



SAINT PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE

DEPARTMENT OF RADIOLOGY

Prevalence of vertebral hemangioma and associated factors among patients' seen through spine MRI at Saint Paul's Hospital Millennium Medical Collage, ADDIS ABABA, ETHIOPIA.

A research submitted to the department of radiology, Saint Paul's millennium medical college, Addis Ababa in partial fulfillment of the requirements for the specialty degree in radiology

August, 2019

Addis Ababa; Ethiopia

Prevalence of vertebral hemangioma and associated factors among patients' seen through spine MRI at St Paul hospital, ADDIS ABABA, ETHIOPIA.

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A research I submitted as a partial fulfillment of postgraduate study in radiology department.

Table of content

Table of content	III
List of Figures	IV
List of Abbreviation.....	V
1. Introduction.....	1
1.1 Background	1
1.2. Statement of the problem	1
1.3. Significance of the study	2
2. Literature Review.....	3
2.1. Prevalence of VH	3
2.2 Associated Factors.....	3
3. OBJECTIVES	4
3.1. General Objective.....	4
3.2. Specific Objective	4
4. METHODS	5
4.1. Study area and period.....	5
4.2. Study design	5
4.3. Source Population	5
4.4. Study Population	5
4.5. Inclusion and exclusion criteria.....	5
4.5.1 Inclusion	5
4.5.2. Exclusion	5
4.6. Sample Size	6

4.7. Sampling procedures	6
4.8. Data Collection.....	6
4.9. Study Variables	7
4.10. Data Quality Control	7
4.11. Data Processing and Analysis.....	7
4.12. Ethical Consideration	7
4.13. Dissemination of the Result.....	7
5. Results.....	8
5.1. Prevalence of VHs.....	8
5.2. Demographical aspects.....	8
5.2.1. Sex	8
5.2.2. Age.....	9
5.2.3. Sex and age.....	9
5.3. Distribution of VHs.....	10
6. Discussion.....	12
Demography	12
Distribution along the spine and vertebral body	13
7. Limitations of this study	13
8. Conclusions.....	14
9. Acknowledgments.....	14
9. References.....	15

List of Figures

Figure 1:- Gender distribution of VH in SPHMMC in 2019.....	8
Figure 2:- Age distribution of VH in SPHMMC in 2019.....	9
Figure 3:- Multiplicity of VH in SPHMMC in 2019.....	11

List of Abbreviation

MRIMagnetic Resonance Imaging

CTComputed Tomography

SPHMMCSaint Paul Hospital Millennium Medical College

VH.....Vertebral Hemangiomas

IRB..... Institutional Review Board

Abstract

Background: - Vertebral hemangiomas are the most common benign spinal neoplasm often located in the thoracic and lumbar spine with a peak incidence of occurrence in the fourth to six decades. Vertebral hemangiomas (VHs) are the most common form of benign tumor in the vertebral column, constituting 2 % of skeletal benign tumors, and 0.8 % of all skeletal tumors. 98–99 % of VHs are asymptomatic.

Objective: - To assess the prevalence of Vertebral Hemangiomas at SPHMMC, Addis Ababa, Ethiopia from September 2018 to February 2019.

Method: - Facility based cross sectional study was conducted on patients' data that had lower back pain and seen through magnetic resonance imaging in Saint Paul Hospital Millennium Medical College (SPHMMC) from September to February 2019. Data was collected using data extraction format. Data's of 293 participants were reviewed in this study and descriptive statistics was applied to describe data using frequency tables and charts and also analytical study was used to relate the Vertebral Hemangiomas with independent variables which have P-value less than 0.2 in descriptive analysis will be added to final analysis.

