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Research

Investigation of Potential Chest Computed Tomography Findings Associated with Incidental Gynecomastia in Adults

Erişkinlerde Saptanan Tesadüfi Jinekomasti ile İlişkili Olası Toraks Bilgisayarlı Tomografi Bulgularının Araştırılması

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ABSTRACT

Objective: To examine the incidence of gynecomastia detected by chest computed tomography (CT) in the adult male population and its association with fatty liver disease, abdominal wall, and retrorenal and subcutaneous fatty tissue thickness.

Methods: Chest CT scans of 1,191 patients were scanned retrospectively. One hundred fifty-eight cases with a fibroglandular tissue diameter (FGTD) of more than 2 cm were accepted as gynecomastia. Forty-five cases with FGTD less than 1 cm constituted the control group. Patterns of gynecomastia, FGTD, the subcutaneous adipose tissue thickness of breast (B-ATT), abdominal wall (AW-ATT) and retrorenal adipose tissue thickness (RR-ATT) were measured in mm. Additionally, the Hounsfield unit attenuation of the liver and spleen was obtained, and a liver-to-spleen (L/S) ratio below 0.8 was considered hepatosteatosis. The correlation between all these parameters was analysed by Kendall's Tau-b.

Results: The incidence of gynecomastia was calculated as 13.2% (158/1,191), observed bilateral in 84.2% (n=133) and unilateral in 15.8% (n=25) of the cases. The dendritic pattern was the most observed type, with 57.6% (n=91) of the cases. There was a significant difference between B-ATT, AW-ATT, and RR-AAT values and gynecomastia ($p<0.005$), but a weak relationship was observed ($r=0.137$, $r=0.132$, $r=0.098$, respectively). When the study population was divided into two groups according to the L/S ratio, no significant difference was found, regarding FGTD and all the adipose tissue thickness parameters ($p>0.05$).

Conclusion: Gynecomastia may signify visceral obesity rather than innocent hypertrophy. In clinical practice, incidental detection of gynecomastia by CT can play a useful role in case management.

Keywords: Gynecomastia, computed tomography, adipose tissue thickness, visceral obesity, hepatosteatosis

ÖZ

Amaç: Erişkin erkek popülasyonda toraks bilgisayarlı tomografisi (BT) ile saptanan jinekomasti insidansını ve yağlı karaciğer hastalığı, karın ön duvarı, retrorenal ve deri altı yağ doku kalınlığı ile arasındaki ilişkiyi araştırmaktır.

Gereç ve Yöntem: Bin yüz doksan bir hastanın toraks BT görüntüleri geriye dönük olarak tarandı. Fibroglandüler doku çapı (FGTD) 2 cm'den fazla olan 158 olgu jinekomasti olarak kabul edildi. Bu kalınlık 1 cm'nin altında olan 45 olgu ise kontrol grubunu oluşturdu. Jinekomasti paternleri, FGTD, memenin deri altı yağ dokusu kalınlığı (B-ATT), karın ön duvarı (AW-ATT) ve retrorenal yağ dokusu kalınlığı (RR-ATT) mm cinsinden ölçüldü. Ek olarak, karaciğer ve dalak dansitesi Hounsfield birimi cinsinden elde edildi ve karaciğer-dalak (L/S) dansitesi oranının 0,8'in altında olması hepatosteatoz olarak kabul edildi. Tüm bu parametreler arasındaki korelasyon Kendall's Tau-b ile istatistiksel olarak analiz edildi.

Bulgular: Jinekomasti insidansı %13,2 (158/1.191) olup, olguların %84,2'sinde (n=133) iki taraflı ve %15,8'inde (n=25) tek taraflı idi. En çok gözlenen tip olan dendritik patern olguların %57,6'sında (n=91) saptandı. B-ATT, AW-ATT ve RR-AAT değerleri ile jinekomasti arasında anlamlı fark ($p<0,005$) saptanmakla birlikte zayıf bir ilişki gözlendi (sırasıyla $r=0,137$, $r=0,132$, $r=0,098$). L/S oranına göre ayrılan iki grup arasında FGTD ve tüm adipoz doku kalınlık parametreleri açısından anlamlı fark bulunmadı ($p>0,05$).

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Sonuç: Jinekomasti, masum bir hipertrofiden ziyade viseral obezite gibi ciddi patolojileri işaret ediyor olabilir. Klinik pratikte, BT ile tesadüfi olarak jinekomasti saptanması olguların yönetiminde faydalı bir rol oynayabilir.

