

## THE EFFECT OF RADIOCONTRAST AGENT ON NEUROSENSORY AUDITORY DISORDER OF PATIENTS UNDERGOING ANGIOGRAPHY OF CORONARY ARTERY DISEASE

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### Contribution

VB data acquisition, drafting the manuscripts in Persian and revising the manuscripts in English. MRM & NA Designing project and supervision. MS & SKHB data analysis, prepare of tables. SAMB & NHB & NP data acquisition and revising the manuscripts in English. All authors read and approved the final manuscript.

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## ABSTRACT

**Objective:** This study was conducted to investigate the effect of contrast agent used in angiography on sensorineural hearing loss.

**Methodology:** This Quasi experimental study was conducted at Valiasr hospital, Birjand, Iran on 157 coronary artery disease patients hospitalized for angiography. The hearing level of the right and left ears was measured individually before and after the angiography. Then, to calculate the mean auditory threshold of the patients, the hearing level was averaged at three different frequencies of 500, 1000, and 2000 Hz. After data collection and introducing them into SPSS 22, descriptive statistics (frequency percentage distribution, mean and standard deviation) were used along with Mann-Whitney and Kruskal-Wallis tests at the significance level of 0.05.

**Results:** Out of the 157 patients studied, 79 (50.3%) were male. The mean age of the subjects was  $57.62 \pm 10.17$  years (29-85 years), which was  $57.67 \pm 9.31$  in women and  $56.85 \pm 11$  in men. The hearing level of the right ear before and after injection of the radiocontrast agent was  $23.69 \pm 13.18$  and  $23.33 \pm 13.30$  db, respectively, while in the left ear, the values were  $25.14 \pm 15.01$  and  $25.02 \pm 15.16$ , respectively, where this difference was not significant ( $p > 0.05$ ).

**Conclusion:** There is no appreciable effect of radiocontrast agent on neurosensory auditory disorder of patients undergoing angiography of coronary artery disease

**Keywords:** Contrast agent, hearing loss, Angiography.

## INTRODUCTION

Cardiovascular disease (CVD) is a major public health problem globally, and is a life-threatening condition due to its high prevalence. Although, there are several prevention programs aimed to reduce the incidence of CVDs, it is estimated as one of the leading causes of death in some countries.<sup>1-3</sup>

Coronary angiography is performed using Iodinated contrast agents, through the intravenous injection of water-soluble iodine contrast agent, which may be performed directly by micropuncture needle, catheterization or catheter insertion. During this experiment, in addition to arterial examination, the capillary and vascular ultrasound examinations were performed.<sup>1,2</sup>

Sensorineural hearing loss (SNHL) is a pathologic disorder of the inner ear, in which the most common cause lies in cochlea. The function of cochlea as a portion of inner ear is dedicated to hearing, and some of the main clinical symptoms of cochlea-related disorders may be hearing impairment, tinnitus and vestibular disorders, such as imbalance and vertigo.<sup>4</sup> A limited number of studies have examined the relationship between contrast agent and hearing impairment.<sup>5-8</sup> Therefore, due to the high prevalence of injection of contrast agent in the clinic and also develop strategies to prevent undesired side effects of contrast agent injection, the present study was carried out to investigate the effect of contrast agent on SNHL in patients undergoing angiography of coronary artery disease in Valiasr Hospital of Birjand city of Iran.

## METHODOLOGY

This Quasi experimental study was conducted at Valiasr hospital, Birjand, Iran on 157 coronary artery disease patients hospitalized for angiography. According to literature review, considering hearing loss in patients undergoing angiography ( $p=0.38$ ,  $d=0.1$  and  $z=1.96$ )<sup>6</sup> and using the proportion determination formula, the sample size was calculated 157.

