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Research Article **Open Access**

Relationship Between Calcium Ion Concentration and Thyroid-Stimulating Hormone in Libyan Women

Nadia Al Rwab[1], Samira Al-Agouri[2], Nagwa Hamed[3] and Hussien Amgawer[4]*

[1, 2, 3] Department of Zoology, University of Benghazi; Faculty of Arts and Sciences, Tocra Branch, Libya.

***Corresponding author:**
hussien.amgawer@uob.edu.ly
Department of Zoology, University of Benghazi; Faculty of Arts and Sciences, Tocra Branch, Libya.

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Abstract

This study aimed to estimate the relationship between the thyroid-stimulating hormone (TSH) and calcium ion concentration in Libyan women, as the study conducted in the city of Tocra- eastern Libya. Venous blood samples were collected in the laboratory from a total of 34 women, whose average age was 20-50 to measure the level of TSH and calcium concentration. The findings showed that the correlation between calcium ion concentration and TSH were strong. The calcium ion concentration increased depending on the increase in TSH.

Keywords: Calcium Ion; Thyroid-Stimulating Hormone (TSH); Tocra; Libya.

INTRODUCTION

The human body controls the amount of calcium in the cells and blood; hence, it moves calcium from the bones into the blood as required to maintain a constant level of calcium in the blood. The lack of calcium-rich food consumption leads to withdrawing calcium from bones to ensure normal cell function which may lead to weakened bones. This can lead to osteoporosis. Therefore, to maintain a normal level of calcium in the blood without weakening the bones, the calcium level in the blood regulated mainly by two hormones: parathyroid hormone and calcitonin that plays an important role in calcium homeostasis (Guyton. C & Hall. J. E, 2011) and secreted by the thyroid gland.

The hormones secreted from the thyroid are regulated by thyroid stimulating hormone (TSH), which is secreted from the front part of the pituitary gland under the influence of the thyroid-releasing hormone (TRH) by the hypothalamus, which stimulates the growth of the thyroid gland and the secretion of its hormones (Boron. W. F & Boulpaep. E. L, 2012). TSH regulates thyroid gland function by stimulating iodine blocking, making and releasing thyroid hormones into the circulatory system. Releasing tri-iodothyronine (T3), thyroxine (T4), and TSH secretion controlled by TRH.

Calcium is a divalent action available in the body. More than 99% of the calcium in the body is concentrated in the skeletal system and about 1% rapidly replaced by calcium in the blood. Small amounts of calcium outside the bones diffuse into the serum, partly bound to the protein and partly ionized. Calcium plays a major role in nerve transmission, which has a vital role in

the ability of the heart to function and it is necessary to regulate the heartbeat. In addition, this ion is involved in blood clotting and hormone secretion (Bongard et al., 2008; Nix. S & William. S, 2009) Intracellular, the calcium is a key to the second intracellular messenger that plays a pivotal role in controlling various cellular processes such as secretion, differentiation, reproduction, motility and cell death. In contrast, extracellular calcium is necessary for a wide range of physiological phenomena including blood clotting, muscle function and maintenance of skeletal integrity (Sharan et al., 2008). Calcium balance tightly regulated by the interaction between gastrointestinal absorption, renal excretion, bone reabsorption, vitamin D and parathyroid hormone (Kumar, 1995).

The thyroid gland plays a major role in calcium metabolism and regulation by excretion. Thyroid stimulating hormones (TSH) are the regulating key of thyroid metabolism to produce both T4 and T3. T4 is the main product and converted in the extremities by removing iodine into T3, which is the main biological activity of thyroid hormones. The production of TSH is regulated by thyroid nutrition. Therefore, TSH is regulated by a negative feedback mechanism related to the serum level of T3 and T4 (Aaron. R. M & Robert. B. S, 2009). The objective of this study was focused on the relationship between the concentration of calcium ion in the human body and TSH in Libyan women.

MATERIALS AND METHODS

Sampling

The study was conducted in Tocra city - Libya. Venous blood samples we recollected in the laboratory from a total of 34 women with an average age of 20-50 to measure the levels of TSH and calcium.

Separation of serum from blood

The blood was placed in test tubes free of anticoagulants. Afterward, the blood was separated using a centrifuge (3000 rpm at 15 minutes), and the blood drawn using a pipette and placed in tubes and a special number and name were given to the tube to avoid losing it.

Measurement of calcium

Calcium level was measured with an electrolyte device.

Measuring the concentration of TSH

TSH concentration in the blood was measured by following the steps included with the TSH test kit and according to the manufacturer's instructions for the ELISA device.

Statistical test

The data were tested using the correlation test between TSH and calcium ion. In addition, the Paired Samples Test was applied to investigate the significance between calcium and TSH.

RESULTS

The current study investigated a total of 34 samples. Through this study, the relationship between calcium ion concentration and TSH was monitored. It was obviously noted that there was a significant difference at $P<0.0001$ in females at different ages. The correlation between calcium ion concentration and TSH was strong (Figure 1).

The calcium ion concentration increased depending on the increase of this hormone. This finding is shown in (Table 1).

Table: (2). Composition of the basal diets (as fed basis) used in the AME digestibility assays**.**

Samples	TSH(MU/L) mean± SD	Ca (MU/L) mean± SD	P- value
34	1.8874 ± 1.49	7.7853 ± 0.97	P<0.0001

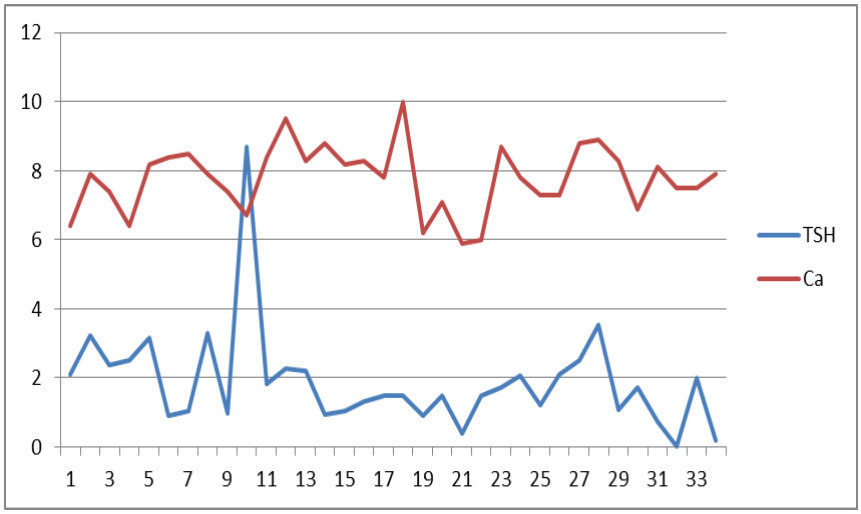

Figure: (1). Correlation between calcium concentration and TSH level in Libyan women.

DISCUSSION

It is known that calcium reduces the activity of the thyroid gland and that its absorption increases the activity of the thyroid gland (Watts, 1989). The secretion of TSH is highly dependent on the concentration of ionized calcium and represents a simple negative feedback loop. However, the level of calcium in the blood drops significantly in patients with elevated TSH concentration in contrast to individuals with normal TSH levels. In addition, renal calcium affected by TSH may decrease in case of hypothyroidism and severe hypothyroidism (Chen & Goodman, 2004). The thyroid gland usually enlarges in response to the increased demand for thyroid hormone that occurs in puberty, pregnancy, iodine deficiency and a viral or genetic immune disorder. In this case, the thyroid follicle synthesis and thyroid hormone will be affected. As a result, high thyroid hormone can lead to Graves' disease or other thyroid abnormalities.

CONCLUSION

In conclusion, the calcium ion concentration increases depending on the increase of TSH in blood.

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Research Article

Open Access

Surgical Outcomes of Congenital Heart Disease in the Eastern Region of Libya

Mariam M. Madany [1], Amenh B. Yousif [2*], Rasmia H. Feituri[3], Naemia Gawbaa[4] Amal Khazmi [5]

[1,3,4,5] Department of Pediatric, Faculty of Medicine, University of Benghazi, Libya.

∗Corresponding Author: amenh.yousif@uob.edu.ly, Department of Family and Community Medicine, Faculty of Medicine, University of Benghazi, Libya.

