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Editorial

Industrial Revolution 4.0: Role of Universities

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Industrial Revolution 4.0 has dawned with a new challenge wherein information technology, internet and cyber-physical systems are going to take a priority with global human life. Indeed it will be a revolution that may change the way human beings think, live and work with access to any corner virtually, whereas industry and business will leap higher with a stronger impact on economic developments. Universities need to prepare both academicians and students to upgrade to the present scenario. Academicians should leverage their knowledge and skills and upgrade themselves to the present and future generation Z (gen-Z). Academicians and students need to adapt to the changing trend and new knowledge and skills based on cyber-physical system as part of everyone's life. Developments and revolutions are part of existence but there is also an urgent call to the world population, wherein human values, ethics and responsibilities of sustaining a good society and planet are everyone's responsibility.

World is preparing for a step forward with the advent of Industrial Revolution 4.0 which needs challenging efforts to prepare our gen-Z with up-to-date skills and knowledge to face the future reality. Higher education and universities need to set their goal in achieving the new Industrial Revolution 4.0 as the world is leaping forward with an utmost speed. Industrial Revolution 4.0 revolves around internet of things, internet of systems and a coupling of cyber-physical systems that are going to rule the world and human system in the future. The First Industrial Revolution started at the late 18th Century which focused on mechanization. James Watt invented the first steam engine in the year 1775 that enabled the locomotive connectivity further new additions such as power-loom, telegraph, telephone, etc. The Second Industrial Revolution or Technological Revolution which started around the mid-19th Century was focused on faster industrialization and manufacturing, machine tools which spanned up to the start of World War I. A wave of globalization was initiated which enabled the migration and movement of people across different regions in the world. Henry Ford contributed to moving assembly lines as a result mass production and mobility took a greater pace contributing to the welfare of mankind. It extended with a revolution in industry and continued to progress in the 20th Century. These two industrial revolutions, helped people to become wealthier with urban living. Mid-1970's to year 2015 was named as the Third Industrial Revolution also called Digital Revolution. It was the era of internet with the first consumer computer made its presence in the year 1976 – 1977 and digital technology grew exponentially with control of mechanization by electronics and computers. Economic transformations started to grow across the boundaries of globe with digital communications, internet and renewable energy. Hydrogen and other storage technologies were developed to store intermittent energies and the entire world was able to connect with living spaces and work spaces with the biosphere. New business models were emerged and the GDP as well as economy of the world showed good signs.

Prof. Klaus Schwab, in his latest book 'The fourth industrial revolution' who is also the chairman of World Economic Forum describes that; fourth revolution enables the technology to be embedded within human body and society[1]. There will be a breakthrough in robotics, nanotechnology, quantum computing, biotechnology, The Internet of

Things, autonomous transport system, Three Dimensional Printing and artificial intelligence. Billions of people will be connected on the digital web with doors open for improving human communication and interaction[2]. Dawn of Industrial Revolution 4.0 has increased the responsibility and delivery of cutting edge knowledge in academia, as higher education institutions and universities need to get equipped with a change in trend towards their approach in educating the emerging Gen-Z. Mobile supercomputing, robotic approach in human functionalities, neuro-technological human brain intelligence and genetic editing and many more advancements need to be focused at a exponential speed and the new generation need to get a thorough knowledge for the application as there will be a change in the way human being will live, interact and work. A fusion of physical, digital and biological systems with industries and world economy is needed that may be the futuristic development. "Universities have to change their curriculum and delivery to ensure that their graduates have jobs", said Datuk Seri Idris Jusoh, Higher Education Minister of Malaysia[3]. Young generation needs to be prepared for a relevant future that is going to be impacted by Industrial Revolution 4.0 and universities need to prepare the platform in academia. The Internet of Things (IoT), is a trend of real time which is focusing on combination of sensor actuators embedded in physical objects and these sensors that generate the data will be used in cyber-physical systems in the production line and automation technology.

Universities must prepare a blueprint that addresses the University-Industry Revolution 4.0 approach to address the present needs and keep up-to-date realistic projects that make our young generation to emulate in their educational scenarios and emerge as competitive leaders and work force for the future[4]. Fourth Industrial Revolution is challenging which is based on information computer technology (ICT) and advancement in robots, cloud technology, artificial intelligence, big data, internet of things (IoT) and virtual reality; all these are playing a greater role in community, economy and people. Unless universities tailor their academic and research blueprint in line with these advancement, there is a dearth of knowledge and those without adapting to this change may end up as islands in the middle of oceans afar and the graduates' employability for the global workforce may not match. Every university and centre of higher education needs to prepare the background for educating the present and new generation to keep pace with the rest of the world. Along these developments and revolutions, there is also an urgent call to the world population, amalgamation of human values, ethics and responsibilities of sustaining a good society is pressing. Human-human interaction may be at a crossroads, instead a human-robot interaction and gradually an evolution in human-robot relationship may adversely affect the family fabric wherein human may end up with a robotic relationship and run away from the responsibility of procreation? Universities have to take a greater responsibility along the lines and our youngsters need to be aware of saving this planet for the future.