Anahtar Kelimeler: Jinekomasti, bilgisayarlı tomografi, adipoz doku kalınlığı, visseral obezite, hepatosetatoz

INTRODUCTION

The most common pathology of the male breast is gynecomastia (1). In the autopsy series, up to 55% rates have been reported (2). Gynecomastia is a benign breast pathology characterized by the proliferation of involutioned ducts and stroma. As a result, an increase in the breast tissue volume is expected. Three peaks have been defined for gynecomastia: neonatal period, puberty and sixth (3) decade. Its etiology is highly variable, and is primarily based on the disruption of the balance between estrogen and androgen levels. It may develop physiologically during puberty and old age or may occur secondary to various endocrine, systemic, tumoral, or toxic causes (4). In the presence of obesity, the increase in estrogen level due to the effect of the aromatase enzyme released from the adipose tissue also causes gynecomastia. It is considered idiopathic if gynecomastia persists for at least 18 months without any underlying cause (5). This condition may occur in middle or elder ages. Clinically, gynecomastia is easy to diagnose, on physical examination, it usually presents as a painful, mobile hard mass behind the nipple. It is generally bilateral and asymmetrical since the etiology is systemic. However, it can also occur unilaterally (4). Three well-defined gynecomastia patterns have a typical appearance on mammography (MG) and ultrasonography (USG). The fluoride phase corresponding to the reversible phase is observed in a nodular pattern. In this phase, it is disc-shaped, well-defined opacity in the retro-areolar area on MG and a hypoechoic mass or area surrounded by adipose tissue on the USG. The chronic phase, which is irreversible, is called the dendritic pattern. This phase is observed as a wedge-shaped heterogeneous density with radiating extensions toward the fatty tissue, with the apex facing the nipple on the MG. The USG equivalent is an irregularly shaped, heterogeneous hypoechoic area with no sharp borders in the same location. The third pattern is a heterogeneous increase in density filling the entire breast on MG and USG, resembling the female breast. It is crucial to exclude any type of malignancy in the differential diagnosis of gynecomastia.

With the increasing frequency of radiological imaging and widespread use of thoracic imaging, gynecomastia has become one of the most common pathologies encountered incidentally in chest computed tomography (CT) (6). However, there is limited knowledge in the literature investigating the clinical significance of incidentally occurring gynecomastia. In this study, we investigated the incidence of gynecomastia detected by chest CT in the adult male population and its association with fatty liver disease in addition to the abdominal wall, retrorenal and subcutaneous fat tissue thickness.

METHODS

This retrospective study was approved by the Non-Interventional Clinical Research Ethics Committee of the İstanbul University-Cerrahpaşa (decision no: E-83045809-604.01.01-406516, date: 13/06/2022). Chest CT images of 1191 adult male cases obtained in our hospital for various reasons and archived in the picture archiving and communication system (PACS) between January 2019 and December 2021 were scanned. Contrast-enhanced scans with insufficient technical quality, women cases, men with a history of breast surgery and patients under the age of 18 years were excluded. Additionally, conditions that may be in the etiology of secondary gynecomastia, such as malignant cases, cases with alcohol or specific drug use, or systemic diseases like cirrhosis, chronic renal failure, hypothyroidism, were excluded. Non-enhanced sequences of angiographic CT scans were evaluated. As a result, 203 adult male cases aged between 18 and 88 were included in the study. The generally accepted cut-off value for fibroglandular tissue diameter for gynecomastia in the literature is 2 cm (7-9). In consequence, while 158 cases were accepted as gynecomastia, the control group consisted of 45 cases with a diameter of less than 1 cm.

According to CT findings, 158 cases constituted the gynecomastia group, while 45 cases formed the control group.

In 91 of these cases, no known disease could cause comorbidity. Additionally, various known chronic diseases such as hypertension (HT), cerebrovascular disease and diabetes mellitus in 47 cases, inflammatory processes such as coronavirus disease-2019, pancreatitis, and sepsis in 23 cases, a trauma in 28 patients and emergency vascular pathology-like pulmonary embolism, or dissection in 14 cases were recorded. The demographic data and variables related to gynecomastia are summarized in Table 1.