Result: - VHs were present in 46 (15.7%) out of 293 individuals in this study. Multiple VHs are seen in 19.6% of all; VHs of the 46 individuals showing VHs, 37 (80.4 %) had only one vertebra affected; 9 (19.6 %) had two and more vertebrae affected in which a rate is slightly higher ($\chi^2=43.338$, $p<0.001$) than the prevalence reported in the literature (10.7 %). Multiple VHs appeared in 3.02 % of the population studied. 30 VHs (65.2 %) were found in females and 16(34.8%) in males. No significant association between sex and VH was found (OR=1.457, $p=0.261$ VHs appear in females early in adulthood (18–39 years), whereas no VH was found prior to middle age (40–59 years) in males. Among males, the age cohort with the highest prevalence of VH (40 % affected) is the 40–59 years; whereas in females, (43.6 % affected), it is the over 60 years. The difference in VHs prevalence in consequent age cohorts was statistically significant in males and females ($\chi^2 =10.666$, $p=0.005$ and $\chi^2 =13.965$, $p=0.001$, respectively). However, “older” age (over 50 years old) was not significantly correlated with the appearance

of VHs in males ($\chi^2 = 3.183$, $p=0.074$) or females ($\chi^2 = 3.456$, $p=0.063$). No significant interaction between sex, age and VHs was found ($p=0.656$).

Conclusions: - The reported prevalence of VHs is dependent on the demographic structure of the population studied. Overall, the phenomenon is more frequent than usually reported. VHs may appear at all vertebral levels and in all areas of the vertebral body.

1. Introduction

1.1 Background

Spinal hemangiomas are the most common benign spinal neoplasm often located in the thoracic and lumbar spine with a peak incidence of occurrence in the fourth to six decades [1]. It is usually asymptomatic and is more frequently seen in women. The peak incidence is in fourth decade and is usually multiple in up to 1/3 of cases. In general, most of them occur in the medullary cavity of bone. Microscopically, there is hamartomatous proliferation of vascular tissue. They are classified as cavernous, capillary, arteriovenous and venous types. Hemangiomas of spine are usually capillary type and in skull, are cavernous. They are thought to be dysembryogenetic disturbances, affecting the proper differentiation of blood vessels [2, 3]. Some researchers define Hemangiomas as ‘‘congenital vascular malformations’’, thus not as tumors but rather as hamartomas [4], i.e., tissue growing at a normal rate, but in a disorganized manner. Most skeletal Hemangiomas (28%) appear in the vertebral column [4]. Vertebral hemangiomas (VHs) are the most common form of benign tumor in the vertebral column [5], constituting 2 % of skeletal benign tumors, and 0.8 % of all skeletal tumors [4]. 98–99 % of VHs are asymptomatic [6, 7]. Based on a large-scale cadaver study, VHs are usually quoted to appear in 10.7 % of the population [5]. However, as modern imaging tools enable the identification of small lesions, which could be missed during autopsy, it is plausible that the actual prevalence of VHs is higher [8].

1.2. Statement of the problem

Females are thought to be more affected by VHs than males; however, the male: female occurrence ratio differs greatly between studies, varying from 1:1.3 to 1:2.25 [3–6, 9–14]. VHs can appear at all ages, but most lesions appear either after the fourth [4, 10] or fifth decade of life [13]. Thus, it has been hypothesized that they develop during life, growing over time to a detectable size [5]. VHs are reported to appear most frequently in the thoracic spine, followed by the lumbar region, and rarely in the cervical and sacral segments [5, 6, 10, 12, and 15]. The appearance of an isolated single VH in the spine is more common, although multiple lesions may occur in one spine [3, 5, 6, 15]. Most hemangiomas appear in the spongy bone of the vertebral body [10]. Identification of VHs in computed tomography (CT) is based on the typical ‘‘polka-dot’’ pattern in axial sections [1, 13], which reflects the thickened trabeculae within the medullary cavity of the vertebral body [8, 16]. Identification of VHs by CT is possible in approximately 80 % of cases [17]. In light of the somewhat contradictory information in the literature regarding VHs, we carried out a large MRI based study, to: (a) examine the association between VHs and sex; (b) examine the association between VHs and age; and (c) reveal the

pattern of VHs distribution along the spine, specifically their preferred location in the spinal column, their location within the vertebral body, and the prevalence of solitary versus multiple lesions.