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Abstract

Congenital heart disease (CHD) refers to a group of structural abnormalities in the heart that are present at birth. However, due to advancements in medical and surgical care, more children with CHD in developed countries are now surviving intoadulthood. This study aims to assess the outcomes of surgically repaired congenital heart disease in the easternpart of Libya. Data was obtained from the medical records of 374 patients, of which 54.2% were male and 45.7% were female, who underwent surgical correction and palliative cardiac surgery between February 2015 and February 2019. The majority of patients were from Benghazi and Al-Jabal Al-Akhdar, and the most common diagnoses were ventricular septal defects (VSD) (25.4%) and complex congenital heart disease (CCHD) (21.9%). The death rate in atrioventricular canal (AVC) defects was 7.4%, CCHD had a mortality rate of 4.8%, and the total mortality rate was 2.9%. In the eastern part of Libya, pediatric cardiac surgery and cardiac surgical intensive care for children with congenital heart disease (CHD) still heavily rely on foreign cardiac surgery missions. There is a need for a comprehensive treatment plan and the development of local capabilities to manage CHD patients independently.

Keywords: Congenital Heart Disease, Surgical Outcome.

INTRODUCTION

Congenital heart disease (CHD) refers to structural abnormalities of the heart or surrounding blood vessels present at birth. It is a common condition affecting newborns. Studies have investigated the occurrence and patterns of CHD in Libya. In a 2018 study by (Mansour, 2018), ventricular septal defect (VSD) was the most prevalent type of CHD, accounting for 14.8% of cases. The most common complex CHD was Tetralogy of Fallot at 13.2%.

The majority of CHD cases in Libya (92.5%) were cyanotic, with a slightly higher prevalence in males. Another Libyan study in 2020 by (Mahmmed et al., 2020). found that the incidence of atrial septal defect (ASD) was 40.4% and VSD was 30.8%. According to a 2014 Iranian study by (SalehiAbarghuie et al., 2015) the most common surgical procedure for CHD was VSD closure, making up 28.5% of cases. Around 20.5% of infants with CHD required early interventional treatment in the first 3 years of life. Overall, the field of pediatric cardiology and cardiac surgery has seen significant advancements, leading to improved outcomes for patients with congenital heart diseases. Studies have shown that with appropriate care, many children with CHD, even complex cases, have a good chance of surviving into adulthood. Research by (Chinawa et al., 2019;

Movahedian et al., 2017; Sharmin et al., 2008) supports this. Within developed high-income countries, pediatric cardiology and cardiac surgery have seen significant advancements, as demonstrated by a 2018 study by (Spector et al., 2018). This has led to successful repairs or treatments for most CHD cases, including complex ones.

However, low-income and developing regions, like Libya's eastern area, often lack the advanced CHD care necessary for their children. Consequently, parents in these areas face challenges when their child is diagnosed with CHD, especially in critical cases requiring immediate surgical intervention. Due to the unavailability of local surgery, these regions rely on cardiac surgery missions from other countries. This leads to a growing number of cases requiring surgery and critical cases that may result in death due to delays in treatment.

MATERIALS AND METHODS

Study Design: This was a descriptive, cross-sectional study.

Study Population: consisted of 374 patients with congenital heart disease (CHD) who underwent surgical correction or palliative cardiac surgery between February 2015 and February 2019.

Data Collection: The data was collected from Tobruk Medical Center and Benghazi Medical Center in Libya.

Diagnostic Tools: The diagnosis of CHD in the patients was made using various methods, including physical examination, pulse oximetry, chest X-ray, electrocardiography (ECG), and echocardiography. These tools were used to assess the nature and severity of the CHD and guide the appropriate surgical interventions.

Inclusion and Exclusion Criteria: The study excluded procedures such as thoracic duct ligation, pacemaker implantation, and stabilizing an unstable sternum. The researchers included the assessment of mortality within 30 days following open-heart surgery to examine the short-term outcomes of the surgical procedures.

Statistical Analysis: The study analyzed the demographic data, including age and sex distribution, as well as the types of congenital heart defects. The descriptive data were analyzed in Microsoft Excel and presented as numbers and percentages in tables.

RESULTS

According to Table 1, the study included a total of 374 patients with congenital heart disease (CHD) who underwent corrective and palliative cardiac surgery. Of these patients, 203 were male, accounting for approximately 54.2% of the study population. The remaining 171 patients were female, representing about 45.7%. The male-to-female ratio in the study cohort was calculated to be 1.8:1.

Table (1). Gender Distribution:

Gender	N	%
Male	203	54.2%
Female	171	45.7%

Table (2) shows that the majority of patients who underwent surgery were between the ages of 1 and 3 years. These two younger age groups made up the majority of the study population.

Table (2). Age at the time of the operation:

Age	N	%
1 week-1 year	128	34.2 %
1 year-3 year	153	40.9%
3 year-5 year	42	11.2%
>5 year	51	13.6%
Total	374	100%

Table 3 illustrates the distribution ofpatients according to their region of residence. The majority of patients in the study were fromBenghazi, accounting for 120 individuals or 32% of the total. Al-Jabal Al-Akhdar region had the second-highest number of patients, with 100 individuals, making up 28.8% of the total. Tobruk, Ajdabiya, the Western Region, and the Southern Region had progressively smaller numbers of patients, with percentages ranging from 6.1% to 18.7.

Table (3). Distribution of patients in different regions

Region	N	%
Benghazi	120	32
Al Jabal Al Akhdar	100	28.8%
Tobruk	70	18.7%
Ajdabiya	36	12.4%
Western Region	25	6.6%
Southern region	23	6.1%

In 2015, a total of 94 operations were performed. The most common operation was PDA (20.2%) followed by CCHD (18%). The male-to-female ratio was 1:1and the mortality rate for the surgical procedures was 2.1%, Table (4).

In 2016, a total of 101 procedures were performed. Among them, VSD procedures constituted 29.7%, while CCHD procedures accounted for 19.8%. The male-to-female ratio was approximately 1.14 to 1, and the mortality rate associated with the surgical procedures conducted in 2016 was 2.9%, Table (5).

Table (4). Distribution of operated heart lesion 2015

CHD	N (%)	M/F	Death /%
ASD	10 (10.6)	6/4	0
VSD	16 (17)	8/8	0
PDA	19(20.2)	9/10	0
AVC	6(6.3)	1/5	1
TOF	14(14.8)	9/5	0
AS	2 (2.1)	0/2	0
PS	3 (3.1)	0/3	0
COA	5 (5.3)	3/2	0
MVR	2 (2.1)	1/1	0
CHD	17 (18)	10/7	1

ASD: atrial septal defect, VSD: ventricular septal defect, PDA: patent ductus arteriosus, TOF: tetralogy of Fallot,
PS: pulmonary stenosis, AS: Aortic stenosis, CCHD: Complex congenital heart disease, MVR: mitral valve repaired

Table (5) Distribution of operated heart lesion 2016

CHD	N (%)	M/F	Death %
ASD	7(6.9)	1/6	0
VSD	30 (29.7)	16/14	1
PDA	2(2.1)	1/1	0
AVC	11(10.8)	4/7	0
TOF	9(8.9)	7/2	1
AS	7 (6.9)	5/2	0
PS	6(5.9)	3/3	1
COA	8(7.9)	5/3	0
MVR	1(0.9)	0/1	0
CCHD	20(19.8)	12/8	1

In 2017, a total of 43 operations were performed. CCHD accounting for (23.2%) and VSD accounting for (20.9%). The male-female ratio was 1.2:1 and the mortality rate was 6.9%, Table (6).

Table (6). Distribution of operated heart lesion 2017

CHD	N (%)	M/F	Death /%
ASD	8(18.6)	2/6	0
VSD	9 (20.9)	6/3	1
PDA	9(20.9)	3/6	0
AVC	2(4.6)	2/0	0
TOF	3 (6.9)	2/1	0
AS	0 (0)	0/0	0
PS	2 (4.6)	1/1	1
COA	0 (0)	0/0	0
MVR	0 (0)	0/0	0
CCHD	10(23.2)	6/4	1

In the year 2018, a total of 95 operations were performed. The most common operation was VSD (29.4%), followed by CCHD (21%). The male-to-female ratio was 1.4:1, and the mortality rate was (2.1%), Table (7).

In 2019, a total of 41 operations were performed,with CCHD accounting for (36.5%) and VSD accounting for (29.2%). The mortality rate for the surgical procedures conducted in 2019 was 2.4%, and the male-to-female ratio was1.04:1, Table (8).