REFERENCES

1. Davis N. (2016). What is the fourth industrial revolution? World Economic Forum. https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/
2. Marr B. (2016). Why everyone must get ready for the 4th industrial revolution. Forbes. https://www.forbes.com/sites/bernardmarr/2016/04/05/why-everyone-must-get-ready-for-4th-industrial-revolution/#11548bf3f90b
3. The Star Online. (2017, 25 Aug). Education framework for institutions created for fourth industrial revolution. https://www.thestar.com.my/news/nation/2017/08/25/ministry-setting-course-for-the-next-transition-education-framework-for-institutions-created-for-fou/
4. Chao R Jr. (2017, 10 Nov). Educating for the fourth industrial revolution. University World News. http://www.universityworldnews.com/article.php?story=20171107123728676

Review Article

Basics of Electrocardiogram (ECG) and Its Application in Diagnosis of Heart Ailments: An Educational Series

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ABSTRACT

Electrocardiogram (ECG) is a record of electrical activity of the heart. PQRST waves represent the electrical activities of atria and ventricles. A complete three-dimensional electrical activity is possible to be recorded using a 12-lead ECG. The normal and different routinely-met clinical ECG are elaborated and discussed. This routine, normal and abnormal ECG, like arrhythmias and heart block records as well as their clinical notes shall be educational information for the medical students.

Keywords: ECG, lead, conduction system, arrhythmia, heart block

INTRODUCTION

Electrocardiogram is the graphical record of different electrical activities of the heart. Electrocardiograph is the instrument or machine that is used to record the electrical activity generated by different parts of the heart such as conducting system, atria and ventricles. The basic functionality of ECG is diagnostic but not therapeutic in nature. ECG helps to specifically point out the abnormalities and an aid in the diagnosis which further enable the therapeutic approach.

FUNCTIONAL ANATOMY OF THE HEART

Human heart is made up of four chambers; two atria and two ventricles. It is connected to both oxygenated and deoxygenated system of blood flow wherein these two separate blood circulations never mix but rather exchange in such a way that oxygenation and removal of waste products continue throughout the human life. Greater circulation starts at left ventricle and via the aorta and subsequent successive generations of arteries, arterioles and capillaries blood are propelled forward while delivering oxygen from the capillaries to the tissues. Tissues exchange the waste and carbon dioxide in return and divert it via the lesser or pulmonary circulation to the alveoli in lungs where waste and carbon dioxide are removed while oxygen is loaded to make it oxygenated blood. Heart, greater and lesser, circulation helps in the oxygenation and de-oxygenation and this mechanical event is governed by a well-synchronized electrical impulse that is regularly generated at the SA node and transmitted along the conducting tissues of the heart.

CONDUCTION SYSTEM OF THE HEART AND SPREAD OF CARDIAC IMPULSE

SA node generates the impulse at regular intervals which is traversed down along the AV node, bundle of His, right and left bundle branches and Purkinje system. Two important unique aspects of this conducting system is that, AV nodal delay and functional continuity of atria and ventricles through AV node. This makes atria and ventricle to function as separate units and giving enough time for the systole, diastole in return, filing and emptying of atria and ventricles into their respective vessels in a synchronized fashion. All these functions are possible because of the electrical impulses that are traversing rhythmically and systematically generated at SA node of a healthy heart.

As the impulse traverses along both the atria, almost 100 million atrial cells contract simultaneously in a short duration of one-third of a second as result of instantaneous depolarization of atrial myocardium.

Simultaneously, the same impulse traverses the AV node and because of AV nodal delay takes a brief time to proceed further to reach the bundle of His and further along the conducting pathway and subsequently to both the ventricles. AV nodal delay is a nature's gift as it allows the atria to completely pump the blood into the ventricles at the same time maintaining the synchrony and pace of atrial emptying and ventricular filling. As the impulse traverses subsequently into the ventricles around 400 million cells of the ventricles depolarize simultaneously that result in ventricular contraction. Atria and ventricles discharge separately in unison because of the intercalated discs among the myocardial cells so that atria and ventricles act as primer and power pumps to direct the blood forward along the closed cardiovascular circuitry.

Each SA nodal impulse results in single heart beat or a single cardiac cycle. This involves, atrial depolarization, ventricular depolarization and their repolarization electrically and atrial systole, ventricular systole and their diastoles mechanically.

HEARTBEAT

A single pacemaker potential of SA node lead to atrial depolarization, ventricular depolarization and atrial and ventricular repolarization. This potential as it is transmitted along the atria, P wave is developed since atria is a syncytium followed by ventricular QRS and then ventricular repolarization – T wave. This is enabling the atria and ventricle to undergo atrial systole, diastole and ventricular systole and diastole with an average 0.8 sec interval in a normal heart that covers a single heartbeat. Voluntary consent from the patients was obtained to publish the recordings and data of ECG.