All thoracic images were obtained by one of the two CT scanners with 128 detectors (SOMATOM Definition AS, Siemens Healthcare, Forchheim, Germany and Revolution

Table 1. Patient population and gynecomastia variables

Variables	Gynecomastia (n=158) n (%)	Normal (n=45) n (%)
Age mean ± SD	48.79±19.98	53.44±18.92
Medical records		
None/not known	75 (47.5)	16 (35.6)
Yes		
Chronic diseases	29 (18.3)	18 (40)
Acute vascular conditions	14 (8.9)	-
Acute infectionous diseases	19 (12)	4 (8.9)
Trauma	21 (13.3)	7 (15.5)
Gynecomastia involvement		
Unilateral	25 (15.8)	-
Bilateral	133 (84.2)	-
Gynecomastia pattern		
Nodular	56 (35.4)	-
Dendritic	91 (57.6)	-
Diffuse	11 (7)	-

SD: Standard deviation

HD, General Electric Systems, Waukesha, WI, USA). CT scan parameters for the thoracic imaging protocol were as follows: 100 kV tube voltage, 200 mA, matrix 512x512, slice thickness of 1 mm.

All CT scans were retrospectively evaluated via the PACS system by two radiologists (E.M.Ö. and E.Y.Ö.) in consensus who were blinded to the any clinical information of the patient. In case of discrepancy, one of the board-certified radiologists (S.A.K. or Y.K.) with more than ten years of experience in radiologic imaging was consulted. First, the fibroglandular tissue diameter (FGTD) and the pattern of gynecomastia were recorded. For FGTD, the mediolateral length of the fibroglandular density was measured in mm. Measurements of higher than 20 mm in the axial plane were accepted as gynecomastia (Figure 1). Gynecomastia patterns were recorded separately for each case, divided into three types: nodular, dendritic, or diffuse (Figure 2).

Then, the subcutaneous fatty tissue thickness of the breast and abdominal wall and the adipose tissue thickness of the retrorenal space were measured and recorded in mm (Figure 3). The breast adipose tissue thickness (B-ATT) was measured at the nipple level, where it was thickest. For the abdominal wall adipose tissue thickness (AW-ATT), the distance from the central part of the rectus muscle to the skin was recorded at the umbilicus level. Retrorenal adipose

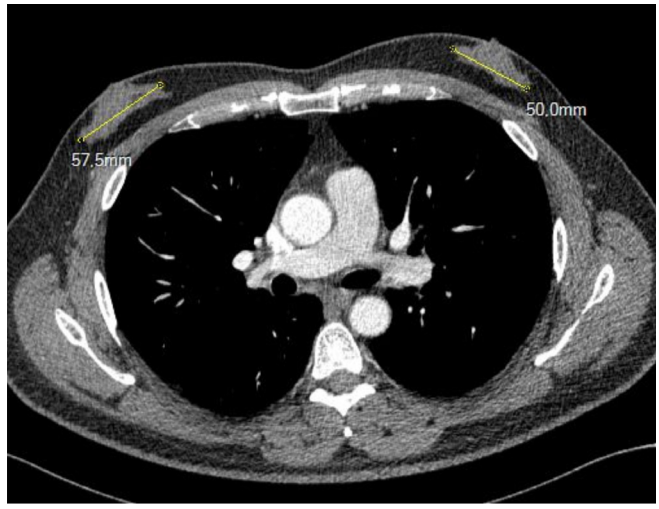

Figure 1. FGTD measurement in the transverse plane in a 48-year-old case with gynecomastia of dendritic pattern on both sides
FGTD: Fibroglandular tissue diameter