Consecutive coronary artery disease patients hospitalized for angiography were enrolled in the study. On the other hand, patients with different types of ear-associated diseases, patients exposed to substantial occupational noise, patients with a history of otological surgery, and patients consuming ototoxic drugs were excluded. The collected information included age, gender, height, weight, abdominal obesity, history of smoking cigarette and opium, history of hypertension, dyslipidemia, diabetes and cardiac disease. In this study, Iodixanol (visipaque) radiocontrast agent, which is a unique and isosmol substance with osmolality of 320 Iodon/ml mg, which is 50- 200 mg given the type of angiography, was used. To this end, once

audiogram (including the air tract threshold) was taken one-two hours before angiography followed by another audiogram the day post-angiography by an audiometrist. The audiogram device used in the study was Intracoustics BC 40, Denmark. The hearing level of the right and left ears were examined individually before and after the angiography; this threshold at three different frequencies of 500, 1000, and 2000 Hz was summed up together and then divided by three in order to obtain the mean auditory threshold at these three frequencies. After data collection and introducing them into SPSS 22, descriptive statistics were used (frequency percentage distribution, mean and standard deviation), while for analyses, Mann-Whitney, Kruskal-Wallis and Wilcoxon Signed Ranks tests were employed at the significance level of 0.05.

## RESULTS

Out of the 157 patients studied, 79 (50.3%) were male and 78 (49.7%) were female. The mean age of the studied subjects was estimated as  $57.26 \pm 10.17$  years (29-85 years):  $57.67 \pm 9.31$  in women and  $56.85 \pm 11$  years in men. Based on the results of the present study, the most common risk factors associated with cardiovascular disease were hypertension (27.4%), dyslipidemia (24.8%), and diabetes (22.3%) (Table 1). The mean auditory levels at different frequencies in the left and right ears before and after injection of the radiocontrast agent are shown in Table 2. The results of the present study indicated that the hearing level of right ear before injection was  $23.69 \pm 13.18$ , while post-injection it was  $23.33 \pm 13.30$ . For the left ear, the values were  $25.14 \pm 15.01$  and  $25.02 \pm 15.16$ . Although there was a slight reduction in the hearing level before and after the injection of the radiocontrast agent in both right and left ears, this difference was not statistically significant ( $p > 0.05$ ) (Table 3). The results of Wilcoxon test showed that the mean level of hearing before and after angiography in right and left ear in patients less than 50 years of age was not significantly different ( $p > 0.05$ ). Whereas, at 50 years of age and above, the mean level of hearing in the right and left ears before and after angiography was significantly different ( $p < 0.05$ ). (Table 4).

**Table 1. Frequency distribution of risk factors associated with cardiovascular disease in the studied patients**

Risk Factors	N (%)
Hypertension	43 (27.4)
Diabetes	35 (22.3)
Dyslipidemia	39 (24.8)
Opium	20 (12.7)
Smoke	7 (4.5)

CVA	6 (3.8)
Valvular disease	5 (3.2)
Congenital heart disease	9 (5.7)
BMI	12 (7.7)
Underweight	48 (31)
Normal	70 (45.2)
Over weight	25 (16.1)
Obesity	
Abdominal obesity	105 (66.9)

## DISCUSSION

Studies have shown that the use of contrast dye for angiography, given its renal excretion, can cause renal complications, that can lead to acute renal failure, in particular in patients with underlying impaired renal function, termed contrast-induced nephropathy. Research has shown that these contrast dye can affect other organs such as the heart. Comprehensive identification of these substances effects on vital organs can be extremely important.<sup>9</sup>

Considering that there is a marvelous anatomical and physiological similarity between the ear and kidney in

**Table 2. The mean auditory level in the right and left ears before and after injection of the radiocontrast agent**

	Auditory level		
	500(Hz) (Mean ±SD)	1000(Hz) (Mean ±SD)	2000(Hz) (Mean ±SD)
<b>Right ear</b>			
Before	23.34±11.29	22.55±13.67	25.19±17.62
After	22.87±12.08	21.94±13.61	25.19±17.70
<b>Left ear</b>			
Before	25.61±12.99	23.12±15.45	26.69±19.92
After	25.06±13.43	23.09±15.82	26.91±19.91

**Table 3. Comparison of the auditory level of right and left ears before and after the angiography**

	Mean ±SD (db)	Median [Q1-Q3]	P-value
<b>Right ear</b>			
Before	23.69±13.18	20 [13.3-28.3]	0.217
After	23.33±13.30	20 [13.3-29.17]	
<b>Left ear</b>			
Before	25.14±15.01	20 [15-30]	0.821
After	25.02±15.16	20 [15-30.83]	

