



Superfluous computed tomography utilization for the evaluation of the pelvis and spinal column in an orthopedic emergency department

Acil ortopedi ve travmatoloji polikliniğinde omurga ve pelvis değerlendirmesi için gereksiz bilgisayarlı tomografi kullanımı

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Amaç: Bu çalışmada, acil ortopedi polikliniğinde omurga ve pelvis bölgesinin değerlendirilmesi için istenen bilgisayarlı tomografi (BT) sıklığı, BT istenme nedenleri ve çekilen BT'lerde pozitif ve negatif inceleme oranlarının belirlenmesi amaçlandı.

Çalışma planı: Ortopedi acil polikliniği tarafından bir yıl içinde (Eylül 2005-2006) BT çekilmesi istenen hastaların kayıtları incelendi. Bilgisayarlı tomografi istenme nedenleri, rapor edilen bulgular, hastaların yaş ve cinsiyetleri kaydedildi. İstem ile ilişkili olmayan bulgular içeren incelemeler negatif, istem ile uyumlu bulgular saptananlar pozitif BT olarak kabul edildi.

Sonuçlar: Ortopedi acil polikliniğine yapılan toplam 24378 başvurunun 1295'inde (%5.3) BT incelemesi istendi. Bunların 817'si (%63.1) omurga ve pelvis incelemeleriydi. Bu incelemelerin 418'i (%51.2) negatif BT olarak değerlendirildi. Negatif BT'li hastaların yaş ortalaması, pozitif BT'li hastalara göre anlamlı derecede düşük bulundu (sırasıyla 40.7 ve 45.1 yıl, $p=0.001$). Tüm grup için, negatif ve pozitif BT'li hastalar arasında cinsiyet dağılımı açısından farklılık saptanmadı ($p=0.670$). Omurga BT incelemelerinde bulunan negatiflik oranı, pelvis için saptanan orandan göre anlamlı derecede yüksek idi ($p<0.001$). Omurga BT'lerinde, üst torakal ve servikal vertebralarda negatif BT oranı, alt torakal ve lomber bölgelere göre anlamlı derecede fazlaydı ($p<0.001$).

Çıkarımlar: Omurga ve pelvis incelemelerinde çekilen BT'ler için bulunan yüksek negatiflik oranı, acil servislerde gereksiz BT kullanımına yönelik tedbirler alınmasını gerektirmektedir.

Anahtar sözcükler: Acil tıp hizmeti; pelvis/radyografi; omurga/radyografi; bilgisayarlı tomografi.

Objectives: This study was designed to investigate the frequency of requests for computed tomography (CT) examination of the spinal column and pelvis in our emergency orthopedic department, the reasons of requests, and the rates of positive and negative CT examinations.

Methods: We retrospectively reviewed patients for whom a request for CT examination was made by the emergency orthopedic department within a year (September 2005-2006). The reasons for CT requests, findings in CT reports, and age and sex of the patients were recorded. Findings unrelated and related to the original request denoted a negative and positive CT examination, respectively.

Results: Of 24,378 admissions to our emergency orthopedic department, a CT scan was requested in 1295 patients (5.3%). In 817 patients (63.1%), CT examination involved the pelvis or the spinal column. Of these, 418 CT scans (51.2%) yielded a negative result. The mean age of the patients with a negative CT scan was significantly lower than those having a positive CT scan (40.7 vs 45.1 years; $p=0.001$). There was no significant difference with respect to sex between patients having negative and positive CT findings ($p=0.670$). Compared to pelvis CT scans, the frequency of negative CTs was significantly higher for spinal column examinations ($p<0.001$). The incidence of negative CT scans for upper thoracic and cervical vertebrae was significantly higher than that found for lower thoracic and lumbar regions ($p<0.001$).

Conclusion: The high incidence of negative CT scans documented for pelvic and spinal column examinations underlines the need for measures to avoid superfluous CT requests in emergency departments.

Key words: Emergency medical services; pelvis/radiography; spine/radiography; tomography, X-ray computed.