1.3. Significance of the study

Around 98–99 % of Vertebral Hemangiomas are asymptomatic [6, 7], which makes difficult in diagnosis with other means. Some vertebral hemangiomas presents with severe back pain after torrential bleeding which may leads to sever neural axis compression and may prone to death. Knowing whether the lower back pain is from vertebral hemangioma or not will help for further follow up of the patient and plane for treatment. Because symptomatic hemangioma typically show marked hypervascularity on spinal angiography knowledge of diagnosis before biopsy or surgery is important. Therefore, this study quantifies the prevalence and its pattern of vertebral hemangiomas seen through Magnetic resonance imaging among patient seen through spine MRI at SPHMMC, Addis Ababa.

2. Literature Review

2.1. Prevalence of VH

A study which was done at Israel at 2015 showed that Vertebral Hemangiomas were present in 26.0 % of the individuals studied, a rate significantly higher ($X^2 = 43.338$, $p < 0.001$) than the prevalence reported in the literature (10.7 %). Multiple Vertebral Hemangiomas appeared in 7.2 % of the population studied. No vertebra was significantly more prone to be affected by a hemangioma. T11 and T12 show the highest prevalence of VHs (3.57 % of vertebrae affected). VHs were found in similar percentages in the anterior and posterior parts of the vertebral body (52.8 vs. 47.2 %, respectively); and at its center and periphery (50.1 and 49.9 %, respectively). VHs usually appeared at mid-height of the vertebral body or slightly higher [18].

Another study which was done at Northern Iran in 2009 showed that among reviewed 782 MRI data the prevalence of Vertebral Hemangiomas was found 26.9%, more common in females (30%) than males (23%), in older age group and in lumbar spine. Most vertebral hemangiomas (65%) were less than 10 mm in diameter. Multiple hemangiomas were seen in 33% of cases [19].

A study which was conducted at Amala Institute of Medical Sciences, India showed that incidental spinal findings were present in 390 patients (30.7%) [20].

2.2 Associated Factors

A study which was done at Israel at 2015 showed that VHs prevalence is sex-independent, appearing in 28.6 % of females and 23.5 % of males ($X^2 = 0.663$, $p = 0.416$); and age-dependent: the mean age of affected individuals (65.8 years) was significantly higher ($p < 0.001$) than unaffected individuals (56.2 years). VH size was also age-dependent ($p = 0.023$) [18].

3. OBJECTIVES

3.1. General Objective

- To assess the prevalence of Vertebral hemangiomas seen through MRI done at SPHMMC Addis Ababa, Ethiopia

3.2. Specific Objective

- To assess prevalence of Vertebral hemangiomas
- To assess the socio-demographic factors associated with VH
- To determine clinical symptoms associated with VH.

4. METHODS

4.1. Study area and period

The study was conducted at SPHMMC, which is found in Addis Ababa and is the 2nd largest hospital in the country. It was built by Emperor Haile Selassie I in 1969 with the help of the German Evangelical Church. It is the training center for undergraduate and a wide spectrum of postgraduate. The hospital has 700 beds it sees an average of 1200 emergency and outpatient clients daily. It has a catchment population of more than 5 million. The radiology department has 11 consultants, 57 residents and 20 radiology technicians.

The study was conducted from June to August 2019.

4.2. Study design

Facility based cross sectional study was used.

4.3. Source Population

All patients who have been seen through spine MRI at SPHMMC were the source population.

4.4. Study Population

All patients who had spine MRI at SPHMMC from September 2018 to February 2019, which was 2,114.

4.5. Inclusion and exclusion criteria

4.5.1 Inclusion

The sample includes all patients' data with complete information that have been seen through spine MRI with in specified study period.