Table (7) Distribution of operated heart lesion 2018

CHD	N (%)	M/F	Death /%
ASD	8(8.4)	5/3	0
VSD	28 (29.4)	18/10	0
PDA	4(4.2)	2/2	0
AVC	4(4.2)	2/2	1
TOF	18(18.9)	9/ 9	0
AS	0	0	0
PS	6(6.3)	3/3	0
COA	6(6.3)	4 2	0
MVR	1 (1)	0/1	0
CCHD	20 (21)	13/7	1

Table (8) Distribution of operated heart lesion 2019

CHD	N (%)	M/F	Death /%
ASD	2(4.8)	1/1	0
VSD	12(29.2)	6/6	0
PDA	0	0	0
AVC	4(9.7)	2/2	0
TOF	6(14.6)	3/ 3	0
AS	1(2.4)	0/1	0
PS	1(2.4)	0/1	0
COA	0	0	0
MVR	0	0	0
CCHD	15 (36.5)	9/6	1

Table (9) shows the distribution of different congenital heart diseases (CHDs) among the patients. The most common CHD was Ventricular Septal Defect (VSD), accounting for 25.4% of the patients. This was followed by Complex Congenital Heart Diseases (CCHD) at 21.9%, Tetralogy of Fallot (TOF) at 13.3%, Atrial Septal Defect (ASD) at 9.3%, and Patent Ductus Arteriosus (PDA) at 9%.

The male-to-female ratio is also provided, with more males than females for most conditions except for ASD, PDA, and Pulmonary Stenosis (PS).

The mortality rate was low overall at 2.9%. The highest mortality was seen in CCHD at 4.8%, followed by Atrioventricular Canal Defect (AVC) and TOF at 7.4% and 4% respectively. VSD, AVC, and TOF each accounted for 18.2% of the total mortality, while PS accounted for 9%.

Table (9) Total Number of congenital heart defects and mortality rate

CHD	N (%)	M/F	Death /%	% from the total mortality
ASD	35(9.3)	15/20	0	0%
VSD	93 (25.4)	60/33	2(2.1%)	18.2 %
PDA	34(9)	15/19	0%	0%
AVC	27(7.2)	15/11	2(7.4%)	18.2 %
TOF	50 (13.3)	30/ 20	2(4%)	18.2 %
AS	10(2.6)	5/5	0	0%
PS	18(4.8)	6/12	1(5.5%)	9%
COA	19(5)	11/9	0	0%
MVR	0	0	0	0%
CCHD	82(21.9)		4(4.8%)	36.3%
Total	374	203 /171	11(2.9%)	100%

DISCUSSION

In Libya. unfortunately, there is a lack of community-based data available on the incidence and prevalence of CHD throughout the country. The underdeveloped nature of resources for CHD treatment in countries with limited resources leads to significant delays in management and a high mortality rate, particularly in newborns with Complex Congenital Heart Disease (CCHD) that require surgical correction.

A study conducted in (Al-Ammouri et al., 2020) found a mortality rateof 17% among Syrian refugee

infants with cardiac disease while they were waiting for surgery. Despite regional and international efforts, the treatment of Syrian refugee childrenwith heart disease remains challenging, resulting in delays in care and increasedmortality. The timing of cardiac surgery for children with congenital heart disease (CHD) is critical, as delayed surgical intervention can result in various complications and higher mortality rates. Conditions such as atrioventricular canal (AVC) and ventricular septal defect (VSD) pose a risk of early pulmonary hypertension, which can resultin a longer stay in the intensive care unit and anelevated mortality rate (Beghetti & Tissot, 2009; SalehiAbarghuie et al., 2015).

Late timing of cardiac surgery in developing countries like Libya can be attributed to several factors, including late diagnosis of CHD and the lack of availability ofcontinuous cardiac surgery programs. These factors contribute to delays in surgicalintervention, potentially exacerbating the risk of complications and mortality rates. A study conducted by (SalehiAbarghuie et al., 2015) involving 789 patients found that 75.8%were younger than 3 years old, indicating the importance of early intervention in this age group. Additionally, 22% of the patients were older than 3 years, highlighting theneed for timely surgical management across a wide age range. In Nigeria, where foreign cardiac missions are sometimes utilized. A study conducted (Nwafor & Eze, 2019) found that 75% of patients undergoing cardiac surgery were under the age of ten. This highlights the prevalence of pediatric cases requiring cardiac surgery in the country. Various indications existfor surgical closure of ventricular septal defect(VSD), which include a large VSD causing clinical symptoms of heart failure and recurrentchest infections, as well as cases of double-commit VSD and outlet VSD with Aortic valveprolapse leading to aortic valve regurgitation, and those with a history of infective endocarditis (Nadas et al., 1964). Such conditions necessitate surgical intervention to address the VSD and associated complications. Furthermore, a study conducted by(Ahmadi et al., 2002) focused on patients aged 3 to 12years, indicating that this age group formed the majority of patients in their study.

This further emphasizes the prevalence of VSD cases requiring surgical closure within this specific age range. In the current study, it was found that 75% of the patientswere younger than 3 years old, with the youngestpatient being just 1 week old and the oldest being 30 years old. Among the patients, 54.2% were males and 45.7% were females. Thesefindings align with previous research that has also observed a younger age profile for patientsundergoing cardiac surgery, which can be attributed to the availability of regular visits by foreign cardiac surgical missions and the high demand for surgical correction of congenital heart disease (CHD) in the population. Pulmonary banding, a surgicalprocedure involving the placement of a band around the pulmonary artery, is commonly usedin cases of multiple muscular VSD (referred to as Swiss cheese) and in infants with low body weight. This approach has been described in studies by (Kowalsky et al., 2006; Rao, 2013).

Transcatheter closure has indeed been implemented as a treatment option for atrial septal defect (ASD) and patent ductus arteriosus (PDA) in the western region of Libya. Transcatheter closure is a minimally invasive procedure that offers severaladvantages over traditional surgical intervention, including fewer complications anda shorter hospital stay. In the case of ASD, which is a hole in the wall between the heart's upper chambers, and PDA, which is the persistence of a blood vessel connecting the aorta and the pulmonary artery, trans-catheter closure has become the preferred method inmany cases.

This procedure involves using a catheter to place a device (such as an occluder) to close the defect or block the abnormal blood vessel. The study conducted by (Madany et al., 2021) in Libya supports the transition to transcatheter intervention for ASD and PDA. According to their findings, on-

ly large ASDs and sinus venous ASDs are referred to surgical intervention, suggesting that transcatheterclosure is now the primary approach for most cases. Infants who have a significant patent ductus arteriosus (PDA) are unlikely to experience spontaneous closure. Therefore, it isgenerally recommended to consider closing such PDAs due to the associated risk of complications. In addition, any PDA that presents with a murmur should be evaluated forclosure as it poses a risk of infective endocarditis, an infection of the inner lining of the heart, or heart valves. Research conducted by (Afif et al., 2016; Chinawa et al., 2019) supports the notion that infants with large PDAs are less likely to have the ductus arteriosus close naturally. Consequently,intervention is typically required to close the PDA and avoid potential complications.Furthermore, the presence of a murmur in a patient with PDA indicates abnormal blood flowand serves as an indicator of an increased risk of complications. To mitigate this risk, it is often recommended to close the PDA when a murmuris detected. In our study, we observed that ventricular septal defect (VSD) was the most frequently operated cyanotic congenital heart disease (CHD) with a prevalence of 25.4%.

This was followed by atrial septal defect (ASD) at 9.3%and patent ductus arteriosus (PDA) surgical ligation at 9%. These findings are consistent with the results reported by (Mirzaei et al., 2016) in a study conducted in Iran, where they evaluated 203 patients who underwent open heart surgery. They found that the most commonCHDs were VSD at 25%, ASD at 13%, and PDA at 11%. Similar patterns have been observed in previous studies conducted in Guatemala (Kowalsky et al., 2006), Egypt (Gamal et al., 2020), and Twiam (McCracken et al., 2018). In a study conducted in Nigeria by (Nwafor & Eze, 2019), they examined 72 patients who underwent congenital heart disease (CHD)surgery. Their findings revealed that ventricularseptal defect (VSD) was the most prevalent CHD, accounting for 27.16% of the cases. This was followed by patent ductus arteriosus (PDA) at 24.6% and atrial septal defect (ASD)at 17.28%. These results align with a study conducted by (Zahid et al., 2013), which showed a similar pattern of CHD prevalence. The previous study drew parallels with our research, indicating that these particular CHDs are commonly observed in these countries.

According to a study conducted by (Jacobs et al., 2019), aortic valve replacement was identified as the most commonly performed surgical procedure. This finding suggests that the high prevalence of certain types of congenital heart disease (CHD) may be influenced by the frequency of aortic valve replacement surgeries. According to a study conducted by (Pozzi et al., 2000), it is recommended that total repair of tetralogy of Fallot (TOF) should ideally be performed between the ages of one to two years. However, in cases where there is significant cyanosis or frequent cyanotic spells, it is advised to consider a systemic to pulmonary artery shunt procedure at an age of less than three months.

