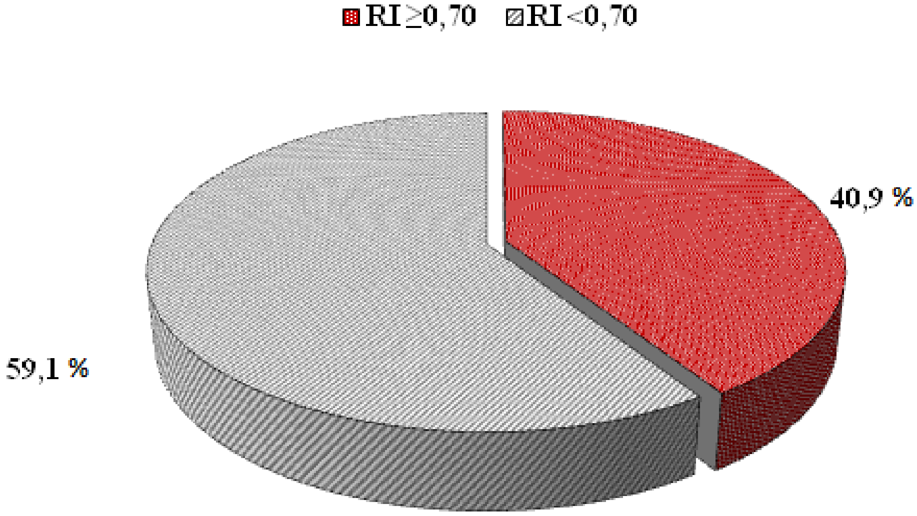


2 Picture. Circulation type (χ^2=48,56; p=0,001).

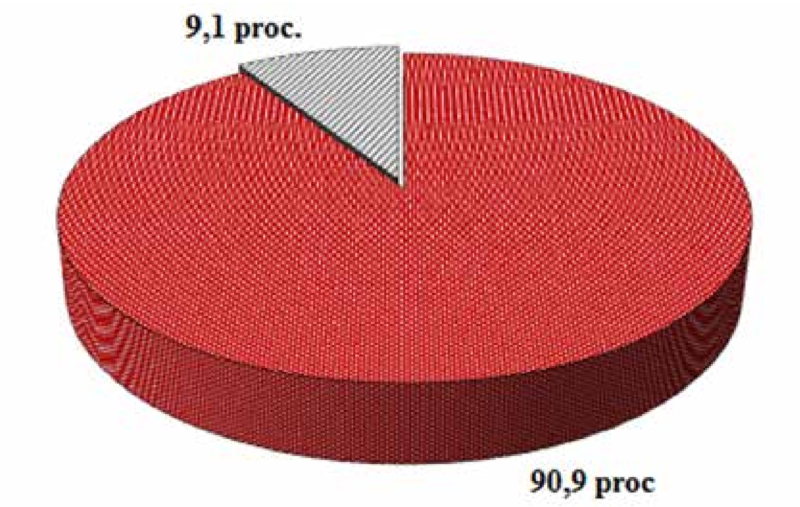


3 Picture. (a,b,c) Flow velocity of metastatic lymph nodes.

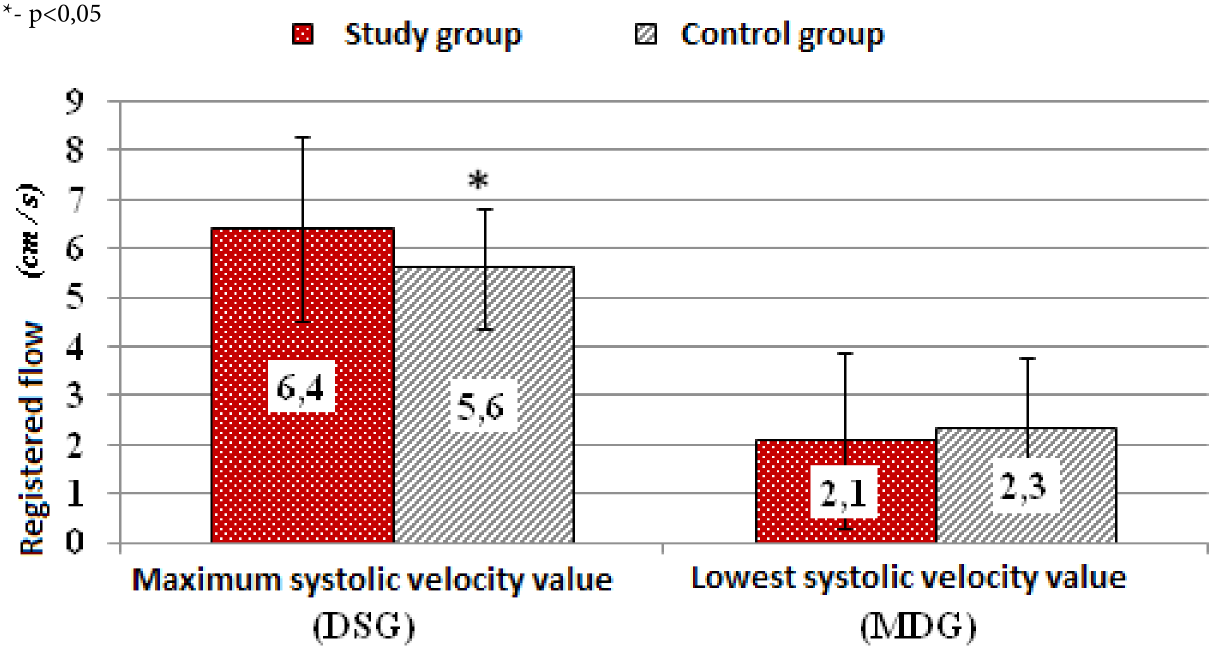
a)



b)



c) *- p<0,05



kinetic features of the lymph node, because in such case the UI accuracy increases.

DISCUSSION OF RESULTS

State of armpit lymph nodes and the amount of affected lymph nodes in the armpit is the unchangeable prognostic factor for women with breast cancer.

In over 60 percent of all primary cases of the breast cancer the armpit lymph nodes are unaffected. It is strived to improve possibilities of non-invasive examination possibilities for identification of metastases in armpit lymph nodes for the healthy tissues to remain unaffected.

Tendency was observed in the exploratory group that tumours of the more aggressive form G2, G3 and HER2+ tend to metastases to regional lymph nodes, but this data was not statistically significant. Jalini study also defined that patients with healthy of affected lymph nodes identified during UI have different clinic-pathologic factors, therefore upon existence of these symptoms (LV1, G3) and healthy lymph nodes in UI , state of such women should be treated carefully and the possible repeated UI could be offered (10). For patients, with metastases in lymph nodes in 95,5 percent of cases the spread by blood vascular and lymphocascular systems was identified. Study of Nwaogu et al. indicate this feature as statistically significant ($p=0.0007$), therefore it is recommended to assess the state of patients with this symptom with more attention in order to avoid falsely negative results (11).