Identification of VHs: - VH were detected in MRI based on the typical T1 and T2 hyper intense; and partially suppressed on STIR sequence. The cervical, thoracic, lumbar and sacral spinal segments were examined in each individual.

Only VHs appearing in the vertebral body were retained for further analyses. The number of VHs in each spine and the location of the lesions (vertebral height) were noted. To determine the location of the VH within the vertebral body, each vertebra was divided into 24 equal sections

4.5.2. Exclusion

Incomplete data were excluded from the study.

4.6. Sample Size

The sample size was calculated using a formula for estimating a single population proportion assuming a confidence level of 95%.

$$n = \frac{Z(a/2)^2 P(1-P)}{d^2}$$

Where

n= the required sample size

Z(a/2)= the critical value at 95% level of significance (1.96)

P= Proportion of patients who had vertebral Hemangiomas were 26.9% [15]

d= Precision of measure (acceptable margin of error), taken as 5%

P= 0.27

d= 0.05

$$n = \frac{(1.96)^2 0.27(0.73)}{0.05^2} = 303$$

Since the population of study (2114) is below 10,000, correction factor is used

$$\text{By } n_f = \frac{ni}{1 + \frac{ni}{N}}$$

$$= (303) / (1 + 303/2,114)$$

$$= 266$$

$$= 266 + 10 \% (266) \dots \text{ for incomplete data}$$

$$= 293$$

4.7. Sampling procedures

The data which was reported by radiologist will be taken from radiology data (sampling frame) base using simple random sampling technique.

4.8. Data Collection

Data extraction format was developed in English based on study objectives and available literature. Data was collected from a radiologist's report using the format by two second year

radiology residents trained by the principal investigator. They were supervised by resident (R3) assigned to neuroradiology.

4.9. Study Variables

Dependent variable: - MRI finding of vertebral hemangioma (present or absent),

Independent variable: - Age, sex, location from respective spine, multiplicity , lower back pain ,Radiculopathy, neck pain and post-operative patient.

4.10. Data Quality Control

Data quality control was ascertained by wise and careful design of the checklist. The investigator checks the data for consistency and completeness. Besides, the fact that the data is filled on a computer based reporting format help us to have consistent and legible data.

4.11. Data Processing and Analysis

Data entry and analysis was performed using Epi-info 7 and SPSS version 21 respectively. Simple tabulation and descriptive statistics was used to look for the prevalence and distribution of vertebral hemangioma findings.

Descriptive statistics was applied to describe data using frequency tables and charts and also analytical study was used to relate the Vertebral Hemangiomas with independent variables which have P-value less than 0.2 in descriptive analysis was added to final analysis. Binary logistic regression model was used to look for the significant association of the independent variables which have P-value less than 0.05.

4.12. Ethical Consideration

Ethical clearance was obtained from SPHMMC IRB. Patient's names omitted from the checklist. Confidentiality of all the documents reviewed was highly secured throughout the data collection of the research process.

4.13. Dissemination of the Result

After accomplishing the study, the results were presented to department of Radiology. Subsequently, attempts will be made to present it on scientific conferences and publish it on scientific journal.

5. Results

The study was carried out on 293 MRI of the entire vertebral column. The study population included 169 females and 124 males, with a mean age of 41.18 ± 15.3 years (40.5 ± 16.5 and 41.7 ± 14.2 years for males and females, respectively).

5.1. Prevalence of VHs

VHs were present in 46 (15.7%) out of 293 individuals in this study. Multiple VHs are seen in 19.6% of all; VHs of the 46 individuals showing VHs, 37 (80.4 %) had only one vertebra affected; 9 (19.6 %) had two and more vertebrae affected

5.2. Demographical aspects

5.2.1. Sex

There were 30 VHs (65.2 %) found in females and 16(34.8%) in males. No significant association between sex and VH was found (OR=1.457, p=0.261).