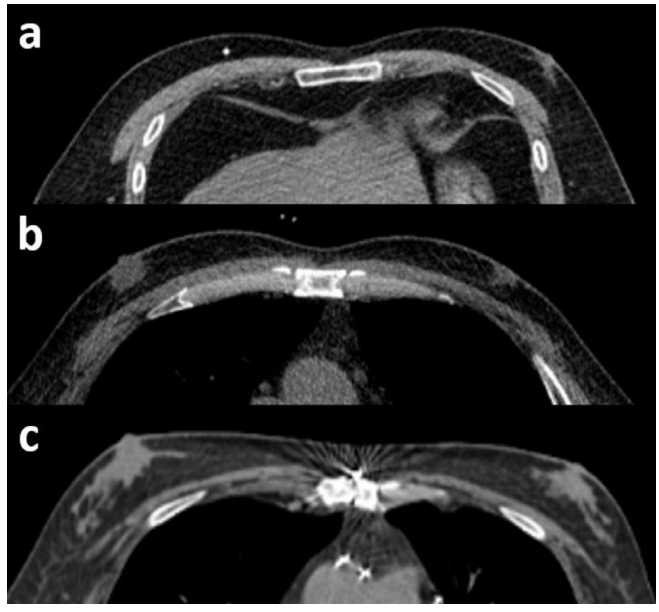

Figure 2. Patterns of gynecomastia, (a) nodular, (b) dendritic, (c) diffuse

tissue thickness (RR-ATT) was obtained by measuring the widest distance of fatty tissue in the retrorenal space at the level of the renal hilum. Finally, the mean Hounsfield unit attenuation of the liver and spleen on CT was recorded (Figure 4). For this purpose, a circular region of interest was used in axial sections passing through the upper abdomen. A liver-to-spleen (L/S) ratio below 0.8 was considered significant for hepatosteatosis.

Statistical Analysis

SPSS version 25.0 was used for all statistical analyses. After descriptive analysis, the patient population was divided into two groups according to the presence of gynecomastia and the L/S ratio. The correlation between all variables

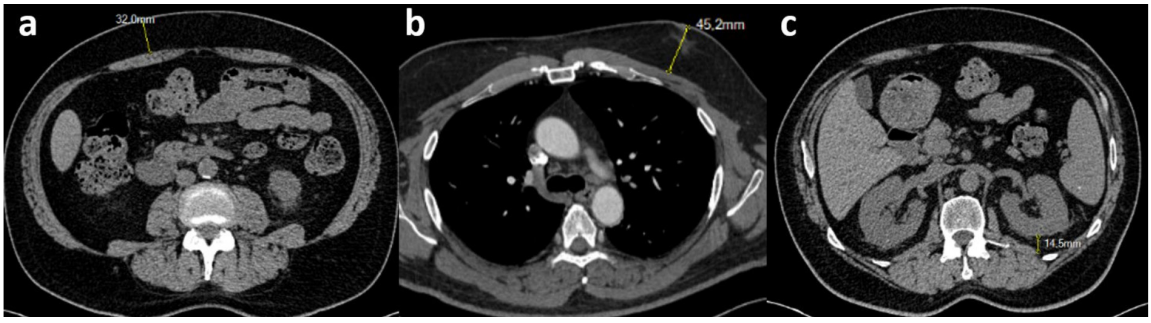

Figure 3. Adipose tissue thickness measurements in a 58-year-old man with dendritic gynecomastia. (a) Retrorenal adipose tissue thickness. (b) Abdominal wall adipose tissue thickness. (c) Breast adipose tissue thickness

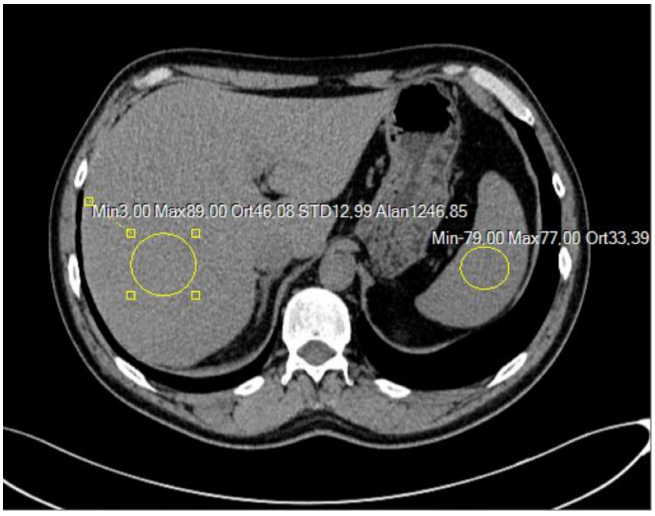

Figure 4. HU measurements of the liver and spleen
HU: Hounsfield unit

was analyzed by Kendall's Tau-b. A p-value of <0.05 was accepted as significant.

RESULTS

The incidence of gynecomastia among scanned CT scans was 13.2% (158/1191). The mean age was 48.79±19.98 in the gynecomastia group, and 53.44±18.92 in the control group. Gynecomastia was bilateral in 84.2% (n=133) and unilateral in 15.8% (n=25) of the cases. The most frequently observed pattern was the dendritic pattern, indicating the chronic phase, 57.6% (n=91). While the nodular pattern was observed in 35.4% (n=56) of the cases, the diffuse pattern was recorded in only 7% (n=11). The mean FGTD was 28.59∓10.17 mm.

