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Research Article

Frequency of Under-Reporting of Lumbar Spondylolysis and Spondylolisthesis on Abdomino-Pelvic CT in Non-Traumatic Patients at Tertiary Care Hospital

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Abstract

Background: Many incidental deformities of musculoskeletal system can usually be adequately recognized through abdominopelvic CT scans. However, abnormalities such as spondylolysis and spondylolisthesis are generally missed by radiologist due to lack of sagittal images on a routine abdominal CT.

Objective: To find out the prevalence of unreported cases of spondylolysis and spondylolisthesis in non-traumatic population undergoing abdominopelvic CT scan at a tertiary care hospital.

Study Design: Cross sectional study.

Setting: Department of Radiology, Liaquat National Hospital, Karachi.

Duration: From 13th August 2017 to 12th February 2018.

Material and Methods: We conducted a cross sectional study on 196 abdominopelvic CT scans of patients without any history of trauma. Two consultant radiologists commented on absence or presence of spondylolysis and spondylolisthesis. The spondylolisthesis was further graded and spondylolysis was divided as unilateral or bilateral. Under reporting was evaluated by whether one consultant reported lesser cases than the other. Then descriptive statistics were calculated and stratification was performed. Finally, we applied post stratification chi square test. P value of < 0.05 was taken as significant.

Results: Of 196 patients recruited, 103 were males and 93 were females. 51.53 ± 12.14 years were the mean age of our study population. Spondylolysis was identified in 46.4% with 76.6% unilateral cases and 23.4% bilateral cases. 54.6% cases were diagnosed as spondylolisthesis. Grade I, II and V were 18.7% each. Whereas grade III was 22.4% and grade IV was 21.5%. 52.0% cases were underreported as observed in this study.

Conclusion: Under reporting in 52.0% of cases suggest that this may result in delayed treatment of spondylolysis and spondylolisthesis.

Keywords: Under Reporting; Lumbar Spondylolysis; Spondylolisthesis; Abdomino-Pelvic CT; Nontraumatic Patients

Introduction

A very usual complain of active adults and adolescents is backache. Physician often have to deal with children and young individuals coming up with this complain. It is even commoner for an orthopedic or sport medicine specialist to encounter this. In fact, 10 to 15% of young athletes will feel back pain at some point in life. However, the key is to realize that in these young active individuals the cause of back ache is different than the adult counterparts [1].

Micheli and Wood [2] established that spondylolysis is the major prevailing reason for backache in young athletes, seen in as many as 47% of low back pain (LBP) cases. On the contrary spondylolysis is rarer in adults. The most common cause being the discogenic backache in this population. Moreover, adults often suffer lumbosacral strain which is rarer in young athletes, seen only in 6% of cases. Spondylolysis and spondylolisthesis are two usual and confounding identification by health care professionals in patients with assessment of low back pain. Spondylolysis is the defect in the pars interarticularis (i.e. isthmus) that may affect one or both sides [3]. Spondylolisthesis is the true displacement of one vertebra on its adjacent caudal vertebra [4].

Spondylolisthesis can be in anterior or posterior direction. In the adult population, defect in bone architecture, trauma or degenerative process are the usual reasons for spondylolisthesis and occur at the level of lumbarspine [5]. These words come from the ancient Greek origin with *spondylos*, meaning "vertebra", and *olisthesis*, meaning "to slide". In year 1772 the Belgian obstetrician Herbiniaux for the first-time observed spondylolisthesis [6] in a complicated delivery due to restricted passage, as a result of forward displacement of L5 over sacrum.

It was later in year 1854 the term was used for the first time by Kilian in Lonstein., *et al* [7]. In more severe cases of spondylolisthesis the vertebra can move in forward and caudal direction. However, there is no such slippage in spondylolysis. Due to vast number of anatomical and clinical types of spondylolisthesis, it is quite challenging to be fully understood by orthopedics, neurosurgeons and pediatricians. It is one of the few pathologies of column with so much therapeutic ambiguity. Spondylolisthesis is just not the slippage of single vertebra over the vertebra below. We must not forget that the whole column above the slipped vertebra moves and hence the expected consequences are faced. The cause of the disease is multifactorial and not yet clearly understood. There lies ambiguity in the natural history as well as in its etiology, pathology and development [8].

Mostly the pain of spondylolisthesis and spondylolysis is well endured by patients. However, at time the seriousness of the symptoms not responding to medical treatment requires surgical therapies [9]. Biomechanical stresses on an inherently week or abnormal pars interarticularis results in its hypoplasia, elongation or sclerosis [10]. This in turn leads to spondylolisthesis and spondylolysis.

