ORIGINAL ARTICLE

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Is Epidural Fat Affected by Peripheric or Visceral Adipose Tissue? A Radiologic View

ABSTRACT

Objective: We evaluated adipose tissue distribution in different anatomical localizations by comparing with epidural fat tissue.

Methods: Sixty patients' (28 female and 32 male) included in our study had abdominal computerized tomography and lumbar magnetic resonance images evaluated retrospectively. Subcutaneous and intraabdominal fat tissue thickness was compared with perirenal and epidural fat. The relationship with demographic characteristics of patients was investigated.

Results: Mean value of subcutaneous fat thicknesses were higher in females (29.9±24.2 mm in females and 16.2±24.5 mm in males), while perirenal fat tissue area was higher in males than females (2118.4±2327.1 mm2 and 1204.1±851.3 mm2 respectively). There was no significant difference in intraabdominal and perirenal fat tissue measurements according to gender (p=0.407, p=0.390; respectively). Also subcutaneous, intraabdominal and perirenal fat tissue measurements showed increments in association with gender (r=0.33, p=0.010; r=0.37, p=0.004; r=0.51, p=<0,001; respectively); however no relationship was detected with epidural fat area (p=0.519). Subcutaneous and intraabdominal fat thicknesses were not related with epidural fat (p values 0.434 and 0.271, respectively); and there was a statistical relationship between perirenal and epidural fat (p=0.010).

Conclusions: Increases in subcutaneous and intraabdominal fat tissue thickness with waist circumference was an expected finding, but no correlation was detected with epidural fat. Thus, we think that the amount of epidural fat does not change with obesity. Also, we concluded that while perirenal fat measurements were higher in the male group and correlated with epidural fat, androgenic effects can play a role in changing the amount of perirenal and epidural fat tissue. This result may be helpful in management of epidural pathologies, though there is a need for supportive studies.

Keywords: Obesity, Epidural Fat, Perirenal Adipose Tissue, Magnetic Resonance, Computerized Tomography

Epidural ve Retroperitoneal Yağlanmanın Abdominal Obezite ile İlişkisi Var mıdır? Radyoloji Bakışı

ÖZET

Amaç: Çalışmamızda, vücutta farklı anatomik bölgelerdeki yağ doku dağılımının epidural yağ doku ile olan ilişkisini araştırmak.

Gereç ve Yöntem: Çalışmamıza 28 kadın ve 32 erkekten oluşan 60 hasta kabul edildi. Olguların batın bilgisayarlı tomografi ve lomber magnetic rezonans tetkikleri, retrospektif olarak değerlendirildi. Hastaların subkutan ve intraabdominal yağ doku kalınlıkları ile perirenal ve epidural yağ doku kesitsel alanları karşılaştırıldı, demografik özellikler ile ilişkisine bakıldı.

Bulgular: Subkutan yağ doku ortalama değerleri kadınlarda (29,9±24,2 mm) erkeklere göre (16,2±24,5 mm) daha yüksek saptanırken; perirenal yağ doku miktarı erkeklerde kadınlara oranla daha yüksekti (2118,4±2327,1 mm2 ve 1204,1±851,3 mm2 sırasıyla). İntraabdominal ve perirenal yağ doku ölçümlerinde cinsiyetler bakımından anlamlı fark yoktu (p=0,407, p=0,390; sırasıyla). Subkutan ve intraabdominal yağ doku kalınlığı ile epidural yağ doku alanı arasında istatistiksel açıdan belirgin bir ilişki saptanmazken (p değerleri sırasıyla 0,434 ve 0,271); perirenal ve epidural yağ doku alanları arasında istatistiksel açıdan anlamlı bir ilişki bulundu (p=0,010).

Sonuç: Epidural yağ dokunun subkutan ve intraabdominal yağ doku miktarı ile ilişkisi yoktu. Ancak perirenal yağ doku ile pozitif yönde ilişkiye sahipti. Böylelikle bel çevresi artışında beklenen bir bulgu olan subkutan ve intraabdominal yağ doku artışının epidural mesafedeki yağ doku ile belirgin ilişkisi olmadığı, epidural yağın obezite ile değişmeyeceği kanısına vardık. Bunun dışında elde ettiğimiz bir başka sonuç ise epidural yağ ile korele saptadığımız perirenal yağ dokunun androjenik etki ile değişebileceği ve epidural aralıkta mevcut olup nörolojik semptomlara neden olabilecek patolojik süreçlerin yönetiminde bu etkiden yararlanılabileceğini düşünmekteyiz.