In the majority of studies (12-14) the cortical thickness in lymph nodes affected by metastases was >3 mm. On the base of our data, the cortical thickness is also a statistically significant feature upon defining metastases in armpit lymph nodes. It was increased – 4,3 mm in the affected lymph nodes and it was 2,2 in healthy lymph nodes ($p<0,001$).

Several studies analysed the proportion between diameters of long and short axes as it may indicate the round form of the lymph node (in healthy lymph nodes it should be >2, in those affected by metastasis <2 (7, 8). In our survey this proportion was not different (>2), maybe because patients whose lymph nodes seemed healthy or suspicious (with increased cortical thickness) during UI were included into the survey.

Statistically significant difference was defined when the hilar blood flow was observed in healthy armpit lymph nodes while in those affected by metastases – mixed blood flow. Jabbar and Das studies also indicate this feature as statistically significant (12, 15).

One of the essential tasks of our survey was to assess kinetic data of blood flow in the lymph node: resistance index (RI) and pulsatility index (PI), the maximum value of the systolic speed (MSS) and the minimal value of diastolic speed (MDS). Data in literature upon assessment of these features is rather controversial. In several studies where the neck lymph nodes were assessed, kinetic features were identified as being important upon differentiating lymph nodes affected my metastases from the reactive ones (16-19). However, Das survey, when assessing morphological features of lymph nodes together with kinetic blood flow data, indicated the reduced statistical indicators (15). On the base of the literature data, theoretical hypothesis was prepared that RI in lymph nodes affected by metastases should be >= 0,70, PI> 1,8, while in healthy armpit lymph nodes RI <= 0,65, PI <1,0. Results were obtained that in healthy lymph nodes I=0,59±0,2, PI=3,06±2,4, MSS=5,34±2,1, MDS=2,53±1,6, in those affected by metastases - RI=0,78±0,2, PI=7,91±4,2, MSS=5,89±1,5, MDS=2,24±1,4. It was defined that MSS in the exploratory group is statistically significantly higher ($p<0,05$) than in the control group. Even though there is no statistically significant difference, RI and PI in lymph nodes affected by metastases tend to be higher than in healthy lymph nodes.

Statistical data from UI analysis in different studies was different (accuracy 63-90 percent, sensitivity – 53-100 percent, specificity – 65-100 percent) (8,12,14,15,20). According to our data, upon assessment of morphological features only, UI analysis' accuracy was 81,4 percent, sensitivity

1 Table. Statistical summary.

	Sensitivity (%)	Specificity (%)	TNV (%)	NNV (%)	Accuracy (%)
H.Abe, 2013 B(2)	56,28	80,83	61,88	76,98	72,09
S.E.Song, 2012 B(2)	82,3	89,1	80,0	86,6	-
B.Lee, 2013 B(2)	53,7	85,1	81,o	60,0	67,9
J.A.Jabbar, 2012 B(2)	95,0	95,0	95,0	5,0	-
Komb. su dopl.	100,0	100,0	100,0	0,0	-
A.Das, 2012 B(2)	87,0	89,0	82,0	92,0	88,0
Komb. su dopl	59,0	65,0	50,0	73,0	63,0
Our data, 2016 B(2)	90,9	75,7	69,0	93,3	81,4
Combination with doppler. (RI)	95,8	82,9	79,3	96,7	88,1
Combination with doppler. (PI)	96,0	85,3	82,8	96,7	89,8

– 90,9 percent, specificity – 75,7 percent. While if kinetic features are analyses together, the accuracy increases by 7 percent (Table 1).

CONCLUSIONS

Cortical thickness and the mixed-type blood flow are statistically significant features for identifying metastases in armpit lymph nodes.

RI and PI in lymph nodes affected by metastases tend to be higher than in healthy lymph nodes, however statistically significant difference was not found therefore only kinetic lymph node blood flow data cannot be trusted.

Upon assessment of morphological and kinetic lymph features of lymph nodes together, the UI accuracy increases ~7 percent.

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DIAGNOSTIC INSTRUMENTS FOR DEEP VEIN THROMBOSIS AFTER LAPAROSCOPIC FUNDOPLICATION

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ABSTRACT

Background. Deep vein thrombosis remains an important health care problem as it is related with the complications having high morbidity and mortality rate. It is considered the third most common acute cardiovascular disease after ischemic heart disease and stroke and effects millions of people worldwide. The aim of this study was to evaluate the rate of deep vein thrombosis (DVT) in patients undergoing laparoscopic fundoplication in two different prophylactic regimes and propose the best. To estimate the sensitivity and specificity of ultrasound (US) for the diagnosis of deep vein thrombosis (DVT) of proximal and distal leg veins.

Materials and methods. The study was performed on 121 patients who were randomized into two groups. All the patients received intermittent pneumatic compression during the laparoscopic fundoplications. The first group received low molecular weight heparin 12 h before the operation, 6 and 30 h after it. The second group received low molecular weight heparin only 1 h before the laparoscopic fundoplication. All the patients underwent color duplex scan examination preoperatively and spiral CT venography with US scan on the third postoperative day to determine the presence and location of deep vein thrombosis.

Results. CT venography revealed posterior tibial vein thrombosis in two (3.3%) I group patients. The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT - sensitivity and specificity 98%.

Conclusions. US is highly sensitive and specific noninvasive imaging option for evaluation of proximal DVT, and it is less accurate for the calf veins. The better anticoagulation effect was obtained when low molecular weight heparin was administered 1 hour before the laparoscopic fundoplication.

Keywords: venous thromboembolism, CT venography, sonography.

INTRODUCTION

Venous thromboembolism is important social and health care problem, because 20-30 % of patients develop deep vein thrombosis (DVT) after general surgical operations, while 5.5 % of patients have this complication when laparoscopic fundoplication are performed without appropriate prophylaxis [1,2]. The most frequent reason for pulmonary embolism are thrombi forming in the channels of proximal leg veins and deep pelvic veins. The development of deep venous thrombosis is related with stasis, hypercoagulation state and injury of the venous wall (Virchow‘s triad).

DVT usually starts in calf veins, but it may develop more proximally and cause life-dangerous pulmonary embolism. 80 - 90 % of pulmonary embolism masses are caused by DVT or a thrombus formed in the pelvis [3,2]. Laparoscopic surgery causes variable serum hypercoagulability; there are data suggesting that the patient dependent positioning in combination with intraoperative pneumoperitoneum decreases venous flow from the lower extremities and possibly increases the risk of DVT development [4,2].

The increased intra-abdominal pressure associated with pneumoperitoneum and reverse Trendelenburg position during laparoscopic fundoplication generates venous stasis in the lower limb by compressing the retroperitoneal vena cava and iliac veins, which is already present due to general anesthesia [5,2]. The combination of stasis, hypercoagulability, and injury of the venous wall allows thrombus to develop.

The intermittent pneumatic compression of the calf with an external pressure cuff for the prevention of DVT is a well-established prevention measure [6,7,8,9]. Methods that have used to prevent postoperative deep vein thrombosis during laparoscopic surgery include not only mechanical techniques, but also drug therapy (low-molecular-weight-heparin).

The prophylaxis and treatment of this disease is very important in the clinical practice, so, an early and exact diagnosis is relevant in order to evaluate the exact location and extent of DVT.

