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Research Article

# Correlation between degenerative lumbar spinal stenosis and systemic diseases

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**Statistics**

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|---|---|
| Figures | 00 |
| Tables | 08 |
| References | 15 |

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Abstract

Background: Impaired blood flow as a result of arteriosclerosis facilitates degenerative changes in the spine. However, associations between Lumber Spinal Stenosis (LSS) and some chronic diseases (hypertension, diabetes, and dyslipidaemia) remain unclear.

Objective: The purpose of this study was to identify association between degenerative lumber spinal canal stenosis and systemic diseases [Diabetes Mellitus (DM), Hypertension (HT) and hyperlipidemia]

Study Design: A cross-sectional prospective analytics study.

Methods: Total 105 patients (37 males and 68 females) diagnosed with LSS using the clinical diagnostic support tool and magnetic resonance imaging to measure the dural sac diameter and spinal canal diameter (Central stenosis, spinal canal diameter <10 mm Diameter).

We investigated the prevalence of some chronic diseases (hypertension, diabetes mellitus, and dyslipidaemia), where the level of haemoglobin A1C, lipid profile

(Total cholesterol and high-density lipoprotein cholesterol) were tested. According to the age, patients were divided into 3 subgroups (40-49 years,50-60 years and >60 years) and then subdivided in to 5 groups according to the associated chronic diseases into those with LSS without any chronic diseases, LSS with only DM, LSS with only HT,LSS with hyperlipidaemia and patient have LSS with multiple diseases

Results: Most of the patients were female (68; 64.8%) and male are (37; 35.2 %).

Patients with LSS and no chronic studied disease were (37: 35.2%), while the patients with chronic disease were (68:64.7%). The patients with single disease were (31, 29.5%), distributed as HT (13: 41.9%), DM (14:45%) and hyperlipidaemia (4:12%). Patients with more than one chronic studied disease were (37:35.2%).

Conclusion: This study revealed a close association between diabetes, hypertension and hyperlipidaemia in patient aged 50 years and above with LSS, which was more common in patients with more than one studied disease. The most common associated single disease was DM, HT and hyperlipidaemia.

Keywords: degenerative spinal disease, hypertension, diabetes mellitus, stenosis

## INTRODUCTION

Lumbar spinal canal stenosis can be defined as a situation in which the space available for the neural and vascular elements in the lumbar spine is decreased. Lumbar canal Stenosis can cause pressure on the neural tissues and subsequent corresponding symptoms but not all patients with spinal narrowing develop symptoms, therefore we think that the term "spinal stenosis" refers to the symptoms of radicular pain and not to the narrowing itself.

Lumbar spinal stenosis is a significant cause of disability in the elderly, and it is the most significant cause of spinal surgery in patients over 65 years of age

## CLASSIFICATION OF LUMBAR SPINAL STENOSIS

Etiological classification: acquired and congenital lumbar spinal canal stenosis

Acquired: Degenerative/spondylotic changes (most common), Post-surgical, Traumatic (vertebral fractures} and inflammatory (ankylosing spondylitis)

Congenital: Short pedicles with medially placed facets (e.g. achondroplasia).

Anatomical classification: Central Canal stenosis, Lateral recess stenosis, Foraminal stenosis and Extraforaminal stenosis.

## MATERIALS AND METHODS

From October 2019 to October 2020, a prospective cross-section study was conducted in Basrah Teaching Hospital; the patients who had degenerative lumbar spinal stenosis seen at consultant clinic and orthopaedic ward were included in this study.

The diagnosis of lumbar canal stenosis was made after evaluation of the patients by history taking and physical findings according to Konno et al criteria [1] and confirmed by MRI findings. The measurements of dural sac and spinal canal diameter were achieved using RADIANT and PHILIPS software for measuring the anteroposterior diameter of spinal canal and dural sac on T1 and T2 sagittal weighted images.

The diameter of the spinal canal measured on MRI T1 weighted images, the anteroposterior Spinal Canal Diameter (SCD) measured in perpendicular way to the long axis of the lumbar spinal canal from the posterior vertebral wall at the mid-portion to the laminar front edge. The Dural Sac Diameter (DSD) measured between the posterior walls of the vertebral body to the anterior border of the spinous process on T2 sagittal section MRI of lumbar spine at L1 to L4. Central stenosis was documented when SCD < 10 mm diameter.