Anahtar Kelimeler: Obezite, Epidural Yağ Doku, Perirenal Yağ Doku, Manyetik Rezonans, Bilgisayarlı Tomografi

INTRODUCTION

Obesity is one of the health problems that increases the amount of adipose tissue. Adipose tissue forms where there is lipid tissue in the body especially in the face, cervical region, presacral side, trunk and episternal area [1]. Adipose tissue in the epidural area is a thin layer, with a physiologic amount acting like a mechanical support for vascular structures and neural components. As it increases to anomalous amounts, compression of neighboring anatomic structures occurs and causes neurological symptoms or infarction. This may be said to be among the reasons for epidural lipomatosis, Cushing syndrome, exogenous steroid exposure or morbid obesity [1,2].

No correlation was detected between obesity and epidural fat thickness in some articles in the literature as the fat thickness was measured anteriorly and posteriorly in the spinal column [1,3]. Lumbar posterior subcutaneous adipose tissue thickness was measured, with all results compared with age, sex and body mass index (BMI). But in these studies, subcutaneous fat tissue was evaluated, while other studies indicated that visceral adipose tissue measurement was more useful for the evaluation of the relationship [3].

In a comparison study combining three groups of patients; the first was normal female group with no obvious androgenic excretion and no PCOS, second group was female patients with PCOS and the third group was a group of healthy male patients. In these groups the androgenic effect on subcutaneous fat tissue, visceral fat tissue and organ specific adipose deposition was investigated. In the female group with PCOS and in the male patient group, intraabdominal and perirenal fat thicknesses were higher than the group of female patients without PCOS. Also, subcutaneous fat thickness was higher in women with PCOS compared to women without PCOS and this is evidence that high serum testosterone levels contribute to abdominal fat deposits [4].

We measured adipose tissue with different parameters, epidural fat thickness with central and peripheral adipose tissue thickness and also retroperitoneal fat and tried to find a relationship by comparing these results with age and sex.

MATERIAL AND METHODS

In this study, 60 patients (28 female, 32 male) applying to our medical faculty hospital with different complications were investigated. Their age range was 28-86 years in the female group and 25-85 years in the male group. Since the study is retrospective, measurements such as body weight, BMI, waist and hip circumference were not known. For this reason, adipose tissue thicknesses in different anatomic regions were measured from CT and MR examinations, which are cross-sectional imaging methods. In addition, findings of exogenous steroid use or Cushing syndrome known to affect epidural fat tissue, were not found in patients' data in the system. For this study we included the cases who had not previously undergone waist or abdominal surgeries, and those who did not have congenital anomalies of the spine or around the abdomen. Fat tissue measurements from lumbar MR and abdominal CT images were evaluated by a radiologist. In order to standardize measurement levels, we obtained values of epidural fat tissue as cross-sectional area (mm2) on MR imaging from axial sections at the level of L3 vertebra superior end plate (Figure 1). We preferred to take measurements from this level, because posterior epidural fat thickness in sagittal series is more prominently seen at this level. We encountered a study in the literature that obtained fat tissue measurements from L3 vertebral level and suggested that single slice abdominal cross-sectional areas at the L3 vertebra are strongly correlated with whole body volumes of muscle and adipose tissue (5). From the same level we took different measurements of epidural fat. Extraction of cross-sectional area of dural sac from the spinal canal was used. On abdominal CT sections we measured subcutaneous adipose tissue at the level of iliac spine, intraabdominal fat thickness 1 cm below the aortoiliac bifurcation and perirenal fat at the right renal hilum level (Figure 2, 3). Results then were compared with epidural fat area.

MR images were obtained with 1.5 TESLA Signa Excite (GE Medical Systems, WI) device as 4 mm thickness sagittal T1 and T2 and also axial T2 weighted sequences. For CT imaging protocol, we used (Toshiba, Asteion) TSX-021B, 4 detectors and 120 kV, 150 mAs, 5 mm section thickness axial images.

Intraabdominal and subcutaneous fat thicknesses, and also perirenal adipose tissue area, were compared with sex and age. The variables were analyzed using SPSS version 19.0 software, with normal distribution examined using the Kolmogorov-Smirnov and Shapiro test according to the number of patients in the groups. For presentation of descriptive data, percentage, frequency, minimum and maximum values and median were used. When normal distribution fitness tests and sample size were examined, data analysis was performed with nonparametric tests. The Mann Whitney U test was used to compare the median values of continuous variables according to sex. The Pearson correlation test was used to examine the relationship between the data with normal distribution and Spearman's correlation test was used for the analysis of data with non-normal distribution. Values with P-value below 0.05 were considered statistically significant.