The classical symptoms in patients with acute leg DVT are pain or sensitivity, edema and swollen legs, but these symptoms are not specific and characteristic to this kind of pathology only.

The clinical signs and symptoms of pulmonary embolism also are not specific: dyspnea or tachypnea 70-80% (respiratory rate >20/min), hemoptysis 11%, pleuritic pain 50% (angina-like chest pain), tachycardia 25-30% (heart rate >100/min), cough 20-37% – nonproductive, and sometimes productive of clear, bloody or occasionally purulent sputum, rales 50% and deep venous thrombosis 15% [10]. In practice it is often difficult to detect DVT and acute pulmonary embolism PE because from one third to 2/3 patients do not have any symptoms of DVT at all according to the data of different literature.

AIM

he aim of this study was to evaluate the rate of DVT in patients undergoing laparoscopic fundoplication in two different prophylactic regimes and propose the best. To estimate the sensitivity and specificity of ultrasound (US) for the DVT of proximal and distal veins.

MATERIALS AND METHODS

This was a prospective randomized clinical study, where 121 patients undergoing elective laparoscopic fundoplication because of gastroesophageal reflux disease, caused by hiatal hernia, were studied. All the patients gave their written informed consent, and The Kaunas Regional Biomedical Research Ethics Committee approved the study (protocol no. BE-2-13). This randomized clinical study was also registered on the ISRCTN registry with trial ID ISRCTN62203940. All the patients were randomized into two groups. The first group of 59 patients received LMWH Bemiparinum (Zibor, Berlin Chemie, Luxembourg) 2500 IU 0.2 ml subcutaneously 12 h before the operation, 6 and 30 h after it. The second group of 62 patients received LMWH Bemiparinum 2500 TV 0.2 ml. subcutaneously 1 h before the operation. Both groups received intermittent pneumatic compression (IPC) during all laparoscopic fundoplication. The IPC was performed using "Kendall SCD™ 700 Series" apparatus. All the patients underwent color duplex scan examination preoperatively and spiral CT venography with color duplex scan on the third postoperative day in order to detect possible DVT. One experienced radiologist reported all these examinations. Images of each extremity were reviewed for the presence of acute DVT in the common femoral vein, superficial femoral vein, deep femoral vein, and popliteal vein, tibial anterior and posterior vein, peroneal vein. We aquired 5-mm-thick axial CT (TOSHIBA, AQUILION ONE TSX-301, slice 320) venograms from the ankle to the iliac wing after injection of 150 ml of 300 mg/ml contrast medium at a flow rate of 3 ml/sec through an antecubital vein on the third postoperative day. Optimal and homogeneous venous enhancement was obtained when scanning was started 180 sec after contrast medium injection.

Criteria for DVT diagnosis were: intraluminal filling defect, or localized nonopacification of venous segment.

Sensitivity and specificity values from ultrasound for femoropopliteal and infrapopliteal DVT evaluation, were calculated. CT venography was used as the gold standart of reference for diagnosis of deep vein thrombosis.

RESULTS

The patients in both groups were similar in terms of age, weight, height, gender, duration of surgery, and American Society of Anesthesiologists (ASA) class (Table). There was no massive or minor bleeding during all laparoscopic operations. No drains were left after the operation. All the patients left the hospital after an uneventful 3-5 days stay. CT venography revealed posterior tibial vein thrombosis in two (3.3%) patients of the Ist group on the third postoperative day [Figure]. The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT - sensitivity and specificity 98 %.

DISCUSSION

DVT is common disease and can result in fatal PE.

Conventional venography was the gold standard in deep vein thrombosis diagnosis and the only imaging test for a long time in order to specify the suspected deep vein thrombosis in legs, pelvis or inferior vena cava [11,12,13]. Contrast enhanced X-ray venography is particularly helpful for assessing recurrent acute deep vein thrombosis in patients with a prior history of deep vein thrombosis in whom venous anatomy is often complex and difficult to evaluate application of other methods [14,13] or when to remove an inferior vena cava filter.

Conventional venography is presently replaced with non-invasive or less invasive radiological examination methods: the first-choice method is ultrasound, but there are also other ones – computed tomography venography and magnetic resonance venography. Ultrasound is the imaging examination of choice for suspected lower extremity deep venous thrombosis.

US is widely recognized as the most cost-effective and preferred imaging modality for diagnosing proximal DVT [15,16,17, 18-23]. US is a non-invasive and easy-to-perform examination without the effect of ionizing radiation and contrast agent (for example, on the bedside, if necessary) and it can be repeated a few times.

Color Doppler ultrasonography (CDUS) has become the initial diagnostic tool due to its high sensitivity for the detection of DVT, and some authors now believe that CDUS should be considered as the gold standard for DVT diagnosis [18].

Doppler color-flow imaging can assist in characterizing a clot as obstructive or partially obstructive; the uneven color-flow can also help to locate the isoechogenic thrombus.

A recent meta-analysis found US to have high sensitivity (range, 93.2%–95.0%; pooled sensitivity, 94.2%) and high specificity (range, 93.1%–94.4%; pooled specificity, 93.8%) for diagnosing proximal DVT [12,13]. In the same study, US was found to have a much lower sensitivity (range, 59.8%–67.0%; pooled sensitivity, (63.5%) for diagnosing distal DVT [13]. Such variations suggest that the diagnostic performances of ultrasonography in distal DVT are poorer than for proximal clots. A meta-analysis by Kearon et al. suggested a sensitivity of 50–75% and an acceptable specificity (90 to 95%) [24]. The calf US examination is not routinely performed in many centers due to relatively low accuracy. However, if the patient indicates local pain in the calf, the examination of this region should be performed. The iliac and pelvis veins are not visible consistently with ultrasound mostly due to gas in the intestine.

CTV permits routine evaluation of deep veins of the calves, the iliac veins/IVC, and the deep femoral vein, none of which are routinely well evaluated with US [12,13].

Many studies found, that the amount of contrast agent used in CTV was lower by about 80% than in venography. Studies comparing the findings of CTV with tones of venography showed 100% sensitivity and 96-97% specificity.

CTV enables comprehensive evaluation of some regions in one examination – i.e., pulmonary CT angiography evaluating pulmonary embolism and evaluation of pelvic and deep leg veins.

Magnetic resonance imaging may also be a promising noninvasive tool in the diagnosis of DVT, but is expensive, has long examination times, and is often difficult in acutely ill patients [25].

CT venography has been compared with sonography for the diagnosis of femoropopliteal DVT in several studies [26-31]. The sensitivity and specificity values of CT venography in these studies ranged from 89 % to 100 % and 94% to 100% respectively [27-31]. Cham et al. [28] demonstrated that of the 116 patients, 15 had DVT that was found at both CTV and sonography, and 4 other patients had thrombus correctly identified in the CTV, that was initially missed by sonography. In Loud et al.'s [29] study of 308 of patients who had sonographic correlation, CT venography was 97% sensitive and 100% specific for DVT in the thighs, and 4 patients had initially negative results from sonography and positive findings from CT venography, but repeated sonography helped to confirm the presence of DVT. In Lim et al. study [32], the sensitivity and specificity of CT venography for femoropopliteal DVT, as compared with sonography, were both 100%.