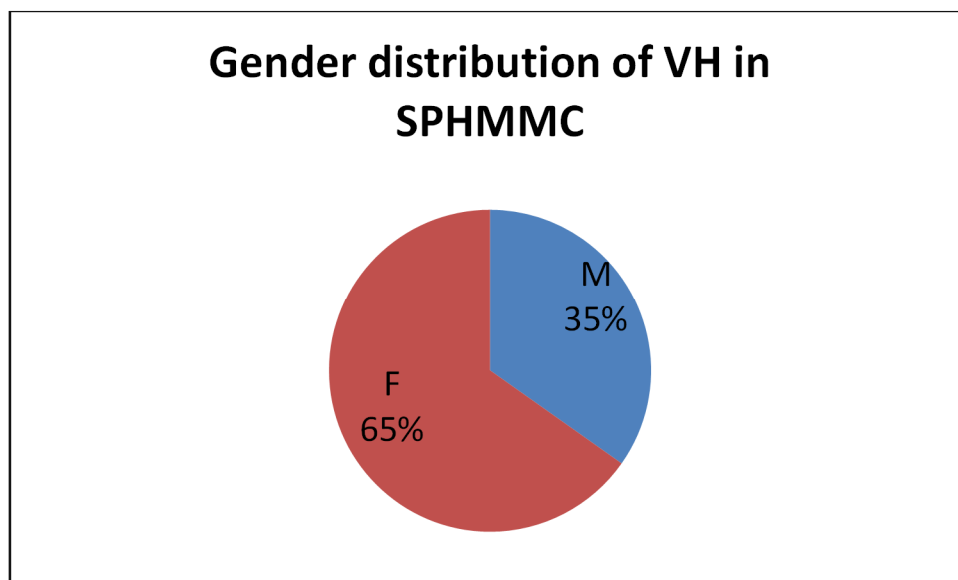


Figure 1:- Gender distribution of VH in SPHMMC in 2019.

Summary:- Out of 46 individuals who have vertebral hemangioma 16(35%) are males and 30(65%) are females.

5.2.2. Age

The age group of individuals that mostly affected by VHS was from 40 to 59 years 20(43.3%) in which 16 for females and 4 for males, a value not significantly higher ($p=0.326$) than the mean age of unaffected individuals (56.2 years). “middle age groups (of 40–59) showed a significantly higher prevalence of VHS than “younger” individuals ($\chi^2=6.809, p=0.009$) The prevalence of VHS varied significantly between the age cohorts: 20.7 % of individuals between the ages of 18–39, 39 % of individuals between the ages of 40–59, and 15.3 % of individuals over the age of 60 years manifested VHS ($\chi^2 =13.928, p=0.001$). VHS covered an average of 6.3 % of the vertebral body between the ages of 18–39, 12.6 % between the ages of 40–59, and 22.3 % in individuals over 60 years of age.