RESULTS

In this study, consisting of female individuals aged 28-86 years and male individuals aged 25-85, the gender distribution was 28 females (46.7%) and 32 males (53.3%) and the mean age was 54.6 ± 14.6 years. The mean age of females were 54.6 ± 12.1 and of males were 54.5 ± 16.6 years. There was no statistically significant difference in terms of mean age for both genders (Table 1).

Table 1. Demographic data of study groups

	Mean±standard deviation	Median (min-max,).
Age	54,6±14,6	56 (25-86)
Gender	n (%)	
Female	28 (46,7)	
Male	32 (53,3)	

Min: Minimum, max: maximum, %: column percentage

Subcutaneous adipose tissue thickness was 29.9 ± 24.2 mm for women and 16.2 ± 24.5 mm for men. The difference was statistically significant (p = 0.001). The mean area of perirenal fat tissue was 1204.1 ± 851.3 in the female group and 2118.4 ± 2327.1 in the male patient group. Perirenal fat tissue area values were higher in the male patient group and this difference was statistically significant (p = 0.034). There was no statistically significant difference between the genders in terms of intraabdominal fat tissue and epidural fat tissue, and p values were 0.407 and 0.390, respectively (Table 2).

Table 2. Variables according to gender

	Female (n=28) Mean ±SD	Male (n=32) Mean ±SD	*p value*
Age	54,6±12,1	54,5±16,6	0,953
Subcutaneous fat tissue	29,9±24,2	16,2±24,5	***0,001***
Intrabdominal fat tissue	74,2±23,5	80,2±33,9	0,407
Epidural fat tissue	59,6±30,0	67,9±35,2	0,390
Perirenal fat tissue	1204,1±851,3	2118,4±2327,1	***0,034***

SD: standard deviation, p: Mann Whitney U test

Table 3. Correlation tables

Age		
	r	*p*
Epidural fat tissue	-0,085	0,519
Subcutaneous fat tissue	0,330	***0,010****
Intrabdominal fat tissue	0,368	***0,004***
Perirenal fat tissue	0,511	***<0,001****
Epidural fat tissue		
	r	*p*
Subcutaneous fat tissue	0,103	0,434*
Intrabdominal fat tissue	0,144	0,271
Perirenal fat tissue	0,330	***0,010****

*r:Correlation coefficient, p:Pearson correlation test, *Spearman's correlation test*

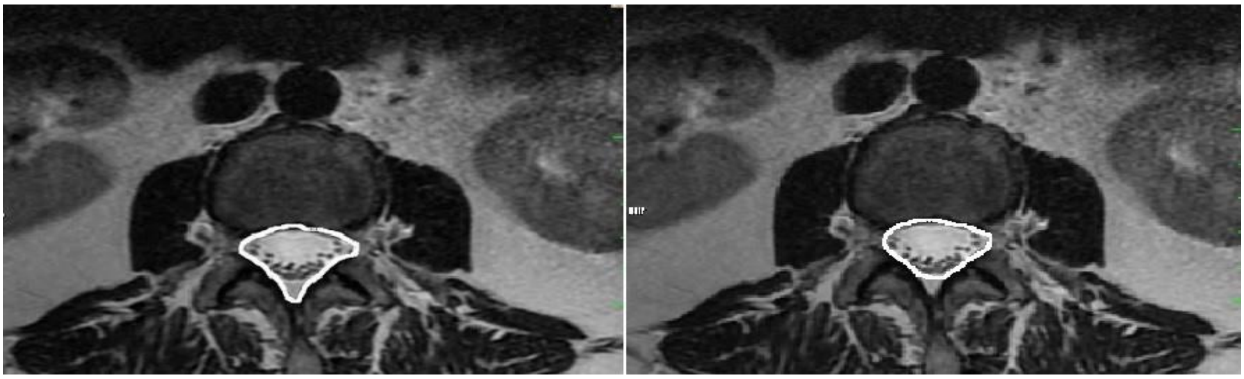

Figure 1. Axial T2 weighted images, measurement of spinal osseous canal (a) and dural sac (b) area at the level of superior end plate of lumber 3 vertebrae.