Most studies only appeared to report proximal DVT. Only few studies reported results for distal DVT. Goodacre et al. performed a systematic review, meta-analysis and meta-regression of diagnostic cohort studies that compared US to contrast venography in patients with suspected DVT. Overall sensitivity for proximal DVT (95% confidence interval) was 94.2% (93.2 to 95.0), for distal DVT was 63.5% (59.8 to 67.0), and specificity was 93.8% (93.1 to 94.4). Duplex US had pooled sensitivity of 96.5% (95.1 to 97.6) for proximal DVT, 71.2% (64.6 to 77.2) for distal DVT and specificity of 94.0% (92.8 to 95.1). Compression US alone had pooled sensitivity of 93.8 % (92.0 to 95.3%) for proximal DVT, 56.8% (49.0 to 66.4) for distal DVT and specificity of 97.8% (97.0 to 98.4) [33].

The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT sensitivity and specificity were both 98%.

CONCLUSIONS

1. Our study demonstrated that hypercoagulation state (inferopopliteal DVT) was observed after laparoscopic fundoplication in patients, when low molecular weight heparin was administered 12 h before the operation together with intraoperative intermittent pneumatic compression.
2. Our recommendation is that LMWH, as DVT prophylactic measure, has to be administered 1h before laparoscopic operation to ensure the drug optimal effect.
3. Ultrasonography has become the first-line accepted imaging method in the diagnostic procedure for patients with clinically suspected DVT. US is highly sensitive and specific noninvasive imaging options for evaluating proximal DVT, and it is less accurate for the calf and pelvic veins, and in asymptomatic patients.
4. CT venography can be combined with CT

Table. Patients demographic characteristics

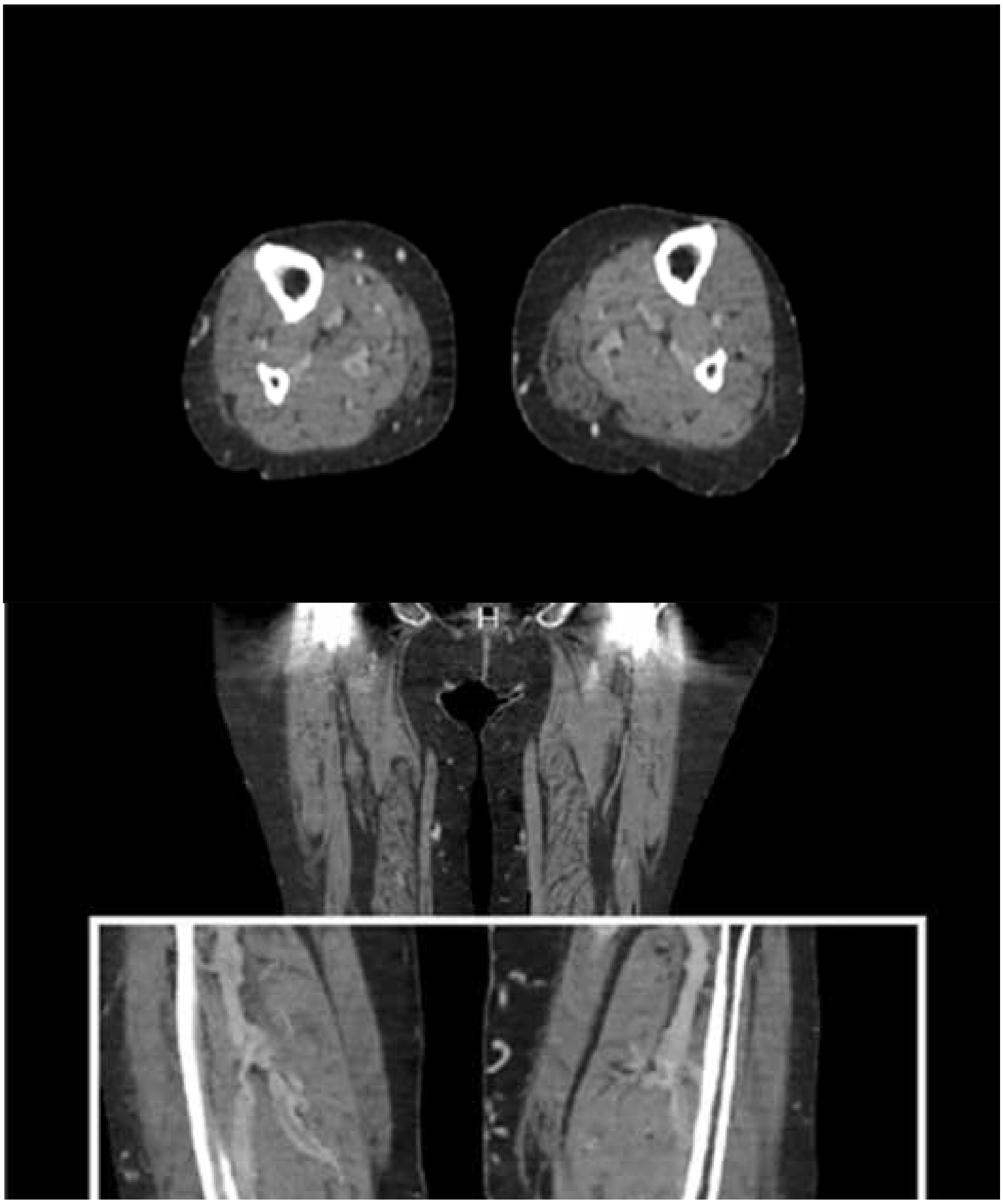
Value	I group (n=59)	II group (n=62)	p values
Age (years)	55.27 ±14.25	55.24±14.65	p=0.886
Male/female (n/n)	18/37	16/35	p=0.881
BMI	27.03 ±5.04	26.72±4.82	p=0.463
Duration of surgery (min)	136.73 ±45.16	129.71±36.84	p=0.638
ASA class			
I	7	6	p=0.921
II	29	30	p=0.921
III	18	15	p=0.921
IV	1	0	p=0.661
Postoperative stay (days)	3.98±0.913	4.04±0.979	p=0.835

Values are mean ±SD

pulmonary angiography and it is nowadays the imaging test of choice in patients with clinically suspected PE.

5. In clinical practice, CT venography for leg vein evaluation has to be compared with sonography.

Figure. Axial and coronal CT venogram: at the calf level - DVT in right tibial posterior vein.