Traffic accidents constitute the 65 % and fall from height constitutes the 15 % of whole orthopedics emergency admissions.^[1, 2] Fractures of vertebral column and pelvis are frequently seen in patients who were subjected to such high energy injuries.^[3, 4] It is suggested to screen vertebral column and pelvis radiologically in these patients and in those unconscious patients having multi-trauma injuries.^[5] Direct graphy is the first and the most frequently used radiologic method in screening.^[6-9] In addition to this, some factors can prevent or delay the diagnosis of the fractures such as: the presence of simultaneous fractures in adjacent or not-adjacent levels in vertebrae, coexistence of other injuries that threaten life, inability to acquire good quality direct graphies in emergency units.^[7,10,11] Many liability cases may arise from such diagnostic and treatment delays.^[12] In suspected patients, advanced screening methods should be used. Computerized tomography (CT) is a frequently used investigation method in the diagnosis of spine and pelvic injuries. When trauma is due to speed over 50 km/hr in traffic accidents, fall from height over 3 metres or when the Glasgow Coma Score under is eight point or if patients have neurological damage, it is suggested to use tomography routinely in vertebral screening.^[13] On the other hand, superfluous utilization of computed tomography cause waste of important financial and manpower resources.

The aim of this study is to find out the frequency of computed tomography which is requested for the evaluation of vertebral column and pelvis at emergency orthopedics department and also to find out the frequency of improper computed tomography requests by evaluating the results.

Material and method

The CT reports of patients who were admitted to the emergency orthopedics department in one year (05.09.2005- 05.09.2006) were evaluated. The emergency orthopedics department registration records, computer-based hospital registration system (Cortex, Tepe Technology Services JSC) and CT reports were utilized in collecting data. The CT evaluations which included random and unrelated findings were regarded as negative. The findings which were directly related to the request were named as positive. CT requests were grouped as cervical, thoracic and lumbar vertebrae, pelvis, sacrum, sacroiliac joint, acetabulum, hip, knee, foot, wrist, shoulder and elbow, hand and wrist and other requests. Thoracic vertebrae

was divided into two groups which were upper thoracic (thoracic 6 and upper) and lower thoracic (thoracic 7 and lower). Iliac bone, sacrum, acetabulum and hip joint CTs were named as pelvis CT in sub-group analysis.

The data was analysed by SPSS 13.0 pocket programme. Descriptive methods were used for determining the frequencies and the averages; t-test was used for comparing the averages; chi square was used for comparing the rates and Spearman correlation analysis tests were used for searching relations. Alpha value was determined as 0,05.

Results

Total of 24378 patients were admitted to our emergency orthopedics department in one year. Totally 1295 CT evaluations were requested (% 5.3). mean age of the patient was 42.8 (7-84) years. The distribution of requests according to regions was shown in Table-1. It was found that totally 817 CT evaluations were carried out for vertebral column and pelvis. 418 of these evaluations (% 51.2) were negative CT. According to their average age, patients with negative CT were found out to be younger than the patients with positive CT (40.7 vs 45.1 years, $p=0.001$). In the whole group, there were no difference between the sexes of the patients with positive CT and negative CT. At the vertebral column, the rate of negative CT was higher compared to the pelvis. ($p<0,001$) At the upper thoracic and cervical vertebra, there were higher rate of negative CT compared to the lower thoracic and lumbar region ($p<0,001$).

Table 1. The distribution computerized tomography requests according to regions shown with number and percent in emergency in a year.

	Number	Percent
Cervical vertebrae	55	4.3
Upper thoracic vertebrae	57	4.4
Lower thoracic vertebrae	148	11.4
Lumbar vertebrae	278	21.5
Pelvis (sacrum, sacro-iliac joint, iliac wing, acetabulum, hip)	279	21.5
Knee	125	9.7
Foot - ankle	184	14.2
Shoulder	135	10.4
Elbow	29	2.2
Hand - wrist	5	0.4
<i>Total</i>	1295	100.0

