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Original Article

Does obesity have an impact on the radiation exposure during lumbosacral transforaminal epidural steroid injections? Retrospective study

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Abstract

Aim: To find out whether obesity or injection level have an impact on the amount of radiation exposure during fluoroscopy-guided lumbosacral transforaminal epidural steroid injections (TFESIs).

Material and Methods: Patients aged 19-65 years who underwent lumbosacral transforaminal epidural steroid injection were retrospectively reviewed. Eighty-three patients with a mean age of 42.7±13.2 (19-65) years with signs and symptoms of unilateral lumbar radicular pain due to single level disc herniation were included. Subjects were categorized as normal weighted (18.5≤body mass index (BMI) ≤ 24.9), overweighed (25≤BMI<30) and obese (BMI≥30) according to World Health Organization BMI criteria. All patients were given unilateral TFESIs, including39 (47%) L5, and 44 (53%) S1 level. Radiation exposure dose and procedure time was automatically measured by fluoroscope.

Results: Radiation dosage increased significantly with increasing BMI (p=0.0001). No statistically significant differences were found when three groups' procedure durations and NRS scores were compared (>0.05). The radiation dosages and procedure durations between the two different injection levels (L5 and S1) were not found to be statistically significant (>0.05).

Conclusion: Obesity is associated with increased radiation exposure independent of procedure duration and the injection level.

Keywords: Body mass index; epidural injection; fluoroscopy; procedure time; kerma-area product

INTRODUCTION

Lumbosacral transforaminal epidural steroid injections (TFESI) are frequently used and proven treatments for low back pain due to spinal disorders such as radiculopathy, spinal stenosis, and herniated nucleus pulposus (1). Fluoroscopic guidance during TFESI is necessary for accurate needle placement and delivery of drugs injected to warrant an effective and safe procedure(1, 2). However, fluoroscopy guidance results in radiation exposure to patients, physicians and other medical staff. Ionizing radiation exposure have cumulative and dose related risks such as cataract formation and cancer growth. For example, 200 rad may cause cataract, 500 rad may cause erythema, 700 rad may cause permanent alopecia or more than 700 rad may cause multiple organ failure. Annual maximum permissible radiation doses for specific organs are as follows; thyroid: 50 rem, extremities: 50 rem, lens of the eye: 50 rem, gonads: 50 rem, pregnant women: 0.5 rem (3). Therefore, to reduce risks and to take measures against radiation, factors affecting amount of exposure must be identified. Type of the procedure and the technique, experience of the operator and the equipment used are known factors that affect exposure dose while body mass index remains controversial level of injection site is less known and they are worthy of further investigation(4).

Obesity leads to increased difficulty of acquiring optimal medical images, reduction of image quality and thus higher amount of radiation dose might be needed for acquiring images of deeper structures(5). Also, the amount of radiation during fluoroscopy-guided lumbosacral TFESI at different vertebral levels might differ from each other due to following reasons: Physicians

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have more experience in performing TFESI at L5 and S1 levels, because they are the most common levels for a herniated disc(6). Procedure levels are different from each other anatomically. There is progressive increase of the width of the intervertebral foramina in craniocaudal direction as determined by Arslan M (7). More experienced operator and a wider foramina may result in decreased procedure time and consequently, decreased radiation exposure. Thus; like obesity, procedure level may be a factor affecting the radiation exposure dose(6).

The aim of the present study is primarily to find out if obesity or injection level have an impact on the amount of radiation exposure during fluoroscopic-guided lumbosacral TFESI.

MATERIAL and METHODS

Patients

We retrospectively reviewed patients aged 19-65 years who underwent lumbosacral transforaminal epidural steroid injection between November 2013 and August 2014.Patients who diagnosed unilateral and single level lumbosacral disc herniation were eligible for study. Diagnosis was made by physical examination and lumbosacral MRI findings. We include patients who had L5 and S1 level radiculopathy because most common sites for lumbosacral disc herniation levels are L4-L5 and L5-S1. The patients were excluded if they had history of prior epidural steroid injection within 6 months or history of prior surgery, because, it could jeopardize accurate evaluation of the TFESI effectiveness. Patients who underwent prior surgery with spinal instrumentation, those with a intrauterine device and patients with lumbar disc herniation at more than one level were also excluded to avoid influence of those on radiation exposure. The patient data including age, gender, BMI, level of injection were recorded. Subjects were categorized as normal weighted (18.5-24.9 kg/m2) and overweighed(25≤BMI<30kg/m2) and obese (BMI≥30 kg/m2) according to World Health Organization (WHO) BMI criteria (8). All patients received single level TFESI.

The institutional review board approval was obtained from the ethics committee. Oral and written informed consents were obtained from all participants.