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CT SCAN AFTER SUSPECTED INTRACRANIAL INJURIES: CORRELATION BETWEEN PERFORMANCE SPEED AND FINDINGS

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ABSTRACT:

Introduction: Computed tomography (CT) is the first-choice examination for a possible head trauma because of its accuracy, reliability, safety, and accessibility. During the acute period of trauma, early diagnostics and application of treatment manipulation can reduce the sickness rates and death rates of trauma patients, as well as the risk of complications, time spent in hospital, and the amount of funds spent on health care.
Methods: Patients selected for the study were aged over 18 and had CT scanning carried out in 2015 in LSMUL KK emergency department (ED) after suspecting intracranial injury (TLK–10–AM:S06). Patients who suffered penetrating trauma, had neuro deficit or skull bone fractures, were excluded from the study. The following data were collected: patient age, sex, times of arriving in the ED and of the CT performance, radiological findings present. The patients were divided into two groups: CT scanning performed in less than 1 hour or performed in over 1 hour.
Results: A total of 2,119 patients with suspected intracranial injury after head trauma underwent CT scanning. 31.4% patients were female, while 68.6% male. For 50.1% patients CT was preformed in less than 1 hour. 84.0% of all patients did not present any radiological alterations related with intracranial injuries. CT was performed in less than 1 hour in 69.6% of cases with diagnosed injuries caused by intracranial trauma, while in the remaining 30.4% of cases – CT was performed in more than 1 hour. A statistically significant difference was observed.
Conclusions: Intracranial injuries in males are suspected twice as often as in females. Most of the patients did not present any radiological alterations related with intracranial injuries. The most often-diagnosed intracranial alteration was subdural haemorrhage. CT was significantly more often performed within the first hour in those cases, where an intracranial injury was detected.

INTRODUCTION

In western countries, head trauma is one of the most frequent causes for contacting emergency department (ED). It is claimed that the rates of head trauma fluctuate between 100 and 300 for a hundred thousand citizens, while intracranial injuries comprise two thirds of all deaths by trauma [1]. The first choice in terms of tests, when
y demand prompt further treatment of the patient [1, 4]. In such case, it is important to carry out injury diagnostics as early as possible. During the acute period of trauma, early diagnostics and application of treatment manipulation can reduce the sickness rates and death rates of trauma patients, as well as the risk of complications, time spent in hospital, and the amount of funds spent on health care [5, 6]. Images of performed radiology tests may present brain and skull injuries, they may be used to evaluate the level of trauma, possibility for surgical treatment, especially when extensive neurological tests are not possible, and they provide information about prognostic factors that determine the aggressiveness of treatment [7, 8]. Alterations of microcirculation, impaired autonomy regulation, brain oedema and axon damage symptoms begin to emerge immediately after the trauma and take the form of a combination of biochemical, clinical and radiological alterations [9, 10]. CT images allow precise localisation of brain oedema and foreign bodies, as well as quick diagnosis of skull fractures, epidural and subdural hematoma, and haemorrhagic and non-haemorrhagic contusion [9, 10, 11]. Due to the wide use of CT, the amount of angiography, X-ray tests, and surgical interventions has decreased.

THE AIM OF THE STUDY

To evaluate the distribution of patients, who had CT carried out in 2015 in the Hospital of the Lithuanian University of Health Sciences (LSMUL), Kauno Klinikos (KK) ED, after suspected intracranial injury; to evaluate CT alterations present in patients, and the relationship with the speed with which the test was carried out.

METHODS

Patients selected for the study were aged over 18 and had CT scanning carried out in 2015 in LSMUL KK ED after suspecting intracranial injury (TLK–10–AM:S06). Patients who suffered penetrating trauma, had neuro deficit or skull bone fractures, were excluded from the study. Overall, the study included 2,119 patients. Using the sample size determination equation (Schwarze, 1993©), it was calculated that a minimum of 325 cases would reflect the whole group of subjects, given a 95% reliability and a 5% margin of error. By way of random selection, 368 patients were chosen and a retrospective analysis of their patient histories was carried out. Out of 368 patient histories, 19 were excluded due to flaws in the medical paperwork. The 349 remaining patient histories were studied. The following data were gathered: patient age, sex, times of arriving in the ED and of the CT scanning, radiological findings. The time between arriving in the ED and performing the CT was evaluated taking into account the algorithm for examining head trauma in grown-up individuals; in accordance with that, CT were classed as performed in less than 1 hour or performed in over 1 hour [2]. For the statistical analysis of the data, SPSS 23.0 software was used. To describe the quantitative characteristics, averages, frequency of features (%) and their 95% confidence intervals (CI) were used. $\chi 2$, Mann Whitney, and Stjudent T tests were applied. Data were considered statistically reliable when $p<0.05$.

RESULTS

Overall in 2015 the ED admitted 2,119 patients, for whom, after head trauma, an intracranial injury was suspected and a CT was carried out. 31.4% (95% CI: 29.4–33.4, N=665) of patients were female, other 68.6% (95% CI: 66.6–70.6, N=1,454) were male. It was observed that intracranial injuries were suspected in male patients twice as often as in females. Overall average patient age was 47.6 yrs. Average age of males was 45.1 yrs., females – 54.8 yrs. The peak of suspected intracranial injuries in male patients was between their 30s and 60s, while in female – between 40s and 90s (Table 1).

When evaluating the time when CT was performed counting from the moment of arrival in the ED, a near–equal distribution was observed among the subjects: for 50.1% out of the 349 patients analysed (95% CI: 44.9–55.4, N=175), the CT was preformed quicker than in 1 hour. For the remaining 49,9% (95% CI: 44.6–54.1, N=174), the CT performance took longer than 1 hour after arriving in the ED. After performing the CT, 84.0% of the patients did not present any radiological alterations related with intracranial injuries. Intracranial traumatic alterations were diagnosed in 56 patients. The most often-observed intracranial injury was subdural haemorrhage, diagnosed in 36 patients. 7 patients presented with subarachnoid haemorrhage, 5 – epidural haemorrhage, 4 – focal brain contusion, 2 – focal brain hematoma, 2 – brain oedema (Table 2). In cases with diagnosed injuries caused by intracranial trauma, the CT was performed less than in 1 hour for 69.6% of patients, and later than in 1 hour for the remaining 30.4% of patients; a statistically significant difference was observed. Without intracranial–trauma–related alterations observed radiologically, over half of the patients had the CT performed later than 1 hour period from arrival at the ED (Table 3). It was observed that CT was performed within the first hour significantly more often in those cases, where an intracranial injury was detected ($P<0.05$).