In a previous study conducted in the eastern part of Libya by (Mustafa et al., 2020), it was observed that 52.2% of patients with Tetralogy of Fallot (TOF) underwent surgery at the age of two years or older. This finding was attributed to an accumulation of TOF cases requiring surgical intervention. Similarly, in a study conducted in (Hashemzadeh & Hashemzadeh, 2010), the median age for TOF surgery was reported to be 5 years. On the other hand, a study by (Bacha et al., 2001) found that 57% of patients underwent primary TOF surgery before the age of 2 years with a median age of 8 months.

Newborns diagnosed with transposition of the great arteries (TGA) have a critical need for a surgical team within the first three weeks of life to have any chance of survival, as indicated by studies conducted by (Chang, 2007). Our study, however, had limited cases of TGA due to the availability of the surgical team at the time of birth, resulting in a small sample size for this specific condition.

In our study, the overall mortality rate was 2.9%. Among the different types of congenital heart diseases (CHDs) examined, atrioventricular canal defect (AVC) had the highest mortality rate at 7.4%, followed by critical congenital heart disease (CCHD) at 4.8%, and tetralogy of Fallot (TOF) at 4%. Comparisons with other studies revealed varying mortality rates in different countries. For instance, Egypt, (Gamal et al., 2020)reported a mortality rate of 4.8%, while in Brazil (Jacobs et al., 2019) found a higher rate of 13.4%. In Lebanon, (Arabi et al., 2011). observed a lower mortality rate of 2.6%, and in Sudan, (Algibali et al., 2018). reported a mortality rate of 6.3%. Furthermore, (McCracken et al., 2018) found similar mortality rates of 6.9% and 7.4% for TOF, respectively, which aligns with the current study findings. The timing of surgical referral for complete atrioventricular canal (AVC) in our patients was delayed, with surgery being performed at an age above 1 year, resulting in a mortality rate of 4.7%. In comparison, a study conducted by (Hirata et al., 2021) reported a lower mortality rate of 2% in patients who underwent surgery at the appropriate age of 3-6 months. Additionally, in a North American study by (Spector et al., 2018), the mortality rates for postoperative tetralogy of Fallot (TOF) and AVC were reported as 1.3% and 2.5%, respectively.

The timing of cardiac surgery in children with congenital heart disease (CHD) is critical to avoid complications and increased mortality. Delayed surgery in cases of AVC can lead to early pulmonary hypertension development, resulting in longer intensive care unit stays and higher mortality rates.

CONCLUSION

In developing countries, delayed cardiac surgeries are caused by a scarcity of cardiac surgeons, leading to delayed referrals for individuals with congenital heart disease (CHD) in the eastern part of Libya. Consequently, international cardiacsurgical missions have been relied upon to addressthe demand for surgeries. The local medical team must provide independent care for CHD patients by developing the necessary skills and expertise to effectively tackle the challenges and provide better care for CHD patients.

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ETHICS

The study obtained ethical approval from the director of the cardiac center, and there is a strong commitment topreserving the confidentiality of all the informationprovided to us.

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Research Article

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Prevalence of Amiodarone-Induced Vortex Keratopathy at Benghazi National Cardiac Centre

Suliman M. Masuod [1], Hana A. Miftah [2]*

[2] Department of Ophthalmology, Faculty of Medicine, Benghazi University.

***Corresponding author:** hennonasr@gmail.com, Department of Ophthalmology, Faculty of Medicine, Benghazi University.

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Abstract

The current study was carried out to determine the prevalence of amiodarone-induced vortex keratopathy and to grade this finding according to dose and duration of use. The study was conducted from the 1st of January to the end of February 2024 at the National Cardiac Center and Benghazi Teaching Eye Hospital. All patients admitted to the cardiac center for a month and received amiodarone were included in this study. Data was collected retrospectively by reviewing medical records. All patients had gone through a complete ophthalmic evaluation. A total of 1056 cases were admitted to cardiac, and 45 (4.3%) cases received amiodarone. Among the cases, 24 were male and 21 were female. Their ages ranged from 20 to 80. Of the 45 cases, 24 (53%) were able to come for ophthalmic assessment. Out of 24 cases, 18 (75%) had vortex keratopathy, most with grade II (33%). Among those with vortex keratopathy, nine had visual complaints such as reduced vision and halos around light. Three of those nine patients had visual complaints but no other findings except for vortex keratopathy. Nine patients showed vortex keratopathy with no other pathology. No other ocular complications of amiodarone use were found among the study group.

Keywords: Vortex Keratopathy, Whorl Keratopathy, Corneal Verticillate Amiodarone, Cordarone, Paceron.

INTRODUCTION

Amiodarone, also known as Cordarone or Pacerone, is a class III antiarrhythmic drug used for treating cardiac conditions such as atrial fibrillation and other life-threatening ventricular arrhythmia such as ventricular fibrillation and ventricular tachycardia. It can be used orally and/or intravenously to return the heart rhythm to normal by blocking signals in the heart. Dosing of the drug is according to the route of use and regimen (initial- loading-maintenance doses) (Mahajan et al., 2020).

Amiodarone has many side effects systemically. Some are common, such as cough, lightheadedness, tingling of toes and fingers, and light sensitivity. Photosensitivity, or photodermatitis, occurs after sun exposure with sunburn, hepatotoxicity, and heart block (Hamilton et al., 2020). Amiodarone rarely can cause thyroid dysfunction, both hyper and hypothyroidism (Cappellani et al., 2023; Gašparini et al., 2023). Ocular side effects include vortex keratopathy and anterior subcapsular cataracts. These effects rarely cause visual impairment, but patients commonly complain of halos around light. Amiodarone rarely causes permanent vision loss due to optic neuropathy (Hamilton et al., 2020; Mäntyjärvi et al., 1998).

Vortex keratopathy, also known as cornea verticillate, whorl keratopathy, or Fleischer vortex, is the most common ocular finding among those using amiodarone, characterized by a basal epithelial lysosomal deposition of golden brownish material, usually at the inferior part of the cornea and usually, bilateral. This effect occurs in most cases using amiodarone at a daily dose of 200 mg or more. Those depositions usually spontaneously resolve after drug cessation (Sahyoun et al., 2022).

There are some other causes of this finding, some of which include drugs such as (NSAID, chloroquine, gentamicin, tamoxifen, meperidine, chlorpromazine, atovaquone, suramin, tilorone, perhexiline maleate, and tyrosine kinase inhibitors vandetanib and Osimertinib) (Astin & Eye, 2001; Maruf et al., 2018; Shah et al., 1995). Fabry disease, which is a life-threatening inherited metabolic disorder (Koh et al., 2019; Lamont et al., 2010), neurotrophic keratopathy, multiple myeloma, and epidemic keratoconjunctivitis, The grading system of amiodarone-induced corneal deposits has been described by Orlando et al (Sahyoun et al., 2022).

Grade I: Appear as microdeposits of golden-brown material just anterior to the bowman layer and look like dust inferior to the pupil and at the mid periphery. They do not take fluorescein stain and are asymptomatic.

Grade II: Appear more linearly aligned with the clear zone between the margin of the deposits and limbus.

Grade III: An increase in the number of filament-like deposits seen in grade II and extending into the visual axis with a whorled pattern seen in the pupillary axis.

Grade IV: Clumping of gold-brown deposits.

This study aims to find out the prevalence of amiodarone-induced vortex keratopathy among patients admitted to Benghazi Cardiac Center, which is the main cardiac center in the eastern part of Libya, and to grade this finding according to dose and duration of use.

MATERIALS AND METHODS

Study design: This descriptive cross-sectional study was conducted from the 1st of January to the end of February 2024 at the National Cardiac Center and Benghazi Teaching Eye Hospital.

Source of data: All patients admitted to the cardiac center during six months (from June to November 2023) and received amiodarone as part of their treatment (45 cases) were included in this study.

Data was collected retrospectively by reviewing medical records of patients filled by resident doctors, using designed Performa, and then refined during patients' visits for ophthalmic evaluation.

Data collected included demographic data such as age, gender, residency, provisional diagnosis, date of admission, causes of admission, other comorbidities, treatment received and doses, and any interventions (catheterizations, stent, coronary artery bypass graft).

All subjects enrolled in this study have given informed consent and gone through a complete ophthalmic evaluation, including a detailed history of any ophthalmic problems such as decreased vision, halos around light, and a history of previous interventions such as investigations or surgeries.

A complete ophthalmic examination was done by the author, including vision and refraction, slit lamp examination of both anterior and posterior segments, intraocular pressure measurement, and sent for investigation (Optical coherence tomography) if needed.

Exclusion criteria: Patients admitted in the same period, but did not receive amiodarone.