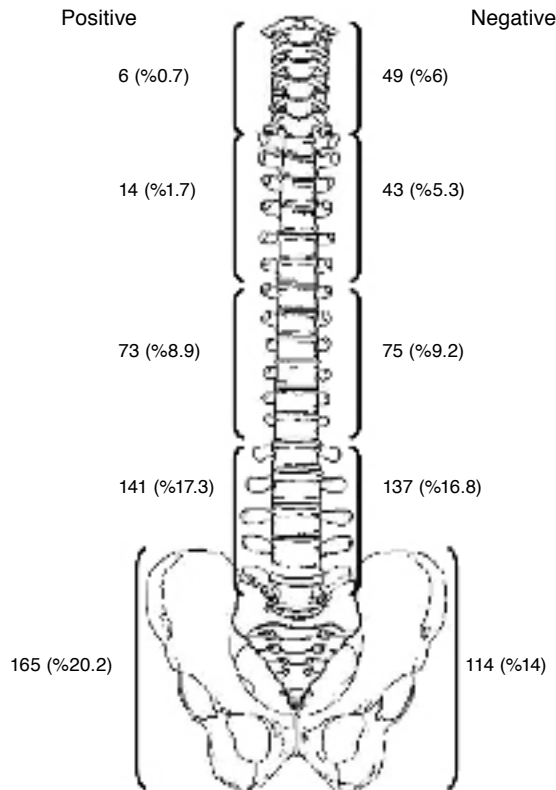


Figure 1. The distribution of areas of vertebrae and pelvis CTs. The numbers on the right side of the figure show the positive CTs and the numbers on the left side of the figure show the negative CTs. First numbers indicate the number of the requests, and numbers in paranthesis indicate the percent of all the vertebrae and pelvis investigations.

Discussion

According to the results of this study, the financial burden of negative CTs' utilized in emergency orthopedics department in 2006 was very high. As it was stated in 2006 budget payment regulations, the anteroposterior and lateral projections direct graphy screening of spine and anteroposterior direct graphy screening of pelvis was 43,91 YTL, on the other hand the CT screening of the mentioned regions costs 243,5 YTL (Table- 2). The cost of the negative vertebrae CTs which was found out in our study was 18,057 YTL and the cost of negative pelvis CTs was 7,444 YTL. Total cost of the negative vertebral and pelvis CT's was 25,501 YTL. Taking into consideration that these figures are also valid in other hospitals, it can be easily recognized that the cost of yearly superfluous utilization of CT reaches very high figures.

The literature generally supports the utilization of CT routinely especially in screening of the spi Howe-

Table 2. The graphies frequently used in the screening of vertebral column and pelvis and the costs in our hospital according to 2006 budget payment regulation.

	Cost (YTL)*
Direct Graphy	
Two-sided cervical vertebrae	11.22
Two-sided thorocal vertebrae	13.09
Two-sided lumbar vertebrae	11.90
Pelvis A.P.	7.70
CT**	
Vertebral CT for four segments	59.40
Pelvic CT	65.30

* : YTL: Yeni Türk Lirası (New Turkish Liras)

** : CT : Computerized Tomography

ver, to our knowledge, the results of the utilization of CT routinely in screening of the vertebral column has neither been studied nor published in our country. Many publications reported that patients who were subjected to high energy injuries frequently had vertebrae and pelvis fractures.^[4, 5, 14, 15] In our previous study, it was found that of 21786 patients who were admitted to emergency orthopedics department, patients having vertebrae and pelvis factures constituted the % 2,6 of total admissions and % 8,1 of all fractures.^[2] Particularly the diagnosis of vertebral fractures should be made rapidly and accurately since they may have vital importance in patients with multiple injuries.^[16] Radiologic screening methods are the most valuable diagnostic instruments for detecting the fractures of both regions.^[6, 8] The first radiologic method referred is direct graphies. In addition to this, CT is frequently utilized when the diagnosis is suspicious. In some conditions advanced screening methods such as magnetic resonance or angiography may also be utilized. Low sensitivity rate of the direct radiographies has made CT be used routinely in the first line assessment of the patients after high energy injuries.^[4,9,16,17] According to some authors, if available, the reformatted slices of the abdominal and thoracic tomographies can provide enough information for this screening.^[17]