No significant difference could be found between the group with gynecomastia, and the control group in terms of age, adipose tissue measurements and L/S ratio (Table 2). However, a significant difference between B-ATT, AW-ATT, and RR-AAT values and gynecomastia (p<0.005), a weak relationship was observed by Kendall's Tau-b (r=0.137, r=0.132, r=0.098 respectively). A moderate association was found between B-ATT and AW-ATT, RR-ATT (r=0.559, r=0.394 retrospectively, p<0.001).

When the patients were divided into two groups according to the cut-off value of 0.8 for the L/S ratio, no significant difference was found in terms of age, FGTD, and all the adipose tissue thickness parameters (p>0.05) (Table 3).

The results of the correlations are summarized in Table 4.

DISCUSSION

Our study found a weak but significant relationship between gynecomastia and B-ATT, AW-ATT and RR-ATT. To the best of our knowledge, the relationship between gynecomastia and retrorenal adipose tissue was investigated for the first time in the literature. Additionally, hepatosteatosis was not associated with gynecomastia or adipose tissue thickness in our patient population.

Gynecomastia, which is defined as the benign proliferation of male breast tissue, is seen with a frequency of 32%-65% in the general population (10). This rate is 60%-90% in the neonatal period, 50%-60% in adolescence, and around 70% in the elderly (3). It is thought that the underlying cause of gynecomastia is the imbalance between estrogen and androgen activity. Various studies have reported that maternal estrogen in the neonatal period, rapid increase in estrogen production in puberty, and decreased androgen production in old age are responsible for gynecomastia. (4,10,11). In addition to idiopathic and physiological causes, gynecomastia can occur in systemic diseases such as chronic liver disease and chronic renal failure, endocrine diseases such as hypothyroidism and hypogonadism, Klinefelter syndrome, the presence of gonadal, adrenal and pituitary tumors, hepatocellular cancer, the use of various drugs, or chronic alcoholism (4). The amount and activity of the aromatase enzyme, which converts testosterone to estrogen in adipose tissue, increase in the presence of obesity. The increased leptin production in obesity also contributes to the development of fibroglandular tissue. The most critical steps in diagnosing gynecomastia are anamnesis

Table 2. Variables according to the presence of gynecomastia

	Gynecomastia (n=158)	Control (n=45)	p-value	95% CI	
				Lower limit	Upper limit
Age	48.79±19.98	53.44±18.92	>0.05	-11.23	1.92
B-ATT mm	19.11±9.32	18.87±11.39	>0.05	-3.03	3.50
AW-AAT mm	18.45±9.11	18.27±10.41	>0.05	-2.95	3.31
RR-AAT mm	9.31±8.66	9.51±9.61	>0.05	-3.15	2.76
L/S ratio	1.20±0.40	1.22±0.42	>0.05	-0.15	0.12

AW-AAT: Abdominal wall adipose tissue thickness, B-ATT: Breast adipose tissue thickness, CI: Confidence interval, RR-AAT: Retrorenal adipose tissue thickness, L/S ratio: Liver-to-spleen ratio

Table 3. Variables according to L/S ratio

	L/S ratio >0.8 (n=160)	L/S ratio <0.8 (n=43)	p-value	95% CI	
				Lower limit	Upper limit
Age	50.56±20.46	47.04±17.05	>0.05	-3.18	10.22
FGTD mm	25.88±12.35	24.64±9.75	>0.05	-2.77	5.26
B-ATT mm	18.79±9.9	20.05±9.37	>0.05	-4.58	2.05
AW-ATT mm	17.95±9.43	20,14±9.13	>0.05	-5.37	0.97
RR-ATT mm	9.07±8.69	10.42±9.45	>0.05	-4.35	1.65

AW-AAT: Abdominal wall adipose tissue thickness, B-ATT: Breast adipose tissue thickness, CI: Confidence interval, FGTD: Fibroglandular tissue diameter, RR-AAT: Retrorenal adipose tissue thickness, L/S ratio: Liver-to-spleen ratio

Table 4. Correlation analysis of measurement parameters in gynecomastia

Parameters	Coef.	Std. Err.	p-value	95% CI	
				Lower limit	Upper limit
B-ATT	0.137	1.68326	0.005	-5.37163	0.97896
RR-ATT	0.098	1.52238	0.046	-4.54283	1.84257
AW-ATT	0.132	1.61032	0.006	-4.58726	2.05098