RESULTS

A total of 1056 cases were admitted to the cardiac center for different cardiac problems, and 45 (4.3%) cases received amiodarone as part of their treatment and were found eligible for the study. Among the 45 cases, 24 were male, and 21 were female, giving a male-to-female ratio of (1.14:1). Their age ranged from 20 to 80, with a mean age of 58.9. 41 and were Libyan, where 4 were non-Libyan. 39 were from Benghazi. All patients suffered from cardiac arrhythmias due to variable etiologies. (42 cases) had other comorbidities such as diabetes mellitus and hypertension (23 cases) and (29 cases), respectively, with 19 of them with both diabetes and hypertension.

Among them, 3 cases received amiodarone for atrial fibrillation or ventricular arrhythmia alone, with no other health problems. The rest were receiving many drugs for other health problems (anti-hypertensive, antidiabetic, diuretics, anti-hyperlipidemic, etc). of the 45 cases, 24 (53%) were able to come for ophthalmic assessment. 83% received 200mg once daily. None received more than 200 mg, table (1). Treatment duration ranged from one month to nearly three years, with a mean of (3.5 months), the majority of cases took the drug for three months or more (83%), table (2).

Out of 24 cases, 18 (75%) had vortex keratopathy, most with grade II (33%) as shown in the table. Among those with vortex keratopathy, 9 had visual complaints such as reduced vision and halos around light. Six of the nine who had visual complaints had other findings that contributed to reduced vision other than keratopathy (cataracts, posterior capsular opacification, high myopia, and diabetic retinopathy and its complications).Three of those nine patients had visual complaints but no other findings except for vortex keratopathy. Nine patients showed vortex keratopathy with no other pathology and didn't have any complaints, and their visual acuity was 6\6. No other ocular complications of amiodarone use were found among the study group.

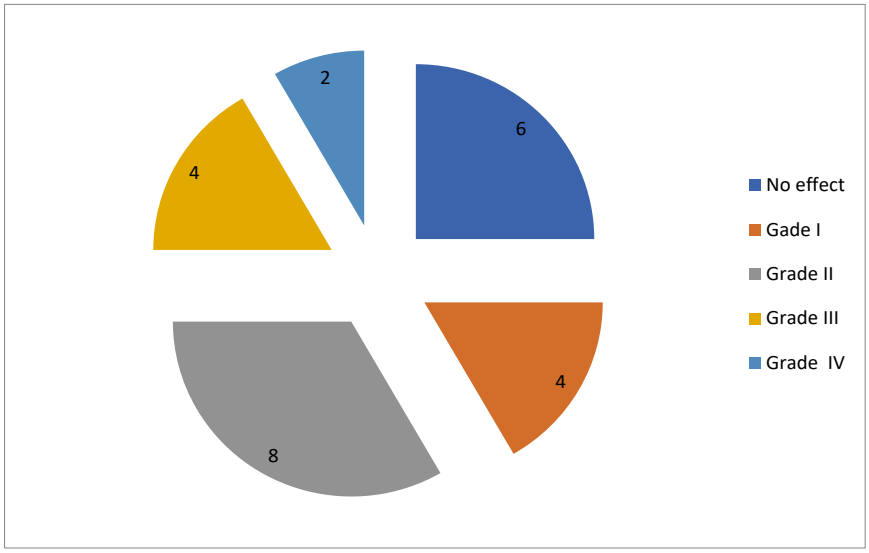

Figure: (1). Patient distribution according to grades.

Table:(1). Correlation between drug dose and grade of vortex keratopathy

Dose (mg)	Grade				
	No finding	I	II	III	IV
100 mg	2	0	2	0	0
200mg	4	4	6	4	2
>200 mg	0	0	0	0	0
Total	6	4	8	4	2

Table (2). Correlation between duration of drug use and grade of vortex keratopathy

Duration	Grades				
	No finding	I	II	III	IV
<3 months	4	0	0	0	0
3-6 months	2	4	6	4	0
6 >months	0	0	2	0	2
Total	6	4	8	4	2

Among the cases that did not show corneal changes, one case gave a history of receiving the drug for one month, six months prior to the examination, another one for two weeks and three months prior to the exam, and the third received amiodarone for 21 days on August 2023. All three received 200 mg once daily, while the other three cases were free of keratopathy, two received a dose of 100 mg for less than two months, and one was still taking the drug with the dose of 100 mg once daily.

DISCUSSION

Amiodarone is an arrhythmic agent used for many types of arrhythmias, both atrial & ventricular, and can be effectively used orally & intravenously (Hamilton et al., 2020). It acts by blocking potassium channels during repolarization, increasing the duration of the refractory period of myocytes and decreasing their excitability.

While in the current study, we found that 18 cases out of 24 (75%) taking amiodarone had vortex keratopathy. The Centre for Adverse Reactions Monitoring claims that 19 cases had corneal deposits in a report of 51 cases having amiodarone-induced corneal complications. Meanwhile, in a study done by Maija Mäntyjärvi, Kaija Tuppurainen, and Kirsi Ikäheimo, cat whiskers like corneal epithelial opacities were seen in 70-100% of patients (Mäntyjärvi et al., 1998).

Vortex keratopathy was seen in 17 out of 18 (94%) cases in at least one eye in the first three months of amiodarone therapy in another study done by Richard G. Orlando, Matthew E. Dangel, and Stephen F. Schaal (Orlando et al., 1984). While Jeffrey B. Florek, Alex Lucas, and Daniel Girzadas considered that the most common ocular side effect, seen in 90% of cases taking amiodarone, is corneal microdeposits of the drug (Florek et al., 2023).

Nine of our cases with vortex keratopathy had visual complaints. Vision is usually not affected by amiodarone, although some might complain of halos around light (Erdurmus et al., 2008). We found that one of the patients reported halos around light, but most of those who complained of reduced vision had other findings more likely to be the cause, such as high myopia, cataracts, and diabetic retinopathies. While the study by The Centre of Adverse Reactions Monitoring had 12 cases with abnormal vision, Jeffrey B. Florek, Alex Lucas, and Daniel Girzadas had 10% of their cases with keratopathy having visual complaints (Florek et al., 2023).

In the current study, the majority of patients (83%) were taking 200 mg once daily. Among the four

cases taking 100 mg, two were evaluated after less than three months of initiation of therapy and showed no deposits, while the other two were taking the drug for a longer time, both showed grade II keratopathy.

Ingram DV, Jaggarao NS, and Chamberlain DA claim that vortex keratopathy can be seen in up to 98% of cases using amiodarone 200-300 mg per day (Ingram et al., 1982). Daily use of amiodarone at 100 mg oral doses can be effective with no side effects (Chokesuwattanaskul et al., 2020). In our study, all patients using amiodarone for longer than three months showed corneal changes. Two patients with grade IV deposits have been using the drug for years, one of them with blurred vision showed dense posterior subcapsular cataracts in both eyes.

We evaluated patients admitted to the cardiac center from June to November 2023. Some were already on amiodarone prior to admission, while others started recently. Our ophthalmic evaluation was in January-February 2024, so the duration of therapy ranged from one month up to three years at evaluation time. Patients who were on amiodarone 200 mg once daily for one month, had not showed corneal changes. While D'Amico DJ, Kenyon KR, and Ruskin JN claim that corneal changes can be seen even after two weeks(D'Amico et al., 1981). 25 vortex keratopathy case reports were systemically reviewed by coauthors Mona Alsheri, MD, and Abdulaziz

In the study of Joury and MD, the time from starting the drug to having those side effects ranged from 2-72 months, with a median of 11.5 months. Amiodarone deposits are usually epithelial in the basal layer (D'Amico et al., 1981; Hollander & Aldave, 2004). However, Mesut Erdurmus, Yusuf Selcoki, Ramazan Yagci, and Ibrahim F Hepsen reported a 65-year-old man with a history of blurred vision and seeing halos around lights had been treated with amiodarone for 6 years. A slit lamp examination of both eyes showed a bilateral, symmetric, whorl-like pattern of brown deposits in the inferocentral corneal epithelium. Severe endothelial deposition was documented with the confocal laser scanning microscope of the HRT II. They concluded that Amiodarone-induced keratopathy with confluent and diffuse endothelial deposition is rare, and it may be indicative of a more severe toxicity associated with amiodarone (Erdurmus et al., 2008).

CONCLUSION

Vortex keratopathy by amiodarone is a common side effect. It's both dose and duration-dependent as its grade increases with larger doses and longer duration of use. It usually doesn't cause visual complaints, but further follow-up for a longer duration and for all patients receiving the drug is recommended, to look for other amiodarone side effects.

Duality of interest: No duality of interest associated with this manuscript.