Procedures

An experienced pain specialist (OHG) to minimize interpersonal variability, which may affect procedure time, carried out all injections. All TFESIs were performed using a “safe-triangle” or subpedicular approach. During the procedure, the patient was positioned prone on the table. The C-arm axis was rotated obliquely 20 to 30 degrees so that satisfactory images of facet joints and pars interarticularis were obtained. After the appropriate target side was identified, the local skin was prepped and draped in a sterile manner. Local anesthesia was applied using approximately 5 cc of 2% prilocaine, consequently. A point that is known as “6 o'clock” position on the pedicle was targeted. Under intermittent fluoroscopic guidance, 22-G, 3.5-inch, 90-mm spinal needle was advanced into the epidural space. After lateral fluoroscopic view was obtained to confirm appropriate insertion depth, contrast agent (1-2 ml iohexol 300 mg/ml) was injected to verify precise needle placement within the epidural space. Following demonstration of a satisfactory spread of the contrast agent in the epidural space along the nerve root the procedure was completed by injecting 3 ml mixture that contains; 80 mg of methylprednisolone acetate, 1 cc of bupivacaine and 1 cc of normal saline.

Material and Methods

To evaluate the efficacy of TFESI, pain level was assessed before and one hour after the injections using the numeric rating scale (NRS). Radiation exposure dose (µGym2)was automatically measured by the C-armed fluoroscope (OEC model 9900 Elite; General Electric OEC Medical Systems Inc., Milwaukee, USA).Procedure time is the time measured between ‘the first image taken by the fluoroscope when the needle is first inserted’, and ‘the image taken after the related root was identified with good contrast spread’. Observers made assessments.

Statistical Analysis

NCSS (Number Cruncher Statistical System) 2007 & PASS (Power Analysis and Sample Size) 2008 Statistical Software (Utah, USA) programs were used for statistical analysis. In addition to the descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum and maximum values), one way variance analysis (one-way ANOVA) test was used to compare quantitative data within BMI and injection level groups and Turkey HSD test was used to determine the group that is causing the difference. Kruskal Wallis test was used when the L5 and S1 level groups were compared according to their BMIs and Mann Whitney U test was used to determine the group that is causing the difference. Pearson Chi-Square test was used for qualitative data comparisons. Statistical significance was accepted as $p<0.01$ and $p<0.05$.

RESULTS

A total of 83 patients with lumbar radiculopathy due to a single level disc herniation to whom TFESI was performed were included. Of these patients 37 (44.6%) were female and 46 (55.4%) were male.

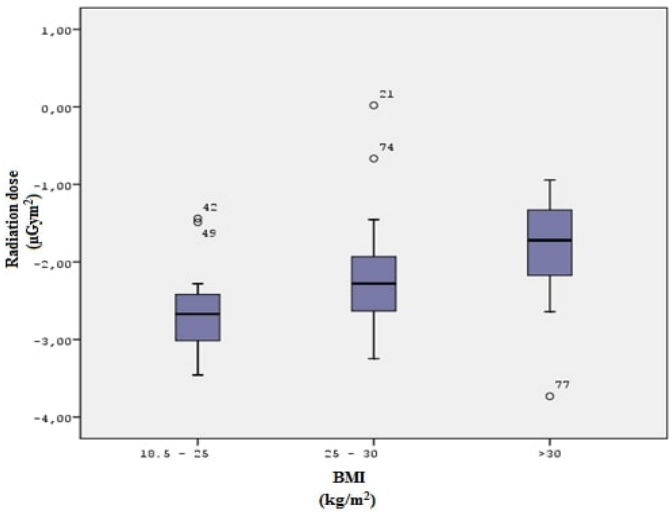

Figure 1. Radiation dosages of BMI groups

Thirty-nine (47%) patients were given L5, and 44 (53%) patients were given S1 TFESI. The mean age was 42.7±13.2 years and mean BMI was 27.4±4.3 kg/m2. Twenty-three patients (27.7%) had a BMI lower than 25 kg/m2, 42 patients (50.6%) had a BMI between 25-30kg/m2and 18 patients (21.7%) had BMI higher than 30 kg/m2.The mean pre-injection NRS score was 7.4±2 and decreased to a mean of 1.8±2.4 one hour after injection. Mean KAP (Kerma-Area Product) value, which is the scattered radiation dosage, was 1300.13±130 µGym2 and mean procedure duration was 861.1±471.1 seconds.

When the radiation dosages of the different BMI groups were compared, the increase in radiation dosage was statistically significant with increasing BMI (p=0.0001; p<0.01) (Figure 1).

The radiation dosages of the BMI subgroups of L5 TFESI group was different. There was an increase in radiation dosage with increasing BMI (p=0.001; p<0.01). The radiation dosages of the BMI subgroups of S1 TFESI group was also different (p=0.049; p<0.05). Normal weight group had lower values of radiation dosages compared to the obese group (p=0.043; p<0.05). There was no statistically significant difference between normal weight group-overweight group and overweight group-obese group. Nevertheless, the difference between the normal weight and overweight groups' radiation dosages was important to note (p=0.051; p>0.05). (Table 1).