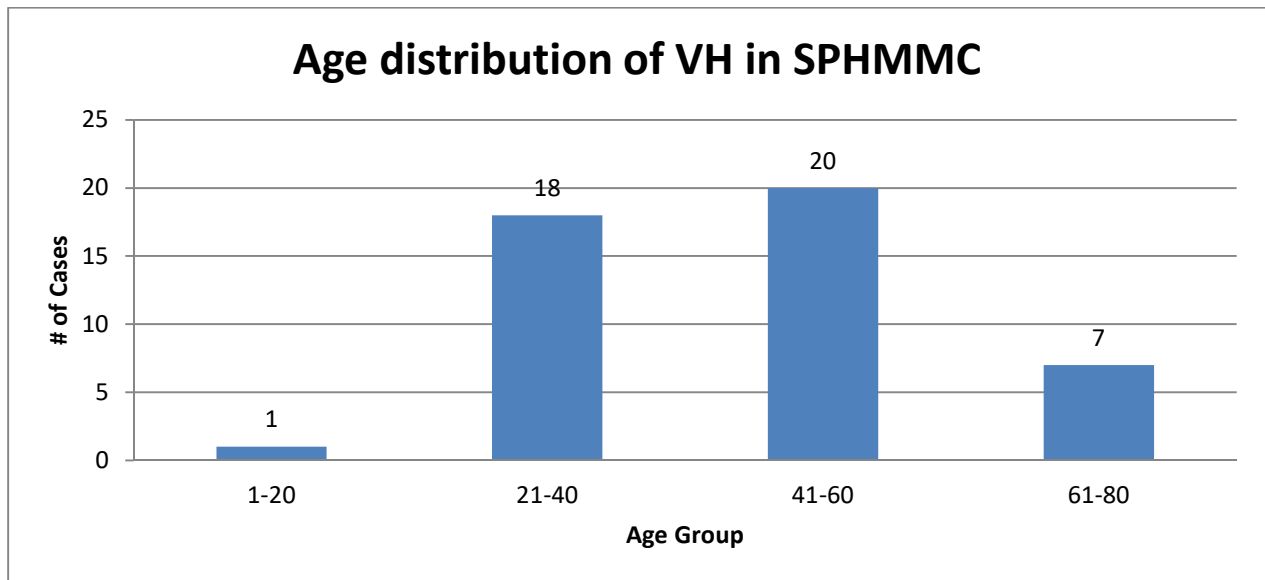


Figure 2:- Age distribution of VH in SPHMMC in 2019.

5.2.3. Sex and age

VHS appear in females early in adulthood (18–39 years), whereas no VH was found prior to middle age (40–59 years) in males. Among males, the age cohort with the highest prevalence of

VH (40 % affected) is the 40–59 years; whereas in females, (43.6 % affected), it is the over 60 years. The difference in VHs prevalence in consequent age cohorts was statistically significant in males and females ($\chi^2 = 10.666$, $p=0.005$ and $\chi^2 = 13.965$, $p=0.001$, respectively). However, “older” age (over 50 years old) was not significantly correlated with the appearance of VHs in males ($\chi^2 = 3.183$, $p=0.074$) or females ($\chi^2 = 3.456$, $p=0.063$). No significant interaction between sex, age and VHs was found ($p=0.656$).

5.3. Distribution of VHs

Distribution of VHs in the spinal column 2% VHs ($n=3$) were found in the cervical spine, 45.6 % ($n=21$) were in the thoracic segment, and 54.3 % ($n=25$) were in the lumbar segment and 4% ($n=6$) were in sacral area. When the ratio between the number of VHs and the number of vertebrae in a given segment of the spine is calculated, the frequency was higher in the lumbar (2.7 %) and followed by thoracic (0.65 %) regions.

The lowest frequency was in the cervical area (1%). The most commonly affected vertebrae were lumbar vertebrae(L2) (4 % of vertebrae affected), followed by T11,T12, L1, L3 and L4 (2.6 % of vertebrae), and by T7,T8 (2.0 % of vertebrae). No VHs were detected in C3 or T1, and only 0.5 % of L5 vertebrae were affected.

In females, 14.3 % of VHs ($n=6$) were in the cervical region, 61.9 % ($n=26$) in the thoracic area, and 23.8 % ($n=10$) in the lumbar segment. The most commonly affected vertebra was T12 (6.1% of vertebrae), followed by T11 and L1 (4.1 % of vertebrae). In males, 10.7 % of VHs ($n=3$) were in the cervical segment, 57.1 % ($n=16$) in the thoracic region, and 32.1 % ($n=9$) in the lumbar area. The most commonly affected vertebra was L3 (4.1 % of vertebrae), followed by T6 and T11 (3.1 % of vertebrae).