The chronic low-grade trauma to the lumbar spine during flexion, extension and rotation are the essential drivers of biomechanical stresses. These are particularly specific to bipedal locomotion of humans [10-12]. Despite the fact, there is some proof that the cause of spondylolysis and spondylolisthesis is the result genetical changes or acute injury [10]. But the higher frequency among those engaged with strenuous exercise and complete absence amongst quadrupeds suggest that upstanding posture in humans is essential driver of these pars interarticularis defects [10,11]. L5 vertebral body is the mostly involved vertebral level in spondylolisthesis and spondylolysis. Vertebral subluxation and disc de generation can occur after sometime of bilateral spondylolysis [13-16].

Although there is frequent association of spondylolisthesis and spondylolysis with pain and disability, many instances of these happen without any related complains i.e. patients may remain asymptomatic [11,17,18]. Previously studies suggested that spondylolisthesis and spondylolysis were frequently associated with pain but one reason for such relationship seems to be that the population in which they were mostly studied had these symptoms. However, nowadays no such relationship is drawn between spondylolisthesis and other lumbosacral abnormalities and it has been reported in asymptomatic population as well [11,19].

Adequate data is provided by abdominopelvic CT scans in patients with or without symptoms to recognize incidental musculoskeletal variations [20]. Nonetheless, musculoskeletal abnormalities portrayed on abdominopelvic CT scans are often neglected by radiologists particularly the bony and soft tissues abnormalities of spine, hip and pelvis. Although most musculoskeletal abnormalities may have no importance but some may be more significant than the abdominopelvic pathologies. The diagnosis and understanding spondylolisthesis and spondylolysis is made easier by advancement in CT imaging but the prevalent presence of spondylolisthesis and spondylolysis in obviously asymptomatic patients have rendered most such conclusions as "fortuitous radiographic findings" [10,11].

The most accurate imaging modality for the recognition of spondylolisthesis and spondylolysis is CT [16]. As far as we know, there is general scarcity of information on the utilization of CT to assess the frequency of spondylolisthesis and spondylolysis in patients looking for medical treatment for unrelated conditions. Our study was designed to decide the rate of spondylolisthesis and spondylolysis in patient population who were referred with complains other than that of lumbosacral region and to discover what amount is really reported.

Material and Method

During August 13th 2017 to February 12th 2018 we conducted this study at radiology departed of Liaquat National Hospital Karachi. The ethical committee approved our study design and we determined sampling size by WHO software taking into account spondylolisthesis being underreported on abdominopelvic CT scans in asymptomatic patients (p) = 85% [20], margin of error (d) = 5%, Confidence level = 95%. The sample size showed up to be 196 patients. Non probability sequential sampling was employed. 30 to 70 of either sex population was registered. The registered patients either had abdominal pain or at least one week evaluated by using VAS score (abdominal pain was taken as positive if VAS score more than 1) or had mild abdominal pain (i.e. 1 to 3). Patients who underwent CT scan for any other reason but trauma were included. Further we excluded patients who had diabetes mellitus, hypertension or known metastatic bone disease. This was evaluated and confirmed by history.

We took patients who had no history of injury and underwent abdominopelvic CT scan within months at radiology department of Liaquat National Hospital. Before enrolment, patients were briefed and written permission were taken. CT scans were assessed again in all these patients to see under reporting of lumbar spondylolisthesis and spondylolysis, Consultant radiologists with expertise of over 5 years reviewed these CT scans. Both were unaware of the final reports of the CT scans done by the other. CT scans were carried out using 16 slice CT scanner and with thickness of 1.25 mm. The parameters kept were 120 kVp and variable mAs so as to accomplish noise index of 25. Most scans were carried out with contrast i.e. Omnipaque 300, 100 ml (300 mg/ml iodine, GE Healthcare). The scan was recovered from digital storage facility. Initially axial images were evaluated and later the sagittal reformatted images were seen. The principle conclusion was either presence or absence of spondylolisthesis and spondylolysis. If spondylolisthesis was present then its grading was noted and if spondylolysis was noted then whether its unilateral or bilateral was commented. If the final assessment of spondylolisthesis and spondylolysis by one specialist was less than the other, the reporting taken as under reporting. A designed Performa was used to record all data using principal investigator. Exclusion criteria was pursued rigorously to avoid confounding parameters. Data analysis was done by SPSS version 21. Frequencies and percentages were computed and qualitative factors were processed such as sex, spondylolisthesis and its grades, spondylolysis (unilateral or bilateral) and under reporting (yes/no). Quantitative factors like age, duration and pain score were displayed as mean ± standard deviation. Effect modifiers for e.g. Sex, age, period and pain score were monitored through stratification. Post stratification chi square test was employed. P value of < 0.05 was taken as significant.