Author contributions: Sluiman Al Nashad : Drafting the manuscript/revising for important intellectual context, Approval of the final version of the manuscript. Hana Shaheen: Conceived & design of the study, collected the data, contributed data or analysis tools, performed the analysis/ interpretation of data.

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Research Article **Open Access**

Influence of Age, Sex, and Refractive Error on Intraocular Pressure Measurement Using Applanation Tonometer Among Healthy Individuals in Shahat

Khalifa K. H. Alqazaar[1], Fatma A. Alsadeg[2*]

[1] Department of Ophthalmology, Faculty of Medicine, Benghazi University.

***Corresponding author:** zahraahmednona@gmail.com
Department of Ophthalmology, Faculty of Medicine, Omar Al-Mukhtar University.

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Abstract

The present study aimed to estimate the distribution of IOP and the relation with gender, age, and refractive error in a healthy Libyan population. This observational cross-sectional study was conducted in Cyrenaic Teaching Hospital from December 2023 to February 2024. 200 patients who presented to the hospital took part in the questionnaire. A Goldman applanation tonometer was used to measure IOP following the instillation of a drop of Benzoyl Peroxide. There were no significant differences noted between IOP in the right and left eyes. There was a correlation between IOP and age, but there was no correlation between IOP and gender ($p < 0.05$). IOP is one of the most important indicators for monitoring the health of the eyes. Concerning age, the mean IOP increased with age and refractive errors. Conclusion: This study supported the hypothesis that age and high myopia are major risk factors for ocular hypertension development.

Keywords: Refractive Errors, Intraocular Pressure, Applanation Tonometer, Gender, Cross-Section Study.

INTRODUCTION

The fluid pressure inside the eye is called intraocular pressure (IOP). It is regulated and can be affected by changes in factors like aqueous humor flow rate, outflow, and episcleral venous pressure. IOP is a delicate balance between aqueous humor production and drainage (Atta et al., 2023). Elevated intraocular pressure (IOP) is one of the most significant risk factors for the development and progression of open-angle glaucoma. Intraocular pressure is a multifactorial trait with a heritability of 29% to 62%. Although some associations with IOP have been demonstrated consistently, such as systolic blood pressure (SBP), other factors, such as age and sex have a less consistent effect (Chan et al., 2016).

Studies have not consistently shown differences in the distribution of IOP related to gender or how it varies with age. According to (Liu et al., 2022), the mean IOP for males (15.2 mmHg) and for females (16.5 mmHg) differed significantly.

Several studies have reported characteristics associated with IOP. Many, but not all, studies report an increase in IOP with age. The relationship between refractive error and IOP is another area of discrepancy. Some studies have suggested that myopia may be associated with the risk of primary

open-angle glaucoma and hyperopia with a possible risk of ocular hypertension. Considering this variability in IOP in different populations and the inconsistencies concerning IOP with age, gender, and refractive error, it is interesting to investigate the distribution of IOP and its associated factors in various populations (Yassin & Al-Tamimi, 2016).

MATERIALS & METHODS

This observational cross-sectional study in Cyrenaic Teaching Hospital, from December 2023 to February 2024. 200 patients presented to the screening unit were included in the study.

Written informed consent was obtained from each patient. This study was authorized by the Faculty of Medicine's Research Ethics Committee (institutional review board) involving human subjects and/or animals. Every patient underwent a complete medical and family history, which included information regarding eye diseases, medical history, and past medical history of diabetes and hypertension—visual acuity screening. The Topcon auto-mated refractometer (Topcon KR Topcon Corporation, Tokyo, Japan) was used to measure refraction. The spherical equivalent (SE) was computed by multiplying half of the cylinder value by the spherical correlation value. Three measurements were obtained. The mean average value was considered as the refractive error. Myopia was defined as SE of ≥-0.50 diopter (D); mild, moderate, and high myopia was defined as SE > −3.00 D ≥ -3.00 D, & ≥-6.00 D, respectively. Hyperopia was defined as SE of ≥+0.50 D; mild, moderate, and high hyperopia were defined as SE < +3.00 D, ≥+3.00 D, and ≥+6.00 D, respectively (Yassin and Al-Tamimi, 2016)[4].

After administering a drop of benzoyl peroxide to each participant's eye and staining the tear with fluorescein, the participant's intraocular pressure (IOP) was determined using a Goldmann applanation tonometer. There were two measurements made. The IOP was defined as the average value. Tonometry was performed again and the mean of at least three measurements was obtained for additional statistical analysis if the IOP measurements were greater than 21 mmHg. All subjects were informed about the condition, and directed to the eye clinic if their IOP was higher than 25 mmHg. Using slit lamp bio-microscopy, the anomalies in the anterior segment were recorded. Every participant had a direct ophthalmoscopy fundus examination to evaluate the disc size, color, vascularity, and degree of cupping.

Exclusion criteria: patients with a history of eye surgery and glaucoma, participants having a cup-to-disc ratio larger than 0.5 or a cup-to-disc asymmetry greater than 0.2, as well as those taking anti-glaucoma medication in either eye, were not included in the study.

Statistical analysis was performed using SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA) to collect, tabulate, and analyze data. The qualitative data were presented as absolute frequencies (number) and relative frequencies (%), whereas the quantitative data were presented as the mean ± SD & range. Two groups with normal variables distribution were by t (student t) test. By Chi-square test, the percent of categorical variables were compared. All of the tests had two sides. Significance was considered as a p-value < 0.05.

RESULTS

This study showed that a total of 200 subjects, 107 males (53.5%) and 93 females (46.5%) were enrolled in this study. The Mean (SD) age was 38.7 ± 2.91 years (Table 1).

Table (1). Demographic characters of the studied subjects.

Variables	Number (n = 200)	Percentage%
Gender		
Male	107	53.5
Female	93	46.5
Age		
Mean ± SD	38.7 ± 2.91	
Range	20–69	
Family history of glaucoma	5	2.5
DM	11	5.5
HTN	10	5
HTN-DM	3	1.5

This study showed that 70 patients < 31 years with a mean age of 22.2± 1.2, were 36 (33.6%) males and 34 (36.6%) females, 51 patients 31-45 years with mean age 39.5 ± 3.04, they were 31 (29.0%) males and 20 (21.5%) females, 79 patients > 45 years with mean age 53.0 ± 7.15, they were 40 (37.4%) males and 39 (41.9%) females, the mean age for total patients was 38.7 ± 2.91 (table 2).

Table 2. Distribution of studied patients according to age group and sex.

Sex / Age	Male		Female		Total		Mean ± SD	P Value
	N	%	N		N	%		
< 31	36	33.6	34	22.2 ± 1.2	70	35.0	22.2 ± 1.2	>0.05
31 - 45	31	29.0	20	39.5 ± 3.04	51	25.5	39.5 ± 3.04	>0.05
> 45	40	37.4	39	53.0 ± 7.15	79	39.5	53.0 ± 7.15	>0.05
Total	107	53.5	93	38.7 ± 2.91	200	100	38.7 ± 2.91	>0.05

This study showed that only 110 cases (55%) had refractive errors (Table 3).

Table 3. Distribution of studied patients according to eye status.

No of patients (cases group)	%	No of healthy (control group)	%
110	55	90	45

This study showed that there was no significant difference noted between IOP in the right eye and left eye. Since there is no significant difference in IOP between the right eye and the left eye, only right eye readings are taken for statistical analysis to avoid confusion (table 4).

Table 4. Comparison of IOP value between right and left eyes (n=110).

Refractive status	No (%)	Right Eye (mm of Hg)	Left Eye (mm of Hg)	P value
Control	120	14.68±1.42	14.82±1.57	>0.05
High myopia	23 (20.9)	18.3±2.6	18.48±2.35	>0.05
Moderate myopia	35 (31.8)	16.4 ±1.9	16.3±2.15	>0.05
Low myopia	52 (47.3)	15.1±1.95	15.19±1.72	>0.05

This study showed a high significance, indicating that high myopia is more likely to result in elevated IOP (Table 5).

Table 5. Correlation of refractive status and IOP.

Refractive status	No (%)	No	IOP (mm of Hg)	P value
Control	120	120	14.68±1.42	
High myopia	23 (20.9)	28	18.3±2.6	<0.01***
Moderate myopia	35 (31.8)	45	16.4 ±1.9	>0.05
Low myopia	52 (47.3)	37	15.1±1.95	>0.05

This study showed that in all the groups there is a significant difference between IOP and age (P value <0.01) (Table 6).

Table 6. Correlation of IOP with age.

Groups	Age (years)	IOP Mean ± SD	P Value
High myopics	< 31	16.85±3.2	0.001
	31 – 45	18.33±2	
	> 45	19.45±2	
Moderate myopia	< 31	16.01±5.04	<0.01
	31 – 45	17.12 ±3.18	
	> 45	17.98±2.25	
Low myopia	< 31	14.05±2.04	<0.01
	31 – 45	15.35±1.95	
	> 45	16.2±2.35	

This study revealed no significant difference between IOP and gender (Table 7).