Total number of 105 patients was involved in this study (68 female and 37 male). Each patient considered fit for inclusion in this study underwent an evaluation that include history taking, physical examination and some investigations looking for studied systemic diseases (Diabetes mellitus, hypertension and Hyperlipidaemia). This was done by measurement of blood pressure many times (three times) on different occasions (in siting position and lying), then collection of blood sample for measuring (HbA1c) and lipid profile analysis. [Total Cholesterol (TC), Low-Density Lipoprotein (LDL) and High-Density Lipoprotein (HDL)]

Five groups of patients were made, these groups are:

A. Patients have LSS without any systemic diseases

B. Patients have LSS with Diabetes Mellitus (DM), the criteria for diagnosis of DM either the patient have medical records of DM and on treatment or the result of HbA1c (≥ 6.1%) during the evaluation.

C. Patients have LSS with systemic Hypertension (HT). The patients had either medical records for HT or the blood pressure more than 140/90 mmHg by during evaluation.

D. Patients have LSS with hyperlipidaemia. The patients have medical records of hyperlipidaemia or the result of investigation showed the TC ≥ 200 mg/dl, HDL-C (<60mg/dl) and LDL-C (>130 mg/dl)

E. Patients have LSS with multiple systemic diseases.

Data obtained and the results were analysed by using the SPSS software (Version 23).

## EXCLUSION CRITERIA

1. Lumbar vertebral fractures
2. Vertebral congenital anomalies
3. Previous spinal surgery
4. Spinal tumours

## RESULTS

A total number of 105 patients with LSS were involved in this study and their gender distribution was analyzed (Table 1) which shows that 63.8% of patients were female.

In 47.6% of studied patients, the age were between 50-59 years followed by age population above 60 years in 30.5% then age between 40-49years in 21.9% (Table 2).

About 41.9% of the studied patients were hypertensive as single and combined associated disease. The proportion of patients with hypertension was significantly higher in the patients with LSS group than people do not had LSS (Table 3).

About 34.3% of the studied patients had diabetes mellitus as a single or combined associated disease. The proportion of patients with diabetes mellitus was higher in patients with LSS than patients did not have LSS (Table 4).

In 25.7% of the studied patients had hyperlipidemia as single or combined associated disease. The proportion of patients with

**Table 1.** Gender distribution of the studied sample

| Gender | Frequency | Percent |
|---|---|---|
| Male | 37 | 35.2 |
| Female | 68 | 64.8 |
| Total | 105 | 100.0 |

**Table 2.** Age distribution of the studied sample

| Age | Frequency | Percent |
|---|---|---|
| 40-49 years | 23 | 21.9 |
| 50-59 years | 50 | 47.6 |
| 60 years and above | 32 | 30.5 |
| Total | 105 | 100.0 |

**Table 3.** Distribution of hypertension in the studied sample

| HT | Frequency | Percent |
|---|---|---|
| YES | 44 | 41.9 |
| NO | 61 | 58.1 |
| Total | 105 | 100.0 |

**Table 4.** Distribution of diabetes mellitus in the studied sample

| DM | Frequency | Percent |
|---|---|---|
| YES | 36 | 34.3 |
| NO | 69 | 65.7 |
| Total | 105 | 100.0 |

**Table 5.** Distribution of hyperlipidemia in the studied sample

| Hyperlipidemia | Frequency | Percent |
|---|---|---|
| YES | 27 | 25.7 |
| NO | 78 | 74.3 |
| Total | 105 | 100 |

**Table 6.** Distribution of chronic diseases and the combination of more than one disease in the studied sample

| Types of chronic diseases | Frequency | Percent |
|---|---|---|
| No disease | 37 | 35.2 |
| HT only | 13 | 12.5 |
| DM only | 14 | 13.3 |
| HT+D.M | 14 | 13.3 |
| HL only | 4 | 3.8 |
| HT+HL | 15 | 14.3 |
| DM+HL | 6 | 5.7 |
| HT+DM+HL | 2 | 1.9 |
| Total | 105 | 100.0 |

