

■ Original Article

Evaluation of bone mineral density as an indicator of possible osteoporosis in patients with rib fracture

Kaburga kırığı olan hastalarda olası osteoporozun bir göstergesi olarak kemik mineral yoğunluğunun değerlendirilmesi

Huseyin YILDIRAN

Konya Numune Hospital, Department of Thoracic Surgery, Konya/Turkey.

ABSTRACT

Aim: The most common pathology after thoracic trauma is rib fracture. In this study, it was aimed to determine whether there is a correlation between characteristics of fractures and bone mineral densities of patients treated with rib fracture after trauma.

Material and Methods: All patients were classified into the following two categories: i) Major trauma (traffic accident, stomping, and fall from height) and minor trauma (falls on a single level, after coughing, and after chopping wood); ii) Patients were also divided into two groups, single rib fracture and multiple rib fractures. In all patients, bone Hounsfield Unit (HU) measurements of L1, L2, and L3 corpuscles entering the thoracic tomography crosssections were performed and their average was recorded. The results were statistically analyzed using the t-test.

Results: Of the 23 patients included in the study (4 women, 19 men), all were over 18 years of age and the mean age was 52.1 (32-89) years. There were 12 patients with major trauma, 11 patients with minor trauma. There were only one rib fracture in 7 patients and multiple rib fractures in 16 patients. The mean bone density of all patients was 177.82.

Conclusion: The detection of significantly lower densities in a single rib fracture suggests that an injury that may not cause fracture in normal bone densities is likely to cause a single rib fracture in these patients. Patients whose bone mineral density average was lower than 160 were more likely to have rib fractures with minor trauma.

Keywords: Rib fracture, bone mineral density, trauma.

Corresponding Author*: Huseyin YILDIRAN, Konya Numune Hospital, Department of Thoracic Surgery, Konya/Turkey.

E-Mail: h-yildiran@hotmail.com

Received 15.08.2018 accepted 12.09.2018

Doi: 10.18663/tjcl.453669

ÖZ

Amaç: Göğüs travması sonrası acile başvuran hastalarda en sık tespit edilen patoloji kaburga kırığıdır. Bu çalışmada, travma sonrası kaburga kırığı tanısıyla yatarak tedavi edilen hastaların ve kırıklarının özellikleriyle kemik dansiteleri arasında ilişki olup olmadığının belirlenmesi amaçlanmıştır.

Gereç ve Yöntemler: Hastalar, i) Majör travma (trafik kazası, hayvan ezmesi, yüksekten düşme) ve minör travma (ayaktayken düşme, öksürük sonrası, odun kırma sonrası) geçirenler; ile ii) Kaburga kırığı sayılarına göre tek ve çoklu kaburga kırığı olanlar şeklinde iki gruba ayrıldı. Hastaların hepsinde toraks tomografisinde L1, L2 ve L3 vertebra korpuslarının kemik Hounsfield Ünitesi (HU) ölçümleri yapılarak ortalamaları alındı. Sonuçlar istatistiksel olarak analiz edildi.

Bulgular: Çalışmaya dahil edilen 23 hastanın (4 kadın, 19 erkek) hepsi 18 yaş üzerinde ve yaş ortalaması 52,1 (32-89) idi. 12 majör travma, 11 minör travma hastası saptandı. 7 hastada tek kaburga, 16 hastada çoklu kaburga kırığı mevcuttu. Tüm hastaların kemik dansiteleri ortalaması 177,82'ydi.

Sonuç: Tek kaburga kırığında anlamlı olarak daha düşük dansiteler saptanması, kemik dansitesi normal bireylerde kırık oluşturmayabilecek bir yaralanmanın bu hastalarda tek kaburga kırığı neden olabileceği ihtimali olduğunu düşündürmüştür. Kemik dansite ortalaması 160'tan düşük olan hastaların minör travmalar ile kaburga kırığı geçirme ihtimali daha yüksek saptanmıştır.

Anahtar kelimeler: Kaburga kırığı, kemik dansitesi, travma.

Introduction

Thoracic trauma is presently one of the causes of serious mortality and morbidity. The most frequently occurring pathology that is encountered in the practice of thoracic surgery after blunt traumas is rib fracture [1]. Bone mineral density has an effect on the occurrence of fractures. It has been shown that more than half of patients sustaining fractures as a result of low-energy trauma suffer from osteopenia [2]. The routine measurement method of bone density is "dual energy X-ray absorptiometry" (DEXA) [3]. In this way, bone densities of femur, vertebra, and hip are measured and the diagnoses of osteopenia and osteoporosis are established and patients are monitored according to the bone mineral density. However, studies have also used tomographic measurements for evaluating bone mineral density [4]. In the present study, the patients who were admitted to our clinic and treated for rib fracture caused by different types of trauma were compared with regard to average vertebrae density evaluated by tomography and the severity of trauma. According to these results, we aimed to investigate whether a relationship exists between the average bone mineral density and the occurrence of rib fracture.