Results

Out of 206 patients, 103 were males and 93 were females. 51.53 ± 12.14 years were the mean age of our study population. 12.93 ± 3.93 months were the mean duration of our study. 1.93 ± 0.82 was the mean pain score. 54.6% cases were reported as positive for spondylolisthesis as shown in table 1. As long as grades are concerned =, it was noted that grade I, II and V 18.7% each, whereas grade III came out to be 22.4% and grade IV to be 21.5% as shown in table 2. Spondylolysis turned out in 46.4% of cases as shown in table 3. Furthermore, it was noted that 23.4% of cases involved both sided and unilateral involvement was seen in 76.6% as shown in table 4. 52.0% of cases were noted to be under reported. Table 5 shows the complete results. Figure 1 CT Scan of Abdomen in sagittal view shows grade II spondylolisthesis of L5 over S1 in appropriate bone window, while figure 2 shows spondylolysis at L5 level with grade I spondylolisthesis of L5 over S1.

	Frequency	%
Yes	107	54.6
No	89	45.4
Total	196	

Table 1: Frequency distribution of spondylolisthesis (n = 196).

	Frequency	%
1	20	18.7
2	20	18.7
3	24	22.4
4	23	21.5
5	20	18.7
Total	107	

Table 2: Frequency distribution of grade of spondylolisthesis (n = 107).

	Frequency	%
Yes	91	46.4
No	105	53.6
Total	196	

Table 3: Frequency distribution of spondylolysis (n = 196).

	Frequency	%
Unilateral	82	76.6
Bilateral	25	23.4
Total	107	

Table 4: Frequency distribution of side involved (n = 196).

	Frequency	%
Yes	102	52.0
No	94	48.0
Total	196	

Table 5: Frequency distribution of under reporting (n = 196).

Figure 1: Grade II spondylolisthesis of L5 over S1.

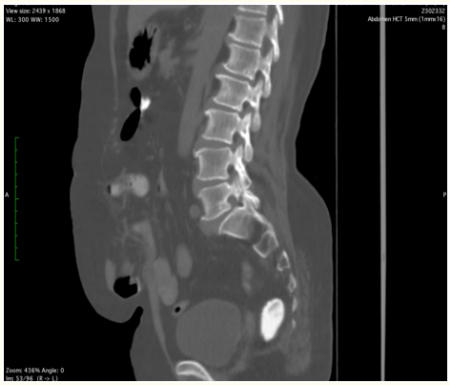

Figure 2: Spondylolysis at L5 level with grade I. Spondylolisthesis of L5 over S1.

Discussion

With increasing age, the fracture prevalence also rises [21]. In spite of this most fractures remain underdiagnosed and undertreated. Previous studies have demonstrated that one of the frequent incidental findings on radiology examination are fractures itself. Clinically important fractures are seen in as many as 6 elderly patients who undergo radiography [22]. However, 16 to 55% of fractures are underreported by radiologists [23-25]. What is worse is that even if reported, these fractures are not always treated. The results of under treatment and diagnosis are clear and should be taken into consideration. Patients with fractures of vertebral body has an increase risk of vertebral and femoral fracture of 4 - 5-fold and 2-fold respectively [26]. If 3 vertebral fractures are already present, this risk rises to 11-fold and 3-fold for vertebral and femoral fractures respectively [27].

There are few factors that may have added to underreporting. In the first place many radiologists only examine the axial images. Although the thin sections were available but no sagittal reformats were taken. Despite the fact, that most severe vertebral fractures are usually missed in axial images. Furthermore, failure to understand the clinical outcome of vertebral fractures and the mistaken belief that in chest or abdominal scan the findings of spine might not be necessary or relevant to report further adds to underdiagnosis. This suggests that there is lack of knowledge amongst radiologist and that academic majors should be taken to make them realize the importance of such findings [27].

In abdominal CT scans of adults, the prevalence and reporting rates of vertebral body fractures was estimated in 2 previous population studies. Bartalena., *et al*. [23] and Obaid., *et al*. [24] revealed that vertebral body compression fracture prevalence rates of 9.5% and 13.6% and CT identification rates of 14.6% and 4.7%, respectively. Assessing vertebra body compression fracture through only axial images is not enough. Even in vertebral body compression fractures the main complain can be flank pain or backache. Such cases suggest that even in studies done for flank pain or backache special consideration should be given to vertebral column as poorly localized pain in these cases can also be due vertebral body compression fracture.