The radiation dosages and procedure durations between the two different injection levels (L5 and S1) were not found to be statistically significant (>0.05) (Table 2).

There was no statistically difference between pre-injection and post-injection NRS scores of normal weight, overweight and obese groups (p=0,347).

DISCUSSION

In our study, when patients with unilateral lumbar radiculopathy associated with disc herniation who were applied fluoroscopy guided transforaminal epidural steroid injection (TFESI) were assessed by body mass index (BMI). It was found that as BMI increased there occurred an increase in radiation doses. This effect of obesity augmenting radiation exposure was consistent with the results of the study where Smuck et al. investigated the effect of obesity on radiation exposure in 209 patients who were applied fluoroscopy guided spinal procedure. In that study, it was stressed that radiation exposure was high in obese patients since fluoroscopy acquisition times and procedural times are prolonged [2]. In our study, on the other hand, no significant difference was found between patient groups with respect to procedure times. Thus, contrary to Smuck et al., our study is in concordance with other studies that found obesity as a risk factor for radiation risk on its own without the effect of longer procedure durations [8, 9].

When patients were categorized by procedure levels as two separate groups that were applied L5 and S1 TFESI, no significant difference was found between both procedure times and radiation doses. This result was not compatible with the results of the study by Hwang Ym et al. in which BMI was not taken into account, and which reported that

Table 1. Radiation dosage and procedure durations of different BMI and procedure level groups

	Normal (n=23)	Overweight (n=42)	Obese (n=18)	P	L5 (n=39)	S1 (n=44)	p
	Mean±SD	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Radiation dosage (µGym2)	80±50	140±160	190±100	**0.01**	130±170	140±90	0.109
Procedure duration (sec)	844.4±358.4	811.7±485.8	997.8±556	0.303	878.6±496.6	845.7±452.5	0.793

SD: Standard Deviation, p<0,05 is significant

Table 2. Radiation dosage and procedure durations of subgroups of L5 and S1.

	Normal (n=23)	Overweight (n=42)	Obese (n=18)	p
	Mean±SD	Mean±SD	Mean±SD	
L5				
Radiation dosage (µGym2)	50±20 (50)	140±220 (90)	200±100 (180)	**0.001**
Procedure duration (sec)	693.8±203.5 (652.5)	856.5±566.4 (638)	1105.4±512.2 (1080.5)	0.075
S1				
Radiation dosage (µGym^2)	100±60 (80)	140±90(120)	190±120(180)	**0.049**
Procedure duration (sec)	960.2±413.5 (826)	774.8±417.4 (645)	863.3±613.4 (586.5)	0.150

SD: Standard Deviation, p<0,05 is significant

differences may occur between radiation doses in different procedure levels[5]. Nevertheless, it was observed in our study that when patient groups were assessed by categorizing into subgroups by BMI, the effect of obesity on radiation dose persisted independently of the level of procedure. In our study BMI or procedure level had no effect on procedure time was in support of the study of Manchikanti et al. that emphasized the importance of the experience of interventional pain therapy specialist performing the procedure for procedure time[3].

No significant difference was found between pre-procedural and post-procedural first-hour NRS scores of our patients that we categorized into normal, overweight, and obese by body mass index. This result was consistent with the results of the study by McCormick et al. reporting that symptomatic improvement after transforaminal epidural steroid injection was at equal rate in obese patients when compared with non-obese patients [10]. The common view of both studies was that the opinions of most operators believing that symptomatic improvement would be less in obese patients and thus avoiding performing TFESI due to possible technical difficulties secondary to obesity was not realistic.

Despite the existence of many studies in the literature assessing radiation exposure and associated factors at the time of angiographic procedures in interventional radiology and various surgical operations, the number of current studies related to fluoroscopy guided interventional procedures is low [11,12]. Therefore, our study is a specific and important study since it assessed radiation exposure and possible associated factors during TFESI, a frequently used and an effective treatment method in the practice of interventional pain management in a comprehensive manner [13].

Study limitations

Our study has some limitations such as the retrospective design, lack of long-term follow-up data, a relatively small sample size, excluding lumbar levels other than L5 and S1, ignoring the localization and the size of herniation, and lack of fluoroscopy acquisition times despite the presence of procedure times for each patient.

CONCLUSION

Obesity is associated with increased radiation exposure independent of procedure duration and the injection level. In addition, knowing that symptomatic improvement after TFESI in obese patients is not different from normal weight patients is important to make correct decisions in the process of determining indications.

Competing interests: The authors found that the conflict of interest did not fully coincide.

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