Many studies stated that computerized tomography is a delicate and positive diagnostic instrument particularly in the diagnosis of spine fractures.^[3,4,9,16-19] To best of our knowledge, this study is the first which tries to find out the accuracy rate of spine and pelvis CT requests in emergency orthopedics department in our country. The findings of acute trauma were not recognized in % 51,2 of vertebral and pelvic CTs which were requested in our emergency orthopaedic

department. Acquiring direct graphies in these patients before CT is a routine practice. Trying to diagnose the fractures by using direct graphies and than the CT increases the financial cost and the time.^[3,18] The principal aim of health services is to increase the quality and to maintain this quality throughly. In this respect, preventing overcosts is very important to achieve this aims. However, calculation of the costs can differ in theory than in practice. In the study of Hauser et al. it was found out that in order to acquire five graphies which are necessary to provide proper screening of spine, $10,5 \pm 0,5$ graphies should be taken on average.^[4] In such cases, the radiation exposure and examination cost is more than it has been calculated. According to the same study, when the spine is screened with CT, less time was spent on stretcher and in the emergency units, and paralel to this, the need for personnel was considerably reduced.

To guarantee the correct diagnosis many orthopaedic emergency department doctors choose to order additional diagnostic tests. On the other hand the increasing costs of additional examinations put very high financial loads onto the repayment system. We can say that specific conditions which was discussed before for the screening of spine with CT has still been valid for our country. As it was stated in the introduction, in patients with determined pre-conditions, vertebral coloumn and pelvis should be routinely investigated with CT, while for the other patients, if there is no finding related to acute trauma in adequate direct graphies, supervision and tertiary assessment protocols should be applied. According to a research, the effects of the protocols which try to reduce additional diagnostic test requests in the emergency unit are permanent and its financial costs benefits are considerably high.^[19]

One of the risks of the protocols which reduce the number of additional examinations and the financial cost is the potential problem of inability to diagnose some important injuries in the first admission. It is probable not to be able to detect some injuries which may cause alteration of treatment, despite training of the personnel and advanced screening methods. The Older the age of the patients and the higher the energy of injury the higher the risk. Although patients with negative CT were younger in our study, the reason of this finding was probably the involvement of the pediatric patients in our study in contrast to Levi's study.^[20] As our aim is to find out the role of negative

CT rate of spine and pelvis, we tought it would be better to assess both the adult and pediatric patients.

The assessment of both adult and pediatric patients results together can be regarded as one of the weaknesses of our study. One other weakness of our study is the assessment of CTs only through the radiology department reports. The reassessment of CT sections of all study group patients would increase the value of our study. However it was impossible to access these films many of which were the dispute at law.

In conclusion, routine CT screening of vertebral coloumn and pelvis in trauma patients is a practice with high financial cost. The emergency services should prevent superflous utilization of CT by preparing protocols according to their budget and by training their personnels. The protocols can be prepared nation-wide and some necessary changes can be made in regional levels. As a result the benefits can be used in the general improvement of health services.^[21]