There was an increase in the area of subcutaneous adipose tissue, intrabdominal adipose tissue and perirenal adipose tissue (Figure 4) with age (r = 0.33, p = 0.010, r = 0.37, p = 0.004, r = 0.51, p = <0.001). There was no significant relationship between epidural fat tissue thickness and the age variable (p = 0.519) (Table 3). There was no statistically significant correlation between subcutaneous fat tissue and intraabdominal and perirenal fat tissue (p values of 0.723 and 0.272, respectively). There was no statistically significant relationship between subcutaneous fat tissue thickness and intraabdominal fat tissue thickness and epidural fat tissue area (p values of 0.434 and 0.271, respectively). There was a statistically significant relationship between perirenal and epidural fat tissue areas (p = 0.010).

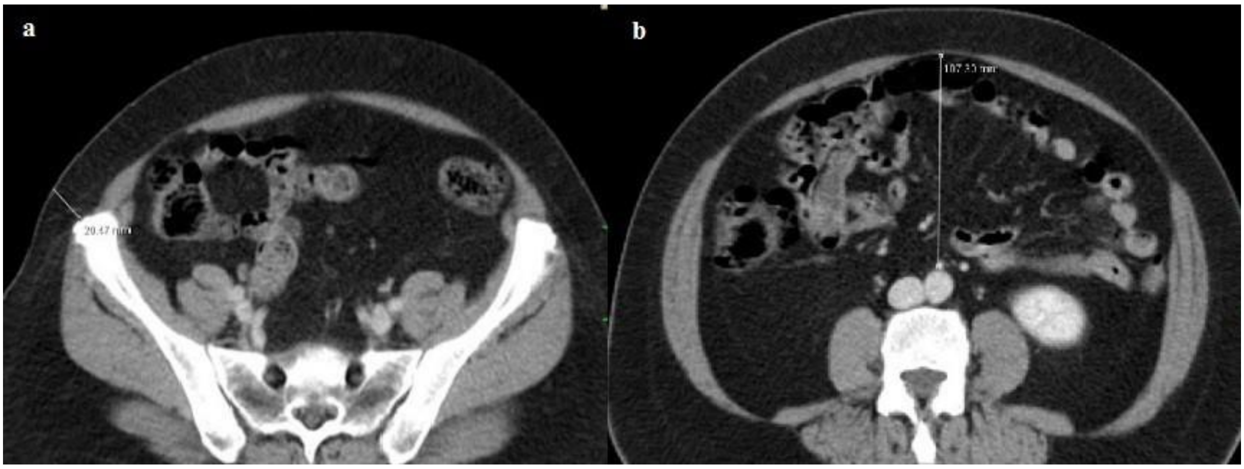

Figure 2. On axial tomography images, subcutaneous (a) and intraabdominal (b) fat thickness were measured from the level of right superior iliac spin and from 1 cm proximally of aortoiliac bifurcation, respectively.

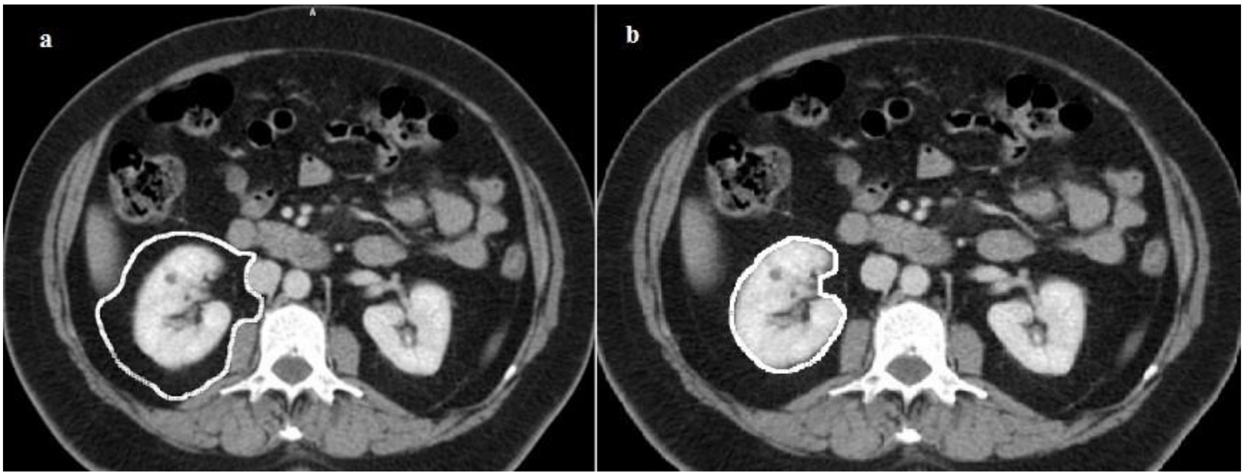

Figure 3. By measuring circumference of perirenal adipose tissue at the side of fat tissue contours (a) and extracting the value of circumference of renal limits (b), on axial CT images at the level of right renal hilum, we get perirenal adipose tissue area.