DISCUSSION

In Lithuania, same as in other countries in Europe and around the world, computed tomography remains the first–choice when diagnosing intracranial injuries. According to the data of our study, most LSMUL KK ED patients with head trauma and suspected intracranial injury, who had computer tomography performed, were male (68.6%). A similar trend in distribution between sexes was also observed when analysing a study carried out in hospitals of the Netherlands [13]. In our study, it was observed that intracranial injuries were suspected in male patients twice as often as in females. The same ratio between males and females was detected in the study carried out by Bordignon K et al. [14]. A different ratio between sexes was ascertained in the United States of America, where males experience head trauma three times as often as females [15]. For male patients tested at LSMUL KK ED, intracranial injuries were more often suspected between their 30s and 60s, while for females a similar distribution was observed between their 40s and 90s. A slightly different distribution according to age groups was detected in the study carried out by Bordignon K et al., where males usually experienced head trauma between their 20s and 40s, and females – between their 20s and 30s. In this study, the overall average age of the subjects was 47.6 yrs., average age of males – 45.1 yrs., average age of females – 54.8 yrs. A lower average age, 30.5 yrs., was detected in the study performed by Bordignon et al. [14]. In this study, the most often–observed intracranial injury was a subdural haemorrhage, diagnosed in 10.3% of subjects. In 2.0% of cases subarachnoid haemorrhage was detected, in 1.4% – epidural haemorrhage, in 1.1% – focal brain contusion, in 0.6% of cases – a focal brain hematoma and 0.6% with brain oedema. In the study mentioned above, with 2,000 patients tested, brain oedema was diagnosed in 1,95% cases, subarachnoid haemorrhage – 1,7%, subdural hematoma –1,65%, brain contusion – 1,15% and haemorrhagic contusion in 1,05% cases [14]. After reviewing the recommendations of the National Institute for Health and Care Excellence (NICE), Scandinavian guidelines for initial management of minimal, mild and moderate head injuries in adults, and Canadian CT Head Rule (CCHR) recommendations, common features can be distinguished, one of the most important of them being the Glasgow Coma Scale (GCS), which is used primarily to evaluate the state of patients in cases of head trauma [2, 4, 16]. This evaluation and present clinical symptoms (e.g. vomiting more than once, post-traumatic seizure, focal neurologic deficit) or other suspected serious pathology (e.g. skull base fractures), are factors that determine the promptness of performing the CT, as well as the further treatment of the patient in general. Most researchers, who have evaluated recourse after head trauma, also evaluate clinical symptoms and GCS in their studies. In our case we were aiming to evaluate the time when CT was carried out, measuring from the moment of arrival in the ED, and the correlation between this time period and the rate of intracranial injury detection, without evaluating the clinical state of the patient. According to study data, in cases where intracranial injury was detected, CT was significantly more often performed faster than in one hour, however, when considering the CT performance speed among all patients, an equal distribution is observed (49.9% and 50.1%). This means that for some patients, who were not diagnosed with any intracranial traumatic alterations, CT was also carried out faster than in one hour. Therefore, it is difficult to determine whether the presented clinical symptoms and GCS evaluation at the time had any influence on the speed of CT performance, but precisely the fact that we have not taken into account the prevailing symptoms, could be named as a shortcoming of our study.

CONCLUSIONS

Intracranial injuries in males are suspected twice as often as in females; a statistically significant difference is observed. Injuries in males are usually diagnosed in between their 30s and 60s, in females – between 40s and 90s.

An equal distribution was observed between patients for whom the CT was carried out either quicker or slower than in 1 hour from arriving in the ED (respectively 50.1% and 49.9%).

84,0% of the patients did not present any radi-

ological alterations related with intracranial injuries. The most often–diagnosed intracranial alteration was subdural haemorrhage.
CT was significantly more often performed within the first hour in those cases, where an intracranial injury was detected.

APPENDIX

Table 1. Prevalence of intracranial injuries in different age groups

Age (decades)	Number of patients (N)	Prevalence (%)	95 % CI
	MALES		
<20	54	3,7	2,7–4,7
20-29	273	18,8	16,8–20,8
30-39	265	18,2	16,2–20,2
40-49	281	19,3	17,3–21,3
50-59	272	18,7	16,0–20,7
60-69	172	11,8	10,1–13,5
70-79	93	6,4	5,1–7,6
80-89 >90	36 8	2,5 0,6	1,7–3,3 0,2–0,9
	FEMALES		
<20	18	2,7	1,5–3,9
20-29	77	11,6	9,1–14,0
30-39	95	14,3	11,6–16,9
40-49	96	14,4	11,6–16,9
50-59	99	14,9	12,1–17,6
60-69	84	12,6	10,1–15,2
70-79	92	13,8	11,2–16,5
80-89 >90	87 17	13,1 2,6	10,5–15,6 1,4–3,8

CI- confidence intervals

Table 2. CT findings in patients with intracranial injuries

Intracranial injury	Number of patients (N)	Prevalence (%)	95% CI
Subdural haemorrhage	36	10,3	7,1–13,5
Subarachnoid haemorrhage	7	2,0	0,5–3,4
Brain oedema	2	0,6	0–1,4
Focal brain hematoma	2	0,6	0–1,4
Focal brain contusion	4	1,1	0–2,3
Epidural haemorrhage	5	1,4	0,2–2,7
Total:	56	16,0	

CI- confidence intervals

Table 3. CT performance duration when intracranial injuries are detected or not detected

CT test was performed	Number of patients (N)	Prevalence (%)	95% CI
	Detected II		
Less than in 1 hour	39	66,9	57,6–81,7
Later than in 1 hour	17	30,4	18,3–42,4
	Not Detected II		
Less than in 1 hour	157	53, 6	47,9–59,3
Later than in 1 hour	136	46,4	40,7–52,1
Total:	***349***		

II – intracranial injury, CI – confidence intervals, CT – computed tomography.

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PET IN EPILEPSY: CLINICAL CASE PRESENTATION

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ABSTRACT:

Introduction: Epilepsy is a disorder of the central nervous system characterized by recurrent seizures unprovoked by an acute systemic or neurologic insult. According to the World Health Organization (WHO) this neurological disorder is affecting about 0.5-1.0% of the population of the World. New, modern radiological studies are of great importance in the diagnosis of pathogenesis and clinical manifestation of epilepsy. The PET / CT study in epileptic assays has never been performed in Lithuania.
This case demonstrates one of the first PET/CT scans of the brains in Lithuania for patient with epilepsy.
The aim: To report the case of epilepsy patient who undergone PET/CT scan of the brain before neurosurgical operation.
Case: Patient Z. B. is a 28-year-old female with a history of epileptic seizures since she was seven. Despite medical treatment she continued to have seizures and surgical treatment was recommended. Before the first surgery epileptogenic focus was evaluated using magnetic resonance imaging (MRI), electroencephalography (EEG) and clinical data. However, after the intervention she still experienced multiple seizures every day. Later she underwent positron emission tomography with 18F-fluorodeoxyglucose (18F-FDG PET) which showed that the lesion of the brain was bigger compared with lesion showed by MRI.
Outcome: After second surgery patient remained seizure free.
Conclusion: Our case demonstrates that 18F-FDG PET is a useful diagnostic tool to evaluate epileptogenic focus in patients with refractory epilepsy.

***Keywords:** ^{18}F-FDG PET, MRI, EEG, refractory epilepsy.*

INTRODUCTION

Epilepsy is a group of neurological diseases characterized by epileptic seizures caused by the excessive electrical firing of a number of neurons. It is one of the most common neurological disease among people of all ages. The prevalence in the world and Lithuania ranges from 0.5 to 1% [1]. According to epidemiological data, more than 30% of the patients continue to have seizures despite medical treatment [2]. Surgical removal of the epileptogenic focus (EF) is an effective method of treatment for patients suffering from refractory epilepsy. Refractory epilepsy patients refers those diagnosed with epilepsy who, despite having undergone two appropriate selected therapy treatments with different antiepileptic drugs, do not manage to obtain seizure free period [3]. A randomized controlled trial by K. Fiest et all confirmed that surgical treatment is superior to prolonged medical treatment in refractory temporal lobe epilepsy [4]. For successful seizure control epilepsy surgery requires selection of the patients suitable for surgery and precise estimation of the EF [5]. Invasive electroencephalography (EEG) is gold standard for detection of the EF, but invasiveness of this approach requires careful patient selection. Magnetic resonance imaging (MRI) is required to exclude structural abnormalities that cause epilepsy: tumors, arteriovenous malformations etc. Brain positron emission tomography with fluorodeoxyglucose (18F-FDG PET) helps to identify the exact location of the epileptogenic focus. Studies, some of with consisted of large number of patients, have reported a sensitivity of 75-90% for temporal lobe epilepsy [6, 8]. The purpose of this case report was to describe one of the first brain 18F-FDG PET scans in Lithuania to identify the epileptogenic zone for the patient with drug resistant epilepsy before resective epilepsy surgery.