Table 7. Correlation of IOP with gender.

Refractive Error	Gender	IOP Mean ± SD	P Value
High myopics	M	18.25±4.2	
	F	18.4±3.95	
Moderate myopia	M	16.36±3.04	>0.05
	F	16.00±3.25	
Low myopia	M	15.60±2.04	>0.05
	F	15.32±2.28	

DISCUSSION

Globally, refractive errors are among the most prevalent ocular issues among people. One of the glaucoma risk factors that is frequently discussed in different research is myopia. Elevated intraocular pressure in myopic persons relative to non-myopic individuals implies a potential pressure-mediated association between glaucoma and myopia. In a large case-control study, myopia was found to be strongly associated with ocular hypertension. It has been observed that about 30% of subjects with primary open-angle glaucoma can be expected as myopic, which is about three times the incidence in a normal population of the same age group (Mathapathi et al., 2016).

Raised intraocular pressure is the most important modifiable risk factor for glaucoma (IOP). While it is well established that older persons are more likely to develop glaucoma, the relationship between age and IOP is still debatable. Age and IOP were found to positively correlate in many prior research conducted in Western populations (Åström et al., 2014); however, some studies conducted in Korean, Chinese, and Japanese populations found no link at all, or a negative correlation (Choi et al., 2014).

Several studies have found a negative correlation between IOP and refractive error (Kim et al., 2014)[8]. Over the past few decades, myopia has become a major global health concern, with a notable increase in prevalence, especially in East Asia (Foster, P. A., & Jiang, 2014)[9]. According to a study detailing the prevalence of various eye illnesses in Korea, myopia was most common in people between the ages of 12 and 18 (78.8%), followed by people between 19 and 29 years (75.3%) (Yoon et al., 2011).

This hospital-based observational cross-sectional study in Cyrenaic Teaching Hospital, from December 2023 to February 2024 on 200 patients who presented to the screening unit and participated in the study for determining the distribution of IOP and its relation to age, gender, and the refractive error in healthy Libyan population. Subjects with normal vision were selected as a control group.

This study showed that 70 patients < 31 years with a mean age of 22.2± 1.2, were 36 (33.6%) males and 34 (36.6%) females. 51 patients 31-45 years with a mean age of 39.5 ± 3.04, were 31 (29.0%) males and 20 (21.5%) females. 79 patients > 45 years with a mean age of 53.0 ± 7.15, were 40 (37.4%) males and 39 (41.9%) females. The mean age for total patients was 38.7 ± 2.91.

The current study showed that there was a High significance, showing that people with extreme myopia are more likely to have elevated IOP. In the same context, (Mathapathi et al., 2016) found a high significance association of mean IOP in high myopia compared to other groups of refractive errors. (Samuel et al., 2019) reported a statistically significant difference (P =0.0001) in the intraocular pressure between patients with high and moderate myopia. The intraocular pressure was observed to increase with the degree of myopia.

Yassin and (Yassin & Al-Tamimi, 2016) reported that despite being conducted on populations within comparable racial and geographic categories, several pieces of research on IOP in several racial and geographic areas indicated significant variability. According to (Tonnu et al., 2005), research conducted on the Japanese population revealed significant differences in mean IOP levels and IOP relationships. These discrepancies can be ascribed to various sample selection techniques, participant exclusion criteria, and IOP measurement equipment.

The current study showed that in all the groups there is a significant difference in IOP to age (P value <0.01). (Tonnu et al., 2005) reported that was a steady increase in the mean IOP from 12.4 mmHg in the group age of (40-50 years), 15.3 mmHg in the group age of (51- 60 years), 17.3 mmHg in the group age of (61-70) years and 18.5 mmHg in the group age above 70 years and concluded that there was positive significance association between age and IOP (r =0.911).

(Samuel et al., 2019) found that the intraocular pressure was higher in the 40–50 age group in all refractive error groups than in the 30-39 age group. This demonstrates that as people age, their intraocular pressure rises. (Mathapathi et al., 2016) discovered that IOP rises with increasing myopia severity, as well as with aging. The study backs up the theory that developing age and high myopia are the main risk factors for developing ocular hypertension. (Amarnath et al., 2015) reported that to age, the mean IOP highly significantly increased with age.

The current study showed no significant difference between IOP and gender, which coincides with (Samuel et al., 2019) who revealed that there was no statistically significant difference in IOP according to gender. (Mathapathi et al., 2016) found no significant difference between IOP and gender.

CONCLUSION

This study supported the hypothesis that age and high myopia are major risk factors for the development of ocular hypertension. IOP is one of the most important indicators for monitoring eye health.

RECOMMENDATIONS

Considering myopia an important major risk factor for glaucoma, myopics are recommended for eye checkups at regular intervals for refractive correction.

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Research Article Open Access

The Visual Outcome of Gunshot Injury after Last Civil War in Tobruk-Libya: A Retrospective Study

Fathy A. Abdolmejed

*Corresponding author: dr.fathiaali@yahoo.com, Department of Ophthalmology, Faculty of Medicine, Tobruk university, Libya.

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Abstract

Ocular trauma is one of the most common causes of acquired blindness. This study aims to determine the epidemiology of ocular trauma in all the age groups in Tobruk Medical Centre- Libya. A retrospective study was conducted in our hospital for one year and all the aged group presenting with ocular trauma in the Ophthalmology and Emergency Departments were enrolled in the study. Age, sex distribution, presentation duration, mode of injury, type of injury, and final visual outcome were analyzed. There were 201 patients, 76% of the patients were male. Injuries usually occurred at home (54%) followed by accidents at workplaces (18%), car accidents (10.5%), fighting (15%), and at school (2.5%). There were 100/201 patients (49%) of cases that required hospital admission and (40.8%) needed surgical interventions. The most common traumas were blunt trauma in 124/201 patients (61.7%). Penetrating trauma with an intraocular foreign body (IOFB) accounted for (11.5%) of cases. The visual outcome was recorded in 200 patients. 22/201 patients (11%) ended with severe impairment of vision (vision hand movement (HM) or less). Blindness with no perception of light (no PL) was the result in 3.5% of trauma cases, while 11/16 patients (86%) with gunshot injuries through fighting have complete irreversible blindness (no PL). We concluded, that most open-globe injuries can cause severe vision impairment. In this study, gunshot injury is the leading cause of permanent loss of vision.

Keywords: Ocular Trauma, Open Globe Injuries, Closed Globe Injuries, Gunshot Injury, Tobruk Medical Center-Libya

INTRODUCTION

Eye injuries are one of the most common ophthalmological emergencies which can lead to anatomical, physiological, and functional effects on the eye (Barry et al., 2019). Eye trauma is one of the most common causes of unilateral permanent loss of vision. Each year about 55 million people suffer eye trauma worldwide (Woreta et al., 2023).

In Blunt trauma, signs include proptosis, decreased visual acuity, pain, lid ecchymosis, chemosis, mydriasis, afferent pupillary defect, increased IOP, and ophthalmoplegia. Treatment requires immediate ophthalmologic consultation. A conservative management with ice packs, pain control, bed rest, control of intraocular pressure, and systemic steroids (Malik et al., 2012).

Management of a ruptured globe requires hospital admission and urgent interventions, such as antibiotics, antiemetics, pain management, and urgent surgical repair of the wound (Sukati, 2011). The

rupture can occur due to blunt or penetrating sharp objects which leads to injury to the outer coats of the eye (cornea or sclera) causing penetration of the Globe. Usually, the ruptures occur in areas where the sclera is thinnest (at the limbus or the insertions of the extraocular muscles) (Sahraravand et al., 2020). The loss of the aqueous from the anterior chamber and the vitreous or the choroidal tissue through a wound are the most common signs of rupture (Das & Rana, 2020).

The ruptured globe can occur due to sharp objects or a small foreign body. It can be clinically diagnosed and confirmed by CT, ultrasound, or MRI. Delaying medical attention can cause the damaged areas to worsen and can result in permanent loss of vision. To achieve better therapeutic success urgent surgical interventions are needed to prevent significant morbidity and decrease the chance of blindness, which is common in these cases (Puodžiuvienė et al., 2018).

In the last 10 years post the latest civil war in Libya, there was an increase in the amount of trauma. Eye injuries from gunshots are one of the most common injuries, which dramatically increased in our community.

The severity of gunshot eye injuries depends on many factors including, type, size, toxicity of the foreign body, and site of the injury. The bullet enters fast into the eye, penetration or perforation leads to photoreceptors and sensitive areas of the retina and optic being injured and loss of their function.