Investigators in two prior published studies assessed prevalence and reporting rates of vertebral body compression fractures at abdominal CT in adults. Bartalena., *et al*. [23] and Obaid., *et al*. [24] reported vertebral body compression fracture prevalence rates of 9.5% and 13.6% and CT identification rates of 14.6% and 4.7%, respectively. Use of only transverse CT images is inadequate for diagnosis of vertebral body compression fractures. In pression fracture was flank or back pain, symptoms that may have been at-

tributable to the vertebral body compression fracture. These cases serve as a reminder for radiologists to pay special attention to the spine when reading scans from studies performed for this indication because vertebral body compression fractures often manifest with poorly localizing pain.

In another study by Williams., *et al*. [25] it was established that only 35% of vertebral body compression fractures were reported by specialist musculoskeletal radiologist, when only axial images were reviewed. As identification if these fractures is so low and sagittal images are important for detection, it is believed that sagittal images were not obtained during picture archiving and communication system work station at the time of initial reporting. Vertebral body compression fractures are not routinely looked for in the abdominal scans and are there for missed in spite of their clinical importance.

As might be expected that the history of backpain and flank pain may call the attention of the radiologist to spine resulting in increased detection of the vertebral body compression fracture. But this is not the case if only axial images are interpreted and unless grossly abnormal. Hence, only obvious fractures were most probably reported then were the moderate fractures, and that was because only the severe fractures were evident on axial images. Moreover, even the history of flank pain and backache stressed out towards renal and ureteric abnormality than that of spine. CT did not report 64% (52 of 81) of vertebral body compression fracture of lower thoracic or lumbar region [26].

Vertebral body compression fracture is related with increased mortality rate in both symptomatic and asymptomatic cases. The rate also increases with the increase in number of vertebral body compression fractures [26]. Therefore to reduce patient's mortality and morbidity rates one needs to report vertebral body compression fractures consistently and unequivocally.

More males than females were included in our study population. 51.53 ± 12.14 years was the mean age. 1.93 ± 0.82 was the mean score with 37.8% having low grade pain. 54.6% cases were reported as positive for spondylolisthesis. Grade I, II and V were reported to be 18.7% each, grade III to be 22.4% and grade IV was 21.5%. Furthermore, 46.4% of cases were deemed positive for spondylolysis. Of them 76.6% were unilateral while 23.4% of cases involved both sides. 52% of cases were underreported in our study. Amongst the positive cases reported more were females with age younger than 50 years, disease of less than 10 days and pain score of VAS 3.

Belfi., *et al*. carried out a study to establish the prevalence of spondylolysis and spondylolisthesis in population undergoing inpatient and emergency abdominopelvic CT scans for unrelated abnormalities [27]. In this study a total of 510 ct scans were reviewed. L5 spondylolysis was noted in 29 suggesting 5.7% incidence rate. Of these 29 cases, 20 were male and 9 were females. The mean age of the females with spondylolysis was 59 years. The mean age of the male patients with spondylolysis was 52 years. The male to female ratio came out to be 2:1 for spondylolysis at L5 vertebral level. No cases of either spondylolysis and spondylolisthesis were reported at any level other than L5 vertebral body. Bilateral spondylolysis was noted in 23 patients and unilateral in 6 patients. Sakai., *et al*. also stated that 90.3% of the cases involved L5 vertebra, 5.4% involved L4 vertebra and 3.2% in L3 vertebra. In another study May stated that in a study population of 360 patients, spondylolysis was identified in 48.3% at L5 vertebral level. 24.1% at L4 vertebral level and 10.3% at L3 vertebral level [6].

Rauch and Jinkins [11] stated prevalence of spondylolysis to be 3% to 10% in general population. Moreover, the prevalence was found to be the same in the population with symptoms and without symptoms. The major symptom being the backache. Rauch and Jinkins also stated that males presented more with spondylolysis than females with the ratio ranging 2:1 to 4:1. Harvey., *et al.* [18] stated that prevalence of spondylolysis was much higher in some sports activities. The ratio being 23% to 63% in patients involved in certain sports in comparison to 4% to 8% as noted in general population. Moreover, Harvey found that almost 95% spondylolysis occurred at L5 vertebra. Finally, Leone., *et al.* [10] also stated that the prevalence of spondylolysis was far higher in individuals involved in sporty activities. These being 63% as compared to general population where the rate came out to be just 6%.

Study Limitations

One of the major limitations of our study is the smaller size of the study sample. Other limitations include single center and non-randomized study. Outcomes might not be generalizable to larger population as out study focused on urban community.

Conclusion

Spondylolysis and spondylolisthesis are two commonly occurring diseases. Both these entities may occur in population who are either asymptomatic or have unrelated clinical symptoms. Therefore, it is important for the radiologist as well as the clinician to know the prevalence of spondylolysis and spondylolisthe-

sis specially when reporting abdominopelvic CT scans. Significant increase in morbidity and mortality are seen with underreporting and delay in treatment of these conditions.

Conflicts of Interest

There were no conflicts of interests among authors.

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