CASE REPORT

Patient Ž. B. is a 28-year-old woman who has a history of epileptic seizures since she was seven. Patient has a family history with her cousin suffering from epilepsy too. At the age of four she presented at the hospital because of fever (39C°) and febrile seizures with an upward gaze, tonic-clonic seizures and fibrillations of the left part of the face. She was treated with diazepam, later on with phenobarbital and seizures stopped. In 1995 our patient experienced her first non-febrile seizure: seizure started with loss of consciousness, back muscle spasm and upward left eye gaze. In 1997 she was diagnosed with partial epilepsy with secondary generalization (cryptogenic partial epilepsy) and treated in the Department of Neurology at Vilnius University Hospital Santaros Klinikos. During the course of the disease patient has tried many antiepileptic medications including carbamazepine and sodium valproate, both in monotherapy and in combination, which failed to achieve seizure control. All antiepileptic drugs she tried failed to sustain seizures. In 2002 because of a drug resistant epilepsy she underwent presurgical evaluation at Lithuanian University of Health and Sciences hospital.

MRI IMAGING AND EEG

EEG demonstrated abnormalities in the right frontotemporal zone, a sleep EEG only registered information from the first two stages of the sleep. MRI showed a part of the right posterior middle frontal gyrus cortex that was thicker (Figure 1). The abnormalities found on EEG were matching the MRI findings (Figure 2).

FIRST SURGERY

Using MRI, EEG and clinical data it was decided to remove the abnormal brain cortex found on MRI. Surgery went without complications, unfortunately, patient had postoperative recurrent seizures 1-4 per night. After the surgery she continued treatment, but she still experienced multiple seizures every day (8-9 per day). In March 2012 she had a control MRI which showed a small abnormal cortex right mass in the same region (Figure 3) but re-operation was not recommended.

Figure 1. Abnormalities of the cortex in the right posterior middle frontal gyrus

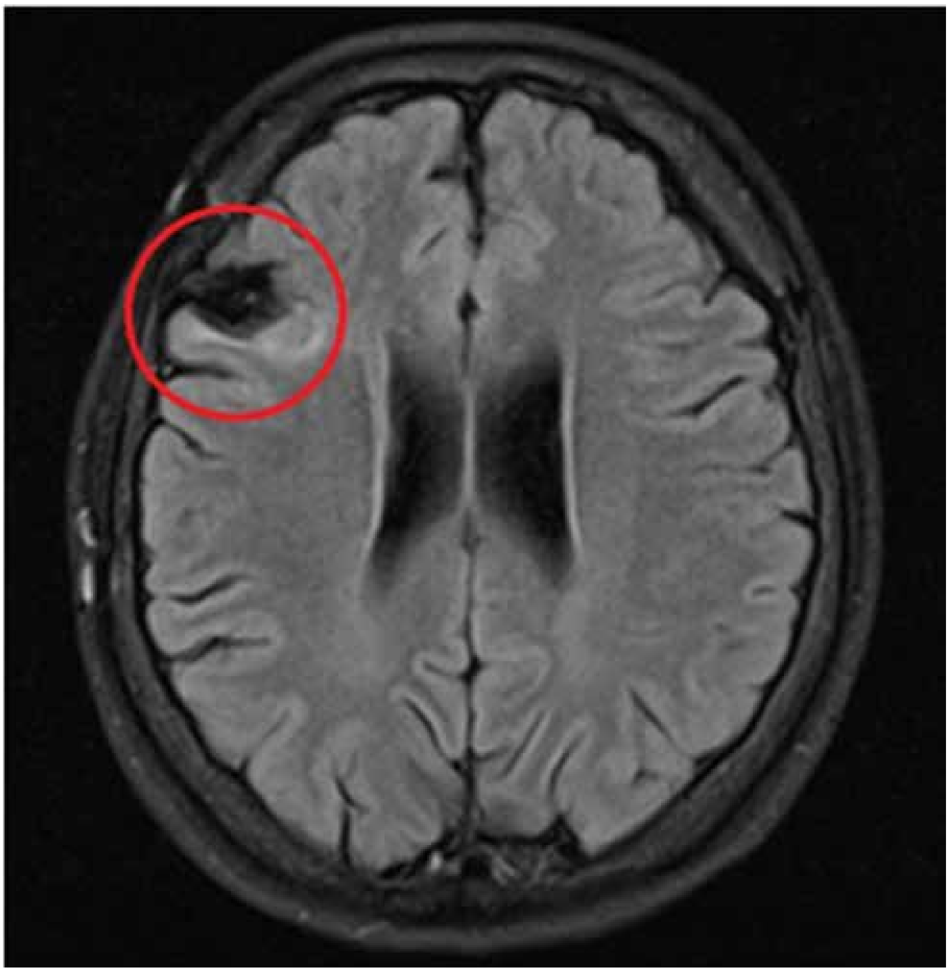


Figure 2. EEG findings demonstrating abnormalities in the right frontotemporal zone.