Material and Methods

Patients who were admitted between November 2017 and January 2018 after sustaining thoracic trauma were included in the study. All patients were classified into the following two categories: i) Patients were divided into two groups as those with major trauma (traffic accident, stomping, and fall from height) and those with minor trauma (falls on a single level, after coughing, and after chopping wood). ii) Patients were also divided into two groups as

those with a single rib fracture and those with multiple rib fractures.

In all patients, bone Hounsfield Unit (HU) measurements of L1, L2, and L3 corpuscles entering the thoracic tomography cross-sections were performed (Threshold: -1000 +1000) and their average was recorded (Figure 1). The results were statistically analyzed using the t-test.

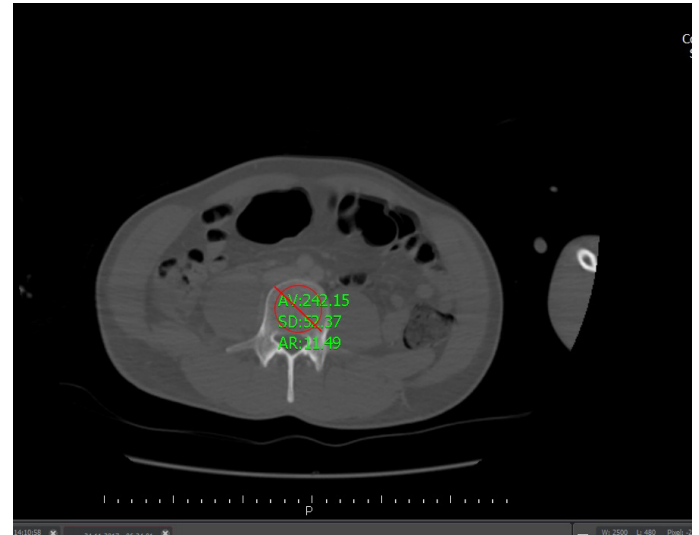


Figure 1. Evaluation for HU with computed thorax tomography.

Results

Twenty-three patients (4 females, 19 males) were included in this study; all patients were over the age of 18 years and the mean age was 52.1 (32–89) years. The mean age of female patients was 50.5 (43–64) years, whereas the mean age of male patients was 52.52 (32–89) years. There were 10 patients under the age of 50 years and there were 13 patients over the age of 50 years. The mean bone mineral density of patients under 50



years was 198.25 HU and the mean bone mineral density of patients above 50 years was 162.11 HU. There was a statistically significant difference noted between the two groups ($p=0.02$).

There were 12 patients with major trauma and 11 patients with minor trauma. Seven patients had a single rib fracture, whereas 16 patients had multiple rib fractures. Five patients (1 female, 4 males) with major trauma had also multisystem trauma.

The mean bone mineral density of all patients was 177.82 HU. The mean bone density in females was calculated as 168.97 HU, whereas it was 179.68 HU in males. There was no statistically significant difference between males and females ($p=0.62$). The mean bone density of seven patients with a single rib fracture was 153.61 HU, and the mean bone density of 16 patients with multiple rib fractures was 188.4 HU. There was a statistically significant difference noted between patients with a single rib fracture and those with multiple rib fractures in terms of bone mineral density ($p=0.04$). When the major and minor trauma groups were compared with regard to the severity of trauma, the mean bone density was found to be 194.4 HU in the major trauma group and 159.73 HU in the minor trauma group, and there was a statistically significant difference between the two groups ($p=0.02$). The mean bone mineral density in patients with minor trauma and those with multiple rib fractures was lower than that of patients with major trauma, and the difference was noted to be statistically significant ($p=0.01$) (Table 1).

Table 1. The characteristics of patients.

	Characteristics	Number	Mean HU	p-value
Gender	Female	4	168.97	0.62
	Male	19	179.68	
Age	<50 years	10	198.25	0.02
	>50 years	13	162.11	
Number of fracture	Single rib fracture	7	153.61	0.04
	Multiple rib fracture	16	188.4	
Type of trauma	Major trauma group	12	194.4	0.02
	Minor trauma group	11	159.73	
Multiple rib fracture with...	Major trauma	8	210.93	0.01
	Minor trauma	8	165.88	
Single rib fracture with...	Major trauma	4	161.34	0.45
	Minor trauma	3	143.32	