AW-AAT: Abdominal wall adipose tissue thickness, B-ATT: Breast adipose tissue thickness, CI: Confidence interval, RR-AAT: Retrorenal adipose tissue thickness, Std. Err.: Standard error, Coef.: Coefficient

and physical examination. The primary imaging methods used for diagnosis are MG and USG. The widespread use of CT recently has increased the prevalence of incidentally detected gynecomastia (6). The mean age was 48.79 years in our study, and it points to that the cases mostly belonged to the middle age group. No comorbidity factor or pathology that could cause gynecomastia was detected in 47.5% of the cases. However, since clinical and radiological follow-ups of these cases were not performed individually, further interpretation could not be made about whether there was idiopathic gynecomastia.

Obesity is accepted as excessive energy accumulation in adipose tissue, and its regional deposition is closely associated with morbidity and mortality (12). The intraperitoneal adipose tissue is the visceral fat area that could be measured by CT scans for decades. Until date, the increase in the ratio of this tissue to subcutaneous adipose tissue has been accepted as visceral obesity in various studies (12-14). Visceral obesity is closely associated with metabolic syndrome and cardiovascular diseases, and reducing visceral adipose tissue also decreases the risks of these obesity-related disorders. Our study found a significant relationship between visceral adipose tissue thickness obtained from the retro-renal area called RR-ATT and gynecomastia ($p<0.05$). As far as we know, there is no other study investigating retrorenal fat tissue thickness and gynecomastia in the literature. Therefore, we believe that clinical evaluation regarding visceral obesity and obesity-related disorders would be beneficial in cases with incidental

gynecomastia detected on CT or primary gynecomastia diagnosed clinically.

Hepatic steatosis, also known as fatty liver disease, is associated with low testosterone and high estrogen levels, similar to gynecomastia (15). However, it is not possible to reach a definite conclusion in the literature to support a significant relationship between hepatosteatosis and gynecomastia. While a positive correlation was found between gynecomastia and subcutaneous fatty tissue thickness and body mass index (BMI) in literature performed with CT, no significant correlation was found with hepatosteatosis (6,16). Besides, CT scan has been reported to be more effective in diagnosing moderate to severe hepatic steatosis (17,18). Although our study did not specifically focus on cases diagnosed with fatty liver disease, no significant association was found with gynecomastia, similar to the literature ($p>0.05$) (6,19).

There may be several reasons for the result of our study to be insignificant with hepatosteatosis and significant but weakly related to adipose tissue thickness. The most critical reason may be the exclusion of patients with comorbidities known to cause gynecomastia. It is predictable that these comorbid factors are associated with gynecomastia or adipose tissue accumulation. In contrast, we focused on incidental gynecomastia detected without these etiological factors.

This study has some limitations. First, although our original sample was not small, a limited number of patients belonging to a particular time were studied. However, we did not analyze our sample by distributing it the age groups. Although some studies in the literature accept a cut-off of 1.5 cm for gynecomastia, we have studied 2 cm above, similar to the most accepted studies (7-9). It was not possible to correlate the gynecomastia findings observed on CT with MG or USG in all cases. BMI and physical examination findings could not be studied because of the retrospective design of the study. Despite the hospital records being examined in detail, it is not possible to know all the drugs used by the patients. Finally, liver size was not studied because it did not fully enter the cross-sectional area in any patients.

CONCLUSION

In conclusion, the resulting data of our study support that gynecomastia may be a precursor to more severe problems such as visceral obesity and obesity-related disorders rather than innocent hypertrophy. In clinical practice, a multidisciplinary management can be adopted in patients detected gynecomastia secondary to the CT scan.

ETHICS

Ethics Committee Approval: Our study was approved by İstanbul University-Cerrahpaşa, Non-Interventional Clinical Research Ethics Committee on 13/06/2022 with the decision number E-83045809-604.01.01-406516.

Informed Consent: Informed consent was waived because of the retrospective nature of the study.

Authorship Contributions

Surgical and Medical Practices: P.Ç.K., Concept: S.A.K., Y.K., A.K.U., Design: S.A.K., Y.K., A.K.U., Data Collection or Processing: E.M.Ö., E.Y.Ö., E.Ş.D., Analysis or Interpretation: S.A.K., Y.K., E.M.Ö., E.Y.Ö., Literature Search: S.A.K., A.K.U., E.Ş.D., Writing: S.A.K., Y.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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