**Table 7.** Correlations between chronic diseases and LSS

| Correlations | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Gender | Age | HT | DM | Hyperlipidaemia | Remixed |
| Gender | Pearson Correlation | 1 | 0.024 | -.244-* | 0.001 | -.056- | -.210-* |
| | Sig. (2-tailed) | - | 0.805 | 0.012 | 0.99 | 0.572 | 0.031 |
| Age | Pearson Correlation | 0.024 | 1 | .310** | .200* | -.152- | -.119- |
| | Sig. (2-tailed) | 0.805 | - | 0.001 | 0.04 | 0.122 | 0.226 |
| HT | Pearson Correlation | -.244-* | .310** | 1 | 0.037 | .251** | 0.164 |
| | Sig. (2-tailed) | 0.012 | 0.001 | | 0.707 | 0.01 | 0.095 |
| DM | Pearson Correlation | 0.001 | .200* | 0.037 | 1 | -.058- | .212* |
| | Sig. (2-tailed) | 0.99 | 0.04 | 0.707 | - | 0.559 | 0.03 |
| Hyper Lipidaemia | Pearson Correlation | -.056- | -.152- | .251** | -.058- | 1 | .223* |
| | Sig. (2-tailed) | 0.572 | 0.122 | 0.01 | 0.559 | - | 0.022 |
| Remixed | Pearson Correlation | -.210-* | -.119- | 0.164 | .212* | .223* | 1 |
| | Sig. (2-tailed) | 0.031 | 0.226 | 0.095 | 0.03 | 0.022 | - |
| *. Correlation is significant at the 0.05 level (2-tailed) | | | | | | | |
| **. Correlation is significant at the 0.01 level (2-tailed) | | | | | | | |

**Table 8.** Correlation between risk factors and LSS

| Variable | Pearson Correlation | Sig. (2-tailed) |
|---|---|---|
| HT | 0.31 | 0.001 |
| Hyperlipidemia | 0.251 | 0.01 |
| More than one disease | 0.223 | 0.022 |
| D.M | 0.212 | 0.03 |

hyperlipidaemia was higher in patients with LSS (Table 5).

Combination of hypertension and hyperlipidemia is the greatest combination of more than one chronic disease (14.3%) with 1.9% of the studied patients sample had a combination of the three diseases (Table 6).

Correlations between chronic diseases and LSS were summarized (Table 7).

To examine the correlation between some risk factors of lumbar stenosis, a bivariate correlation analysis was performed; many variables were studied, but the variables, which show a significant correlation with lumbar stenosis, are hypertension, hyperlipidemia, and presence of more than one disease and Diabetes Mellitus (Table 8).

## DISCUSSION

This current cross-sectional study showed that DM, HT and hyperlipidaemia are more common among patients with LSS.

The effects of LSS are by not only mechanical compression, but also by decreased blood flow to the nerves. In other words, blood flow to the nerves is involved in the symptoms of LSS. Some chronic diseases such as hypertension, diabetes, and dyslipidaemia induce arteriosclerosis and affect blood flow to the lumbar spine, nerve roots, and paravertebral muscles; this enhances degenerative process in the spine [2].

Age: This study found that patients with LSS in the age group between 50 years and above had a higher prevalence of hypertension, diabetes and hyperlipidaemia. Frymoyer et al found a relationship between increasing age of patients and disc degeneration and he found that the disc degeneration occurs at a rate of 3-4% per year. [3].

Gender: The female patients were more prevalent in this study in 63.8%. This finding is consistent with results of Griffith et al and Wang et al whom showed that elderly female had more severe lumber disc degeneration and canal stenosis than elderly male. It has been postulated that a decrease in oestrogen level have very important role in accelerating disc degeneration in postmenopausal women [4, 5].

The observation that as age increases, disc space narrowing progresses more rapidly in female than in male, would support the notion that sex hormones do influence disc degeneration and canal stenosis. Other potential factors that tend to be more common in female should be considered, such as weak postural muscle, and more heavy lifting (relative to their strength), including shopping [6].

Diabetes mellitus and lumber spinal stenosis. We found in our study that a high percentage 34.3% of LSS patients suffer from concomitant diabetes mellitus. It is well established that DM causes pathology in different systems including the peripheral nervous system, the blood vessels, and the intervertebral discs and joints, causing early degeneration.