References

1. Dağlar B, Taşbaş BA, Bayrakçı K, Özdemir G, Savaş MS, Günel U. Acil ortopedi ve travmatoloji poliklinik başvurularında gereksiz bilgisayarlı tomografi kullanımı. In: XVIII. Milli Türk Ortopedi ve Travmatoloji Kongre Kitabı; 18-23 Ekim 2003; İstanbul, Türkiye. s. 201-2.
2. Daglar B, Bayrakci K, Tasbas BA, Ozdemir G, Agar M, Gunel U. Emergency department orthopedic applications in a year at a referral hospital: prevalence study of 21783 patients. In: 6th European Trauma Congress; May 16-19, 2004; Prag, Czech Republic. European Journal of Trauma 2004;30 Suppl 1: p. 64.
3. Berry GE, Adams S, Harris MB, Boles CA, McKernan MG, Collinson F, et al. Are plain radiographs of the spine necessary during evaluation after blunt trauma? Accuracy of screening torso computed tomography in thoracic/lumbar spine fracture diagnosis. J Trauma 2005;59:1410-3.
4. Hauser CJ, Visvikis G, Hinrichs C, Eber CD, Cho K, Lavery RF, et al. Prospective validation of computed tomographic screening of the thoracolumbar spine in trauma. J Trauma 2003;55:228-34.
5. France JC, Bono CM, Vaccaro AR. Initial radiographic evaluation of the spine after trauma: when, what, where, and how to image the acutely traumatized spine. J Orthop Trauma 2005;19:640-9.
6. Durham RM, Luchtefeld WB, Wibbenmeyer L, Maxwell P, Shapiro MJ, Mazuski JE. Evaluation of the thoracic and lumbar spine after blunt trauma. Am J Surg 1995;170:681-4.
7. Dai LY, Yao WF, Cui YM, Zhou Q. Thoracolumbar fractures in patients with multiple injuries: diagnosis and treatment-a review of 147 cases. Trauma 2004;56:348-55.
8. Gray L, Vandemark R, Hays M. Thoracic and lumbar spine

- trauma. *Semin Ultrasound CT MR* 2001;22:125-34.
9. Wintermark M, Mouhsine E, Theumann N, Mordasini P, van Melle G, Leyvraz PF, et al. Thoracolumbar spine fractures in patients who have sustained severe trauma: depiction with multi-detector row CT. *Radiology* 2003;227:681-9.
 10. Patel RV, DeLong W Jr, Vresilovic EJ. Evaluation and treatment of spinal injuries in the patient with polytrauma. *Clin Orthop Relat Res* 2004;(422):43-54.
 11. Dai LY, Jia LS. Multiple non-contiguous injuries of the spine. *Injury* 1996;27:573-5.
 12. Gould MT, Langworthy MJ, Santore R, Provencher MT. An analysis of orthopaedic liability in the acute care setting. *Clin Orthop Relat Res* 2003;(407):59-66.
 13. Daglar B, Tasbas BA, Bayrakci K, Ozdemir G, Gungor E, Gunel U. Improper use of computerized tomography (CT) at the orthopedic emergency applications in an educational institute. In: 6th European Trauma Congress; May 16-19, 2004; Prag, Czech Republic. *European Journal of Trauma* 2004;30 Suppl 1: p. 64.
 14. Sung CK, Kim KH. Missed injuries in abdominal trauma. *J Trauma* 1996;41:276-82.
 15. Sava J, Williams MD, Kennedy S, Wang D. Thoracolumbar fracture in blunt trauma: is clinical exam enough for awake patients? *J Trauma* 2006;61:168-71.
 16. Brown CV, Antevil JL, Sise MJ, Sack DI. Spiral computed tomography for the diagnosis of cervical, thoracic, and lumbar spine fractures: its time has come. *J Trauma* 2005;58:890-5.
 17. Sheridan R, Peralta R, Rhea J, Ptak T, Novelline R. Reformatted visceral protocol helical computed tomographic scanning allows conventional radiographs of the thoracic and lumbar spine to be eliminated in the evaluation of blunt trauma patients. *J Trauma* 2003;55:665-9.
 18. Brandt MM, Wahl WL, Yeom K, Kazerooni E, Wang SC. Computed tomographic scanning reduces cost and time of complete spine evaluation. *J Trauma* 2004;56:1022-6.
 19. Gallagher EJ, Trozky SW. Sustained effect of an intervention to limit ordering of emergency department lumbosacral spine films. *J Emerg Med* 1998;16:395-401.
 20. Levi AD, Hurlbert RJ, Anderson P, Fehlings M, Rampersaud R, Massicotte EM, et al. Neurologic deterioration secondary to unrecognized spinal instability following trauma-a multicenter study. *Spine* 2006;31:451-8.
 21. Eryılmaz M. Ülkemizde acil sağlık hizmetleri: İhtiyaca yönelik güncel çözüm önerileri. *Ulus Travma Acil Cerrahi Derg* 2007; 13:1-12.