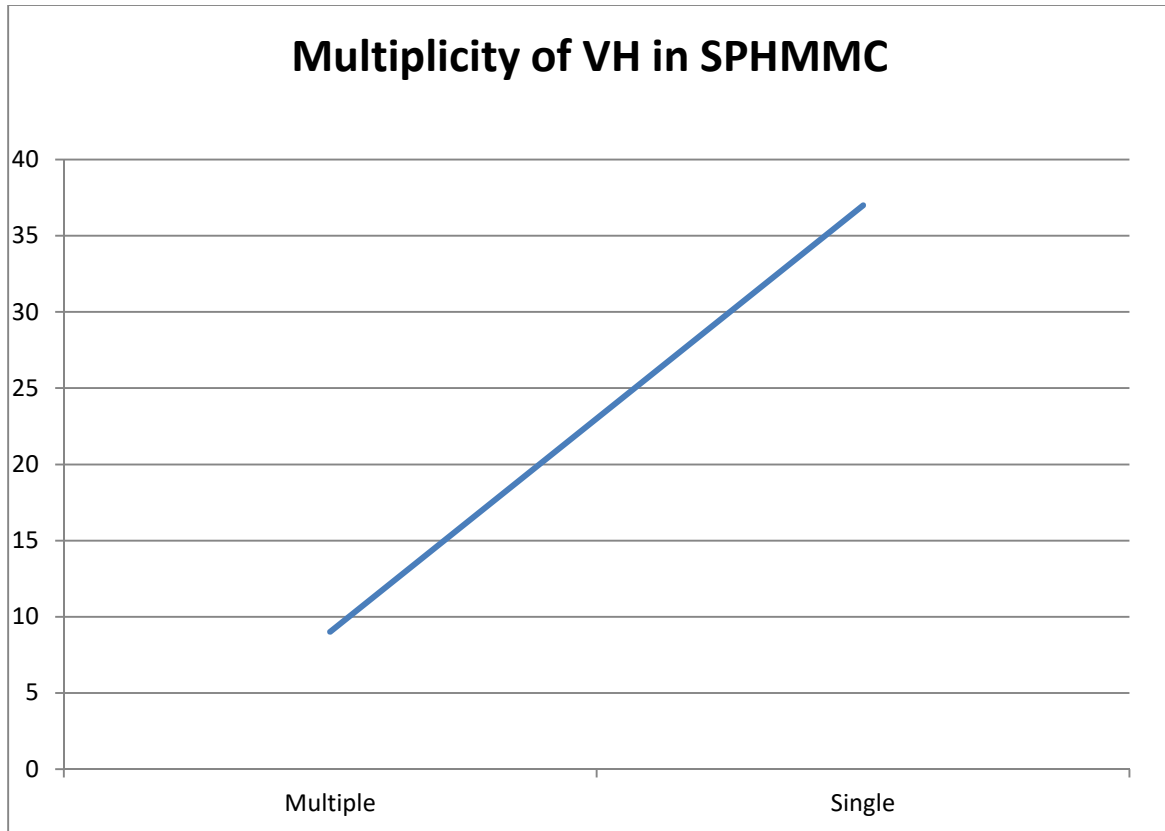


Figure 3:- Multiplicity of VH in SPHMMC in 2019.

From total of 46 individual 37 of them have single vertebral involvement and 9 of them have multiple vertebra involvement.

6. Discussion

Demography

VHs were present in 15.7 % of the individuals inspected in this study, a value not significantly higher ($\chi^2=63.338$, $p<0.2311$) than the prevalence usually reported in the literature, of 10.7 % [5]. Even this high value may be an underestimation, as only 80 % of VHs are successfully identified in MRI [17]. Nevertheless, when only “large” VHs were considered, the prevalence dropped to 9.7 %, a value much closer to that found in previous studies (10.7 %) [5]. This suggests that small VHs tend to go unnoticed in autopsy studies and routine radiological examination. This finding confirms the claim that the detection of small lesions by modern imaging methods is likely to reveal a higher frequency of VHs than 10.7 % [8]. Indeed, a recent review of 293 spinal MRIs revealed a VH prevalence of 15.7 % [15], a value similar to the one found in our MRI based study.