Kawaguchi et al. [7] studied patients with lumbar spinal stenosis caused by ossification of the posterior longitudinal ligament and ligamentum flavum and they found that 35% of them were diabetic and 30% were obese (this is similar to our result). In addition, the microangiopathy associated with DM may interfere with nutrient diffusion through the vertebral endplates, leading to acceleration in disk degeneration therefore the DM may also be a risk factor for the development of lumbar spinal stenosis.

Hypertensive lumbar spinal stenosis: We found in our study high prevalence of systemic hypertension among patient with spinal stenosis which is about (41.9%) Hamdan et al [8] found that 46% of LSS patients were hypertensive, this result support the finding of our study, The relationship between high blood pressure and spinal stenosis can explained by direct and indirect way.

## DIRECT WAY

1. Severe lower backache causing increase sympathetic stimulation (increase catecholamine release and increase blood pressure.
2. Compression of renal sympathetic nerves resulting in vasoconstriction of afferent arterioles and hypertension.
3. Compression of urinary bladder sympathetic L2-L3 or parasympathetic S2-S3 cause bladder distension which reflex increase in heart rate and blood pressure.

## INDIRECT WAY

1. Bed rest and decreased activity (predisposes to obesity) and non-steroidal anti-inflammatory drugs used in treatment of spinal stenosis, both predisposes for high blood pressure
2. Some drugs used in treatment of hypertensive act by causing systemic venous dilatation and this cause venous congestion at spine resulting in bone overgrowth and spinal stenosis [8].

Hypertension is not only a risk factor for coronary vascular impairment and Peripheral Arterial Disease (PAD), but also may be associated with spinal diseases [9-11]. When arteriosclerosis resulting from hypertension progresses and calcification of the posterior wall of the abdominal aorta occurs, the risk of progression of intervertebral disc degeneration and the incidence of lower backache increase. Complications of diabetes mellitus and arteriosclerosis resulting from hypertension represent risk factors associated with poor outcomes of LSS treatment. [12-13] and these accompanying chronic diseases must be treated when treating LSS.

Hyperlipidemia with lumber spinal stenosis: In our results, dyslipidaemia might be associated with a higher risk of developing lumbar spinal stenosis. The prevalence of hyperlipidaemia among patient with LSS was 25.7%.

There might be a link that connects serum lipids level and Lumbar disc degeneration, one logical link between them is atherosclerosis, which could be responsible for a decrease in the blood flow to the corresponding lumbar segment and causes the malnutrition of Intervertebral Disc (IVD). The insufficient nutrient supply to IVD cells definitively leads to IVD Degenerative disease and spinal canal stenosis [14].

On the contrary, one common risk factor for hypertension, diabetes mellitus and dyslipidaemia is the accumulation of abdominal fat; the patients with symptomatic LSS such as intermittent claudication and leg pain have no ability to practice exercise that is recommended to prevent hypertension, diabetes, and dyslipidaemia [15].

Impacts on the prognosis of diabetic patients who undergo spinal fusion procedures, spinal canal stenosis surgery, and disk herniation surgery are frequently studied. In addition to an increased risk of postoperative infection and related medical complications, the poor prognosis with respect to symptoms in diabetic patients compared with nondiabetic patients has been shown to improve after surgery [3].

Limitations: One limitation is that this study used a cross-sectional design. This means that the study could not reveal whether LSS leads to hypertension and diabetes or whether hypertension and diabetes lead to LSS.

Another limitation of this study that need to include control group from general population.

## CONCLUSION

This study revealed a close association between diabetes, hypertension and hyperlipidaemia in patient aged 50 years and above with LSS, which was more common in patients with more than one studied disease. The most common associated single disease was DM, HT and hyperlipidaemia.

Physicians should consider the possibility of concomitant hypertension, diabetes mellitus and hyperlipidaemia when examining patients with LSS aged 50 years and above.

## RECOMMENDATIONS

1. Further study is required to involve a control group, to compare the prevalence of chronic diseases among patients of LSS to the general population.
2. Further study to follow patients with LSS after treatment, to look for the effect of chronic disease on treatment outcome and the effect of treatment of LSS on control of chronic disease.

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