**Table 4. Comparison of the auditory level of right and left ears before and after the angiography according to age**

	N	Mean ±SD (db)	Median [Q1-Q3]	P-value
<b>Age (Years) &lt;50</b>				
<b>Right ear</b>				
Before	35	22.78±12.04	18.75(13.75-30)	0.086
After	35	21.85±11.87	20 (12.5-26.25)	
<b>Left ear</b>				
Before	35	23.82±13.76	20(12.5-31.25)	0.513
After	35	24.03±13.88	21.25(13.75-30)	
<b>Age (Years) &gt;50</b>				
<b>Right ear</b>				
Before	122	22.68±15.01	24.37(16.25-35)	0.030
After	122	28.27±15.13	25(17.5-37.5)	
<b>Left ear</b>				
Before	122	29.42±16.39	25(17.50-35)	0.002
After	122	30.22±16.50	26.25(18.43-38.75)	

maintaining fluid balance and electrolytes, that have led to similar drug being administered in some clinical cases. However, the auditory effects of contrast agents on the kidneys have not been clearly identified.<sup>10-12</sup>

Based on the results of the present research, the most common risk factors associated with cardiovascular disease were hypertension (27.4%), dyslipidemia (24.8%), and diabetes (22.3%), which are comparable to the results of other studies. In the study by Tan et al., diabetes, dyslipidemia, and hypertension were observed in 5.7%, 16.8%, and 41.3% of patients, respectively.<sup>13</sup> In the study by Zandparsa et al., the frequency of diabetes, hypertension, and hyperlipidemia was observed as 43%, 72.1%, and 78.2%, respectively.<sup>14</sup>

Based on the results of the present study, there was a slight decline in the mean auditory level of individuals before and after injection of the radiocontrast agent in both right and left ears, though this difference was not statistically significant. In the study by Tan et al. examining the relationship between cardiovascular disease and risk factors associated with hearing defects, a statistically significant relationship was observed between the average hearing and Framingham 10-year risk of cardiovascular disease; the patients with a risk score higher than 20 had greater hearing impairment in comparison to those with a risk score of 0-5.<sup>13</sup> In the study by Wattamwar et al., it was found that developing cardiovascular disease is associated with faster reduction in the hearing level of patients.<sup>15</sup> Yamasoba et al. also found that slow blood circulation to the vertebrobasilar system is associated with neurosensory hearing loss.<sup>16</sup> In the study by Kamal et al. to examine the effect of applying coronary stent on the hearing function of patients with myocardial infarction, the brain stem hearing delay had a significant difference especially in I wave before and after the surgery, where de delay in wave I had a more dramatic reduction after the treatment as compared to waves III and V.<sup>17</sup> In the study by Zhang et al. to compare Iodixanol with Iopromide in patients with renal disease undergoing angiography with or without PCI, no statistically significant difference was observed in the incidence of nephropathy caused by the radiocontrast agent in both groups. However, Iodixanol caused a significant decline in the incidence of cardiovascular consequences as compared to Iopromide.<sup>18</sup> Generally, different mechanisms affect the auditory function of people. Cardiovascular disease is one of the most common causes of hearing impairment due to diminished blood flow to the cochlea.<sup>16</sup>

In this study, age was significantly correlated with neurosensory hearing loss, which is in agreement with the results of other studies.<sup>19,20</sup> Hearing loss is usually gradual and increases with age and exposure to risk factors is why many people do not notice their hearing loss for many years.

One of the main limitations of this research was not using the gold standard method and low sample size. Thus, it is suggested that in future more extensive studies with a larger sample size using standard hearing test be conducted.

## CONCLUSION

There is no significant relationship between contrast agent and hearing loss. Although, further studies in this subject are needed to achieve conclusive results.

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## Ethical issues

This study was approved by the Ethics Committee of the Birjand University of Medical Sciences, Birjand, Iran (Ir.bums.REC.1396.77).