The male: female ratio for the presence of VHs in our study was 1:1.186, a female-biased occurrence rate closely resemble as that found in previous studies, which ranged between 1:1.3 and 1:2.25 [3–6,9–14]. The prevalence of VHs for females was 18.06 % and for males 13.03 %; however, no significant association was found between sex and the occurrence of VHs. These frequencies slightly lower than that of the ones found in a recent MRI-based study, of 30 and 23 % for females and males, respectively [15]; but are significantly higher than the 12.5 % for females and 8.9 % for males found in the largest autopsy study to date [5].

Smaller VHs may go unnoticed in autopsy studies and routine imaging-based medical examinations. The latter may be particularly problematic, as the proximity of VHs to the spinal column may cause them to induce pain and neurological symptoms [6,7]. Furthermore, the lack of correlation between sex and the presence of VHs supports the idea that sex hormones are not decisive factors in the development of VHs [18], as has been suggested to explain pregnancy-related VHs.

The prevalence and size of VHs increased with age, for both sexes, strengthening the hypothesis that the lesions develop during life [5]. The peak in prevalence in males was at a younger age than females. As has been suggested previously [18], the lack of a prevalence peak in the fertile years for females negates the suggestion that sex hormones play a role in VH development. This

is further strengthened by the fact that there was no significant difference in VH prevalence in females before and after 50 years of age, the approximate average menopausal age in Israel.

Distribution along the spine and vertebral body

The tendency of VHs to appear in the mid-thoracic, lower thoracic and lumbar regions is in agreement with previous studies, with slight differences in percentages between regions [5,10–12,14]. As other studies have shown that VHs in the sacral segment, which was included in the current research, but they are uncommon [5,14]. However, when the prevalence was examined for each vertebra separately, percentages of VHs were low for all vertebrae, ranging from 0 to 3.6 % of each vertebra. In a large autopsy study, the individual prevalence rates per vertebra were even lower, peaking at 1.2 % of T12 vertebrae affected by VHs [5]. Considering the low rates along the entire spine, it may be inferred that VHs are a systemic phenomenon. However, it is possible that local stresses on specific parts of the spine (lower thoracic and lumbar regions) may aggravate VHs already present in those regions. This notion gains partial support from the fact that L5 shows a very low prevalence of VHs.

Due to the location of L5 in the lumbar lordosis (most posterior on the sagittal plan) and the sharp inclination of its discal surfaces, the line of gravity falls outside the vertebral body of L5. Thus, this vertebra is less exposed to loading than others.

7. Limitations of this study

MRI have been shown to be an adequate imaging method for the study of vertebral hemangioma as positive identification of these lesions could be made in 80 % of cases. In comparison, VHs were positively identified in 65 and 52 % of cases on, CT scan X-RAY respectively. However, we could not reliably define the size, percentage of vertebral involvement, content and extra osseous extent of the lesions based on the retrospective data which does not include the size, percentage and whether extra osseous extension or not. In particular, we could not reliably define the content of the lesions based on the MRI signal intensity fat and vascular tissue, nor based on the differential micro-morphology of veins and arteries

Thus, all types of VHs (with or without fatty infiltration; cavernous, capillary and mixed) were grouped together and analyzed as one homogeneous entity.

8. Conclusions

VHs are known to be the most common form of benign tumors in the vertebral column [4,5]. This MRI-based study has shown the prevalence of this vascular malformation to be higher than previously thought, as current medical imaging methods allow the detection of even very small lesions. Although in raw numbers, there were more VHs among females; VHs were found to be a sex and age-independent phenomenon.

9. Acknowledgments

The authors would like to thank Dr. Shewalem Negash Assistant professor of Musculoskeletal radiology SPHMMC for her uncountable advice and her assistance; SPHMMC radiology department staffs and SPHMMC other department staffs. I also thank to Mr.Aman Yusuf (MPH) Assistant professor of public health SPHMMC for his logical and educative comments and advise.

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