Discussion

The majority of cases with chest trauma are attributed to blunt trauma. The most common cause of chest trauma is traffic accidents. Isolated rib fractures can occur after trauma, but they may also be accompanied by life-threatening tracheobronchial, vascular, and cardiac injuries [5]. The number of affected ribs and their consequences vary on the basis of the severity of trauma, age, and patient characteristics. In addition to being a painful condition, rib fractures are significant because clinical conditions such as pneumothorax, hemothorax, diaphragmatic, and intra-abdominal injuries accompany them. Chest X-ray and thoracic computed tomography (CT) scans are the most frequently performed investigations after obtaining anamnesis and performing physical examination upon admission to the emergency room [6]. Thoracic CT is presently considered the gold standard imaging technique for the evaluation of pulmonary parenchyma, bone structures, and other intra-thoracic organs after chest trauma [7]. The HU, which is used for evaluating tissue density in CT, has become a standard measure of bone quality in conventional CT [8]. Bone mineral density is a very important measure in evaluating the fracture risk. DEXA is a widely accepted gold standard method in the measurement of bone mineral density [9]. Osteopenia or osteoporosis can be diagnosed on the basis of the measurement of bone mineral density. Rib fractures can occur as a result of high-energy injuries, which can be defined as major trauma, such as traffic accidents, fall from height, stomping, and so on. However, rib fractures that occur during activities such as coughing or wood breaking that are not supposed to cause an injury may suggest an underlying pathology in the bone structure. Patel et al. attempted to establish a standard HU value on CT scans of 2,200 patients by measuring thoracic and lumbar vertebral corpuses; they compared HU values of the 1st through the 4th lumbar vertebrae on DEXA and reported that a decrease in HU values was related to osteopenia and osteoporosis [9]. Radiologically, the mean HU value of 189.3 (± 58.9) was defined as normal, the mean HU value of 139.4 H (± 48.8) was defined as osteopenia, and the mean HU value of 107.2 (± 60.4) was defined as osteoporosis [9]. Osteoporosis is significant because of the increased risk of bone fracture as a result of the deterioration of the bone tissue structure and low bone mineral density [10]. Bone fracture can occur even with low-energy trauma; thus, osteoporosis screening is recommended for patients under the age of 50 years also.

In this study, the HU values in the cancellous portion of the

1st, 2nd and 3rd lumbar vertebral corpuses were measured on unenhanced thoracic CT scans of patients on their first admission to the hospital to include upper abdominal sections for visualizing all ribs, and the average of measurements obtained from the vertebrae was recorded for each patient. The mean bone mineral density for inpatients was 177.82 HU. This value is close to the normative HU value. Because of the increased risk of osteoporosis among patients aged above 50 years of age, the present study compared the HU values of patients in this age group with those of patients aged below 50 years, and the difference was noted to be statistically significant. The mean bone mineral density in patients above 50 years of age was measured as 162.11 HU and this was noted to be lower than normative values and the values of the other group. When the patients were examined according to number of rib fractures, significantly lower bone mineral density in patients with a single rib fracture suggests that an injury that is not supposed to cause a fracture in patients with a normal bone mineral density may cause a single rib fracture in these patients. Significantly lower HU values in patients in the low-energy trauma group compared with those in the major trauma group suggest that the bone structure is fragile in these patients. Interestingly, any activity that would not normally cause an injury has caused rib fractures in these patients and the underlying etiology requires investigation. In the present study, patients with a bone mineral density lower than 160 HU were more likely to have a rib fracture after sustaining low-energy trauma. This value is below the normative value and at the limit of osteopenia.

Conclusion

In the practice of thoracic surgery, it is recommended that patients with a single rib fracture or patients with rib fractures as a result of low-energy trauma be referred to relevant clinics for osteoporosis screening.

Declaration of conflict of interest

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

References

1. Liebsch C, Seiffert T, Vlcek M et al. The fracture patterns of serial rib fractures: A retrospective analysis of 383 cases. *Ortopaedic Proceedings* 2018; 100: 92-92.
2. Pereira L, Bliuc D, Stanford P, Eisman JA, Center JR. More-than-minimal-trauma fractures are associated with low bone density: an 8-year prospective study. *Osteoporos Int* 2017; 28: 103-10.
3. Kanis JA. Diagnosis of osteoporosis and assessment of fracture risk. *Lancet* 2002; 359: 1929-36.
4. Genant HK, Cann CE, Ettinger B, Gordan GS. Quantitative Computed Tomography of Vertebral Spongiosa: A Sensitive Method for Detecting Early Bone Loss After Oophorectomy. *Ann Intern Med* 1982; 97: 699-705.
5. Türk F, Özcan V, Yuncu G, Ekinci Y, Girgin S. Künt göğüs travması sonrası masif hemotoraksa neden olan izole sağ aurikula yırtığı. *Türk Gogus Kalp Dama* 2014; 22: 410-13.
6. Günay Ş, Eser İ, Kürkcüoğlu İC. Künt toraks travmalarında erken dönemde kemik sintigrafisi, bilgisayarlı tomografi ve direkt grafinin karşılaştırılması. *Tıp Araştırmaları Dergisi* 2013; 11: 103-6.
7. Göya C, Hamidi C. Torasik Travma. *Trd Sem* 2016; 4: 272-85.
8. Mah P, Reeves TE, McDavid WD. Deriving Hounsfield units using grey levels in cone beam computed tomography. *Dentomaxillofacial Radiology* 2010; 39: 323-35.
9. Patel SP, Lee JJ, Hecht GG, Holcombe SA, Wang SC, Goulet JA. Normative vertebral Hounsfield unit values and correlation with bone mineral density. *J Clin Exp Orthop* 2016; 2: 14.
10. Çobanoğlu U, Hız Ö, Sayır F, Ediz L, Şehitoğulları A. Travmatik ve atravmatik sternum kırıkları: 13 olgunun analizi. *Türk Toraks Derg* 2012; 13: 146-151.