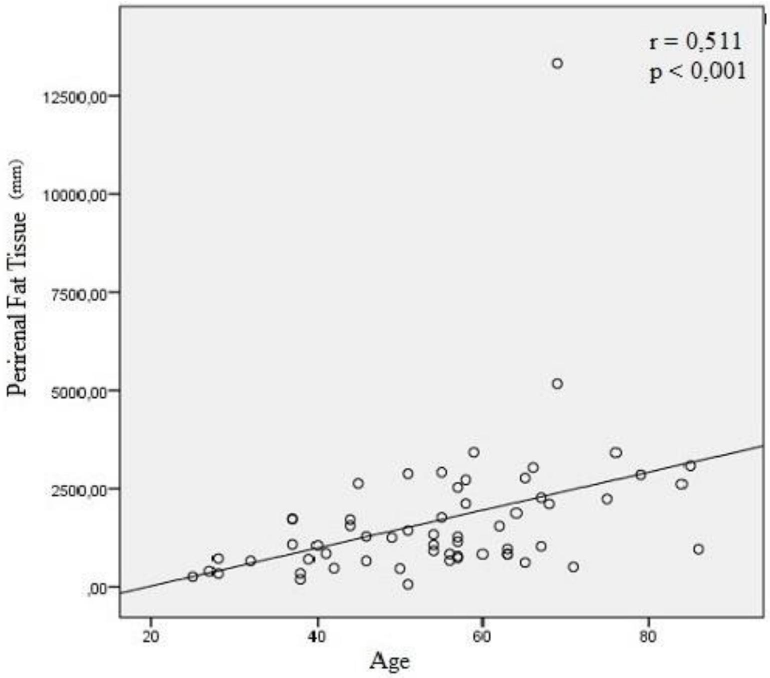

Figure 4. Strong correlation between age and perirenal fat tissue.

DISCUSSION

Obesity affects about 3% of the population of industrialized developed countries. Obesity and its complications are increasing worldwide and it is a widespread problem affecting both health care costs and mortality. Obesity is a major risk factor for conditions such as insulin resistance, type 2 diabetes, nonalcoholic disease and cardiovascular disease, especially when combined with excess visceral or ectopic fatty tissue [6].

In addition to general fat distribution in the body, ectopic fat accumulation in specific parts of the body has also been associated with many diseases. Ectopic fat tissue or regional fat accumulation and cardiometabolic risk affects systemic energy metabolism in the liver and muscle tissue. Pericardial, perivascular and renal sinus fat tissue indirectly affect cytokine secretion, as well as having direct toxic effects on neighboring anatomic organs [7].

In a study that investigated the effect of regional fat distribution and contribution to the development of cardio-metabolic diseases, ectopic fat contributed to insulin resistance by the direct vasculature effect of perivascular oil, suggesting that the capillary cross-sectional area in muscles decreased and thus muscle blood flow and glucose uptake decreased. Because of this, it is argued that perivascular fat secretion stimulates inflammation by secretion of various cytokines and insulin-stimulating mechanisms cause damage to endothelium-dependent vasodilatation, resulting in vascular complications and consequently contributing to the development and progression of atherosclerosis [7]. It is also stated that the accumulation of intrarenal and perirenal fat plays a decisive role in renal function and blood pressure [8].

Epidural lipomatosis is a rare clinical entity characterized by an increase in the amount of fat tissue, especially in the lumbar and thoracic spinal canal. It is usually associated with local or systemic steroid therapy, hypothyroidism, Cushing's Syndrome or morbid obesity. Idiopathic epidural lipomatosis is a very rare (7.6%) process in which the cause is unknown [1].

In a study indicating that epidural lipomatosis frequently accompanies central obesity, it was emphasized that this type of obesity is typically characterized by prolonged steroid therapy or confusion with Cushing's syndrome [9].

A 63-year-old male patient with BMI 32.6 kg/m2 and insulin resistance presented by Maillot et al. was diagnosed with epidural lipomatosis by CT myelography taken for low back pain symptoms. On images taken before and after a diet, it was observed that symptoms regressed with weight reduction. This showed there is a correlation between central obesity and epidural lipomatosis due to the decrease in the amount of fat tissue measured in the epidural interval in the post-dietary period [10].