## REFERENCES

1. Hassankhani H, Zhinalzadeh A, Fakhri M, Asadi P, Almasi A. Shift work and cardiovascular risk factors in the nurses of the emergency and intensive care wards of educational hospitals affiliated to Kermanshah University of Medical Sciences in 2012-2013 Clin Res Paramedical Sci 2012;1(3):55-63.
2. Toori MA, Kiani F, Sayehmiri F, Sayehmiri K, Mohsenzadeh Y, Ostovar R, et al. Prevalence of hypercholesterolemia, high LDL, and low HDL in Iran: a systematic review and meta-analysis. Iran J Med Sci 2018;43(5):449-65.
3. Parsa AFZ, Ziai H, Fallahi B. The relationship between cardiovascular risk factors and the site and extent of coronary artery stenosis during angiography. Tehran Uni Med J 2010;68(3).
4. Junck L, Marshall WH. Neurotoxicity of radiological contrast agents. Ann Neurol 1983;13(5):469-84.
5. Karim MR, Balsam L, Rubinstein S. Permanent hearing loss with iopamidol following aortic angiography in a hemodialysis patient: a case report and review of the literature. Am J Kidney Dis 2010;55(4):712-6.

6. Erkan AF, Beriat GK, Ekici B, Doğan C, Kocatürk S, Töre HF. Link between angiographic extent and severity of coronary artery disease and degree of sensorineural hearing loss. *Herz* 2015;40(3):481-6.
7. Torihara K, Morimitsu T, Nagai T. Effects of contrast media on the stria vascularis. *Acta Oto-Laryngol* 1994;114(sup514):122-6.
8. Matsuoka A, Shitara T, Okamoto M, Sano H. Transient deafness with iopamidol following angiography. *Acta Oto-Laryngol* 1994;114(sup514):78-80.
9. Wessely R, Koppa T, Bradaric C, Vorpahl M, Braun S, Schulz S, et al. Choice of contrast medium in patients with impaired renal function undergoing percutaneous coronary intervention. *Circ Cardiovasc Interv* 2009;2(5):430-7.
10. Phelan PJ, Rheault MN. Hearing loss and renal syndromes. *Ped Nephrol* 2018;33(10):1671-83.
11. Suntjens EB, Smid BE, Biegstraaten M, Dreschler WA, Hollak CE, Linthorst GE. Hearing loss in adult patients with Fabry disease treated with enzyme replacement therapy. *J Inher Metab Dis* 2015;38(2):351-8.
12. Hoskins BE, Cramer CH, Silviu D, Zou D, Raymond Jr RM, Orten DJ, et al. Transcription factor SIX5 is mutated in patients with branchio-oto-renal syndrome. *Am J Hum Genet* 2007;80(4):800-4.
13. Tan H, Lan N, Knuiman M, Divitini M, Swanepoel D, Hunter M, et al. Associations between cardiovascular disease and its risk factors with hearing loss—A cross-sectional analysis. *Clin Otolaryngol* 2018;43(1):172-81.
14. Zandparsa A, Habashizadeh M, Farsani EM, Jabbari M, Rezaei R. Relationship between renal artery stenosis and severity of coronary artery disease in patients with coronary atherosclerotic disease. *Int Cardiovasc Res J* 2012;6(3):84.
15. Wattamwar K, Qian ZJ, Otter J, Leskowitz MJ, Caruana FF, Siedlecki B, et al. Association of cardiovascular comorbidities with hearing loss in the older old. *JAMA Otolaryngol Head Neck Surg* 2018;144(7):623-9.
16. Yamasoba T, Kikuchi S, O'uchi T, Higo R, Tokumaru A. Sudden sensorineural hearing loss associated with slow blood flow of the vertebrobasilar system. *Ann Otol Rhinol Laryngol* 1993;102(11):873-7.
17. Kamal N, Badawy S, Taha H, Baghdady A, Mustafa M. Effect of coronary stent application on the audiovestibular functions in patients with ischemic heart disease. *Egypt J Ear Nose Throat Allied Sci.* 2013;14(2):123-8.
18. Zhang J, Jiang Y, Rui Q, Chen M, Zhang N, Yang H, et al. Iodixanol versus iopromide in patients with renal insufficiency undergoing coronary angiography with or without PCI. *Medicine* 2018;97(18):e0617.
19. Mattos LC, Veras RP. The prevalence of hearing loss in an elderly population in Rio de Janeiro: a cross-sectional study. *Braz J Otorhinolaryngol* 2007;73(5):654-9.
20. Hong SM, Park I-S, Kim YB, Hong SJ, Lee B. Analysis of the prevalence of and factors associated with hearing loss in Korean adolescents. *PLoS One* 2016;11(8):e0159981.