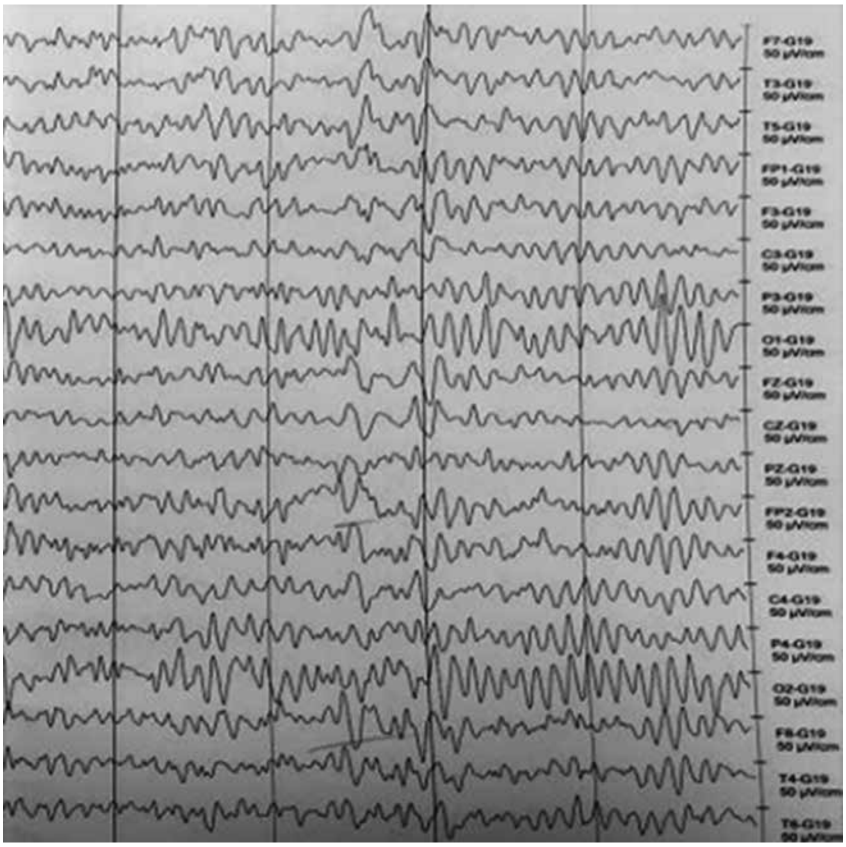


Figure 3. Small abnormal cortex mass in the right

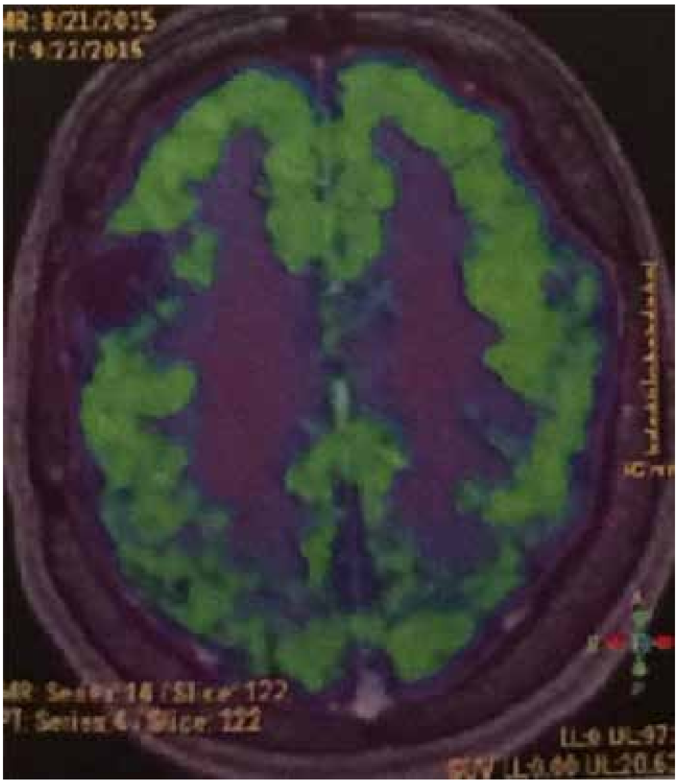
POSITRON EMISSION TOMOGRAPHY

Before the second surgery she underwent PET scan with 18F-FDG at Hospital of Lithuanian University of Health Sciences which showed hypometabolism in the right frontal region in the cross-section of the frontal and precentral sulcus with a hypoperfusion zone around this area (Figures 4, 5, 6). Compared with MRI taken before PET, the localization of the lesion was in the same place like on MRI scan, but the zone of hypoperfusion was bigger.

RESULTS

In 2015 she was considered for reoperation after the first failed resective epilepsy surgery. Patient has remained seizure free since the second surgery.

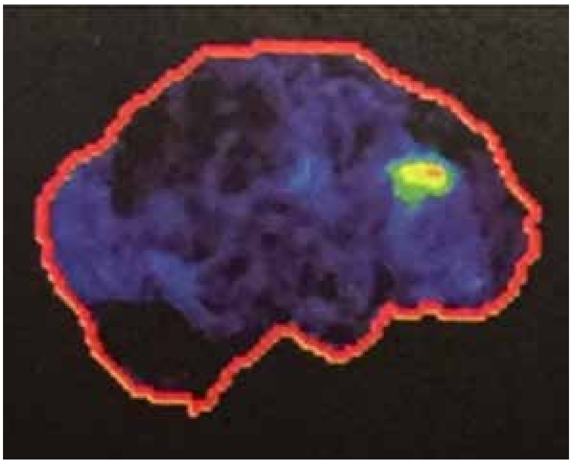
Figure 4. Hypometabolism with a hypoperfusion zone around in the right frontal region.

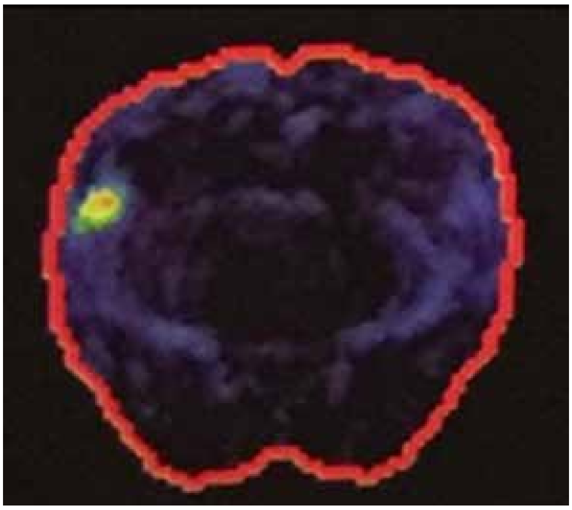


DISCUSSION

PET is widely available noninvasive technique in the world that plays an important role in the presurgical evaluation of patients with medical resistant refractory epilepsy. It can help to make

Figures 5, 6. Sagittal and frontal views.





decision in over 50% of patients with both positive and negative MRI findings before the intervention [7]. To our knowledge so far, only few patients with refractory epilepsy were examined using 18F-FDG PET in Lithuania. The use of this technique is was limited by the lack of indications for brain PET scans and a high cost. PET is valuable technique with high sensitivity especially for evaluating people with temporal lobe epilepsy (TLE). It can localize EF with up to 90% sensitivity for TLE and for extratemporal epilepsy (extra-TLE) up to 55% [8;9]. In this case 18F-FDG PET was applied because it can provide important information in addition to MRI as first surgery based on MRI results wasn't successful. Studies showed that PET co-registration with MRI improves detection of the lesion and surgical success [10]. There are several advantages of PET/MRI co-registration. First, it provides improvement in EF localization with requiring little additional time and workload, furthermore, hybrid system minimizes patient discomfort while improving the detection of EF. Finally, when examining pediatric patients in comparison to PET/CT, the effective dose is reduced [11]. Recent study shows that statistical parametric mapping may improve the sensitivity of ^{18}F-FDG PET in cases where visual assessment is negative [12]. Some non-FDG brain PET studies such as 11C-flumazenil (FMZ) PET are thought to be more sensitive and accurate than FDG-PET in the detection of EF in patients both with TLE and extra-TLE epilepsy [13] but their use in clinical practice is limited because they usually have short half-life and require cyclotron on-site [14]. PET is superior method in lateralization of the EF comparing it with ictal SPECT, other imaging modality used for EF localisation, although they are both more sensitive than MRI. Multimodality approach (use of MRI, PET and ictal SPECT) together is especially beneficial in cases of negative MR findings[15].

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