Apart from these entities, another study investigating the relationship between epidural fat and obesity, which excluded patients with steroid treatment, thyroid pathology or Cushing's disease, found epidural fat was not affected by abdominal obesity and BMI when the amount of subcutaneous fat tissue was found to be high in obese patients [1]. As BMI was initially and is still mostly used to show the increase in the amount of fat in the body, its reliability in terms of reflecting the fat distribution in the body should be questioned [11,12]. Also, in this study, the waist circumference measurement, which can indicate abdominal obesity, was added to the BMI values. This measurement can give information about fat distribution and thus can report the risk ratio in terms of conditions such as coronary artery disease [11-13-14-15].

We aimed to evaluate the possible association of fatty tissue area in the epidural space with measurements of subcutaneous fat thickness, which may be indicative of peripheral lipidation; intraabdominal adipose tissue thickness showing central obesity; and perirenal fat area as a marker of retroperitoneal fat. No statistically significant relationship was found between subcutaneous fat tissue with intraabdominal and perirenal fat tissue ($p = 0.723$ and 0.272, respectively). This is due to the fact that subcutaneous adipose tissue and visceral fat tissue with intraabdominal and perirenal components have different origins in the embryological period [16].

In our cases, the values of subcutaneous, intraabdominal and also perirenal fat tissue were found to increase with the increase in age (p values: 0.010, 0.004 and <0.001, respectively, Figure 4). In the other comparison, subcutaneous fat thickness was found to be significantly higher in females than in males ($p = 0.001$), and the amount of perirenal fat tissue was higher in the male gender ($p = 0.034$). The mean increase in subcutaneous fat thickness in the female gender was similar to that found by Wu et al. In addition, we did not find any statistical difference in terms of gender and age with fat tissue measurements taken from the epidural space, similar to the study performed by Alıcıoglu et al. [1,2]. There was no significant correlation between fat tissue measured in the epidural area and the subcutaneous and intraabdominal fat tissue thickness (p values: 0.434 and 0.271, respectively) in our study. There was a positive correlation between epidural and perirenal fat tissue area found (p 0.010). While there was no statistically significant difference between genders in terms of epidural fat tissue area ($p = 0,390$), the amount of perirenal fat was higher in men compared to women. This suggests that the amount of perirenal adipose tissue may increase with androgenic effect. In a study investigating the androgenic effect on subcutaneous adipose tissue, visceral adipose tissue and organ-specific fat deposition in women with PCOS and without significant androgen release and also in healthy men, it was stated that the intraabdominal and perirenal fat tissue thicknesses in women with PCOS and in males were higher than in women without PCOS. Apart from this, subcutaneous fat thickness in women with PCOS was higher than in non-PCOS women. This also confirmed the contribution of serum testosterone levels to abdominal fat tissue deposition [4].

There are some limitations of this study. One is related to the number of patients. We obtained some measurements from CT and some from MR sections. Because of this we attempted to select patients who had both abdominal CT and lumbar MR images. We took care that these exams were completed at relatively close dates. For this reason, we included limited patients over three years. The other limitation might be that the imaging modalities were different. In fact, we wanted to obtain the maximum number of patients, so we did not choose patients who had both lumbar and abdominal MRI. In our center, the number of patients with abdominal CT examination is higher than abdominal MRI, so we preferred patients with abdominal CT. We also could have chosen ultrasonography (US) especially for intraabdominal and subcutaneous fat measurements to use the same modality. But further consideration led us to believe we did not have a choice about using US, because we wanted to rule out probable mistakes that might be due to compression during US application, especially for the subcutaneous fat measurement. So, we selected CT and MRI imaging methods.

In conclusion, subcutaneous and intraabdominal fat tissue thicknesses, which may be indicators of obesity and especially waist circumference, are not exactly related with epidural fat tissue limited by the spinal osseous canal. However, as the perirenal fat tissue area increased, epidural fat also increased. Thus, we believe that the amount of adipose tissue in these different localizations may be related. In addition, while perirenal fat measurements were higher in the male group and was correlated with epidural fat, androgenic affects can play a role in changing the amount of perirenal and epidural fat tissue. This result may be helpful in management of back pain or neurological symptoms originating from the naepidural area, such as spinal lipomatosis, etc. We believe that future studies with more cases and using different parameters will contribute to our study and the literature.

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