Furthermore, losing the natural contents of the eyeball and the time delay between the injury and getting a consultation following the injury may result in more destruction of the anatomy and physiology of the eyeball.

Objective: This study attempts to inform the government about the risk of gunshot eye injuries and to find possible solutions to this critical problem.

MATERIALS AND METHODS

In a retrospective study of ocular trauma, we included all new patients with eye injuries treated at the Ophthalmology Department of Tobruk Medical Center in 1 year (between Jan. 2019 - Dec. 2019). The data were from direct history from the patients or their relatives, examinations, and patient questionnaires. We recorded age, gender, laterality, possible previous amblyopia, detailed status findings at the first presentation, time at first consultation after injury, diagnoses, and type of management.

We analyzed the data, presented the distributions (Excel, Microsoft Office 2010, Spss 25), and calculated the percentages from the reported results.

In this study, we identified the patterns of gunshot eye trauma, and late visual and post-traumatic anatomical outcomes and compared them with other types of eye trauma in patients presented at our hospital in the all-age groups.

RESULTS

There were 201 patients with trauma in Tobruk Medical Center in one year. 76% of the patients were male, and 24% were female. The mean age was 25 years (range 1-80 years). 125 patients (62.2%) were adults aged 18 or more and 76 patients (37.8%) were children < 18 years.

Table (1). Shows the distribution of age group with trauma in one year in Tobruk Medical Center:

	Age average	Total	Male	Female
Children	(1-18 years)	76	52	24
Young age	(19-50 years)	109	89	20
Old age	(Older than 50 yrs)	16	13	3

Injuries mostly occurred at home (54%) followed by accidents at workplaces (18%), car accidents (10.5%), fighting (15%), and at school (2.5%). Hospital admissions account for around 51% of total eye trauma, and (41%) of the cases needed surgical interventions. The time interval between injury and consultation was in the first three hours in 45% of patients, 51.4% after 24 hours, and 5.5% after 3 days.

The most common traumas were blunt traumas (61.7%), trauma directed with a blunt object, and indirect trauma after falling. The penetrating trauma with gunshots and penetrating with other small sharp objects form (34.3%), and there were (33.5%) of these penetrating cases presenting with IOFB.

The visual outcome was recorded in 200 patients. The majority of non-perforating injuries result in a good visual outcome, as only (4.5%) of blunt trauma cases had significant visual morbidity (irreversible blindness). In the perforating eye injuries, about 58% of cases had significant visual morbidity, most of them resulting from gunshot injuries from fighting.

There were 22 patients (11%) who suffered severe impairment of vision (vision HM or less), in 11 patients complete blindness (no PL) occurred in (5.5%) of trauma cases, irreversible blindness was common in gunshot injury cases, four-fold more than other perforating eye trauma, and two-fold than the blunt trauma cases, i.e irreversible blindness significantly a result of gunshot injury from fighting ($P<0.032$).

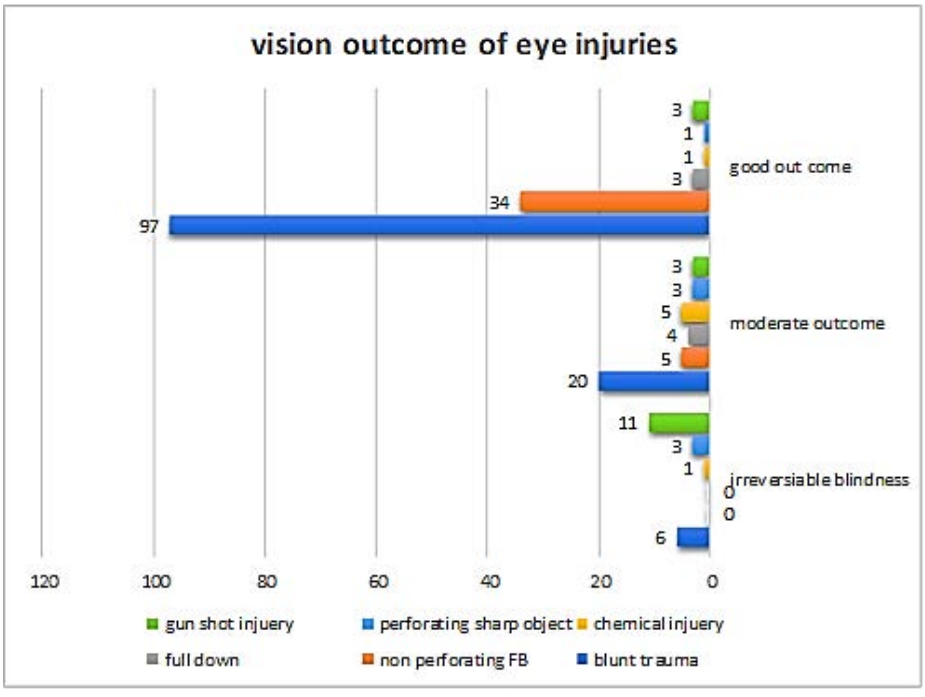

Figure (1). Shows different types of eye injury and their grade of vision impairment:

Table (2). Shows different types of eye injury in relation to the site of trauma:

	Type of trauma	At home	At school	Trauma at street	Work-place	Car acci-dent
A	Blunt trauma with a non-sharp object (non-perforating)	71	5	13	8	20
	Falling down	7	-	-	-	-
	Chemical injury	4	-	-	4	-
	Perforating trauma with a sharp object	27	-	-	24	1
B	Perforating trauma (gunshot injury)	-	-	16	1	-

A Non-gunshot injury. B. Gunshot injury.

DISCUSSION

Eye injury is a common reason for an emergency in the ophthalmology department, the injuries may be due to blunt, penetrating trauma, or due to chemical agents, or ultraviolet radiation (MacEwen et al., 1999). Closed globe injury with blunt objects was the most common eye injury and more common in males. The outcome of blunt trauma cases is usually good, but if trauma is severe leading to a complete transection of the optic nerve or macula scaring, this type of eye injury can cause a significant vision impairment (Mohseni et al., 2024).

Usually, trauma patients presenting with visual acuity correspond with increasing severity of the ocular injury. Trauma with perforating injuries or ruptures usually presents with worse vision than those with a closed eye globe, because the loss of inner content of the eye can lead to worsening its physiological function (Fujikawa et al., 2018).

In perforating eye trauma with a foreign body, severity is considered due to many factors like size, type, sharp or rough edges, toxicity, and fast embedding of the foreign body inside the eye. Furthermore, the long time remaining of the FB inside the eye, can lead to inflammation, toxicity, and more loss of the anatomical eye content and increase eye morbidity (Kannan et al., 2016).

When patients have any type of eye trauma, they should see an ophthalmologist as soon as possible (Patel, 2015). Early consultation can save vision with eye injury (Alem et al., 2019). In the current study, the majority of patients about (98%) presented for consultation after 6 hours post-trauma, this can lead to more damage to the sensitive eye tissue and more impairment of eye function (Fujikawa et al., 2018).

A leading cause of visual loss in this study is mainly due to gunshot injury because bullets lead to significant eye tissue disruption and destruction and sometimes ruptures are severe and not possible to repair (Chopra et al., 2018). Many factors like the point of injury to the eye and the distance of patients from the source of the bullet increase the severity of damage and morbidity of the eye function (Castro et al., 2020). As consistent with other studies, ruptured eye injury results in clinically significant visual impairment (Beshay et al., 2017; Guly et al., 2006).

Patient education and safety measures like wearing glasses during work and sports are very important to decrease the risk of eye trauma. It is highly recommended and important to make the public know the risk causes of eye trauma because most eye injuries can be prevented (Cassen, 1997; Morris et al., 2014).

CONCLUSION

Ocular trauma is a frequent reason for emergency, its mostly need hospitalization which expensive for patient and Health care service. Most of cases usually come later to get a consultation. Gunshot

injury in fighting is the commonest cause of trauma blindness in our community (P<0.001), eye injury remains a preventable cause ocular morbidity. Therefore, we need early appropriate management and health-prevention strategies.

ETHICS

"I hereby declare that the clinical research paper titled '**The visual outcome of gunshot injury after last Civil War in Tobruk-Libya: a retrospective study**' has received ethical approval from the relevant regulatory bodies and/or institutional review board, such as the Tobruk Medical Centre Ethics Committee, prior to its initiation. This statement serves as an assurance that the research study conducted for this paper adheres to the highest ethical standards, ensuring the safeguarding of human subjects and upholding the integrity of the research process.

Duality of interest: The author declare that have no duality of interest associated with this manuscript

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