ELECTROCARDIOGRAPH

Figure 1 Electrocardiograph
[CoLin 6 channel ECG Ref: YM406i, SN MD 094120800233-2012-08 (Korea)]

Electrocardiograph or ECG machine is able to pick the electrical deflections that are produced during atrial and ventricular depolarization and repolarization from the specific points of the skin in a non-invasive manner and is able to record simultaneously the deflection on a grid of ECG paper.[1] Pacemaker potential helps in initiating the discharge of SA node. It is a rhythmic impulse that is able to produce a depolarization wave followed by repolarization and is able to traverse along the conducting system of the heart and simultaneously able

to spread along the atrial muscle fibres. This results in complete depolarization of both the atria resulting in a deflection which is picked up by the ECG electrodes resulting in 'P' wave. P wave is a depolarization wave of atria, in other words, it is the resultant summated depolarization of every atrial fibres. This is followed by atrial repolarization. In the ECG record due to the ventricular depolarization already making its way, atrial repolarization will be masked or submerged in the ventricular depolarization wave-QRS complex. Atria and ventricles are connected functionally only through AV node as there is a fibrous tissue or ring that separates the atria and ventricle electrically and AV node is the only link that connects the two functionally. It is a nature's gift that aids the mechanical component of atria and ventricle and aids in the continuous forward flow of blood along the closed cardiovascular circuitry. This is supported by AV nodal delay as the impulse is delayed for a few milliseconds duration because of the resistant nature of AV node, which gives enough time for the ventricle to fill, atrial systolic phase. The impulse from AV node traverses along the bundle of His, right and left bundle branches and then on into the Purkinje fibres which travels into the interiors of ventricular musculature and as a result the whole ventricular musculature depolarizes simultaneously and a 'QRS' complex which is a positive deflection in the electrocardiogram is recorded. Followed by this, ventricles repolarize fully with a resultant T wave in the ECG.

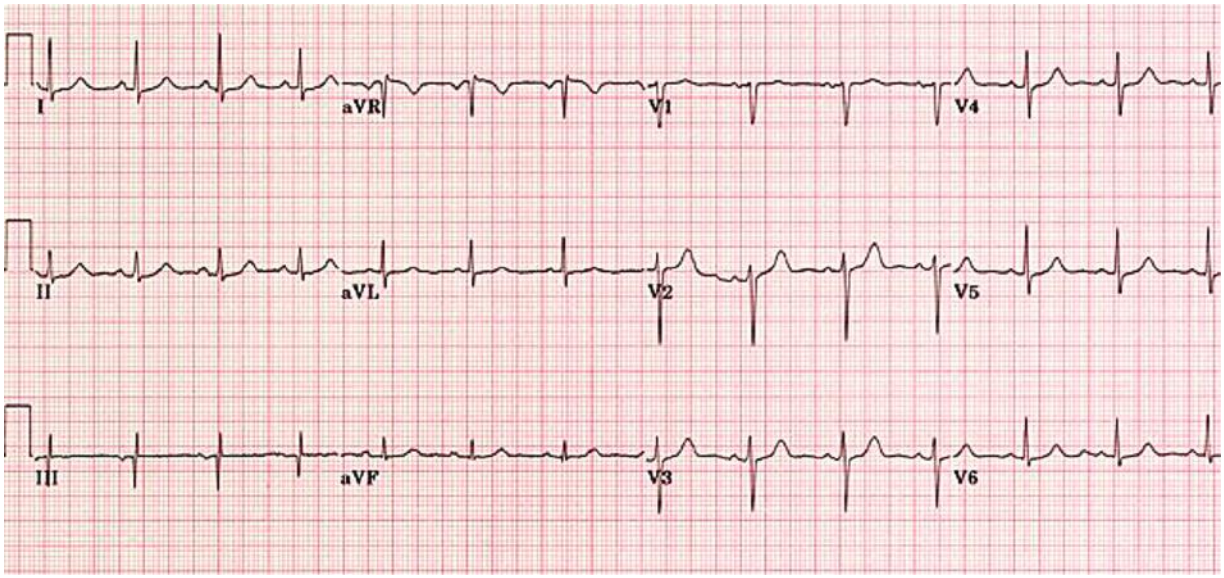

Figure 2 12-lead ECG record, normal sinus rhythm of heart rate 100/min

ECG Leads

A lead is an electrode with positive and negative terminals connected to the specific areas on the body surface. Leads pick up the electromotive force that is generated by the heart at different specific locations of the body. Generally, these terminals of leads are fixed on the skin surface as per the international standard locations. There are practically 12 leads that need to be used to record the electrical activity to know the complete three dimensional view of the heart. Accordingly, leads are classified as:

Standard limb leads: Lead I, Lead II and Lead III

Augumented standard limb leads: aVR, aVL and aVF

Precordial or chest leads: V_1, V_2, V_3, V_4, V_5 and V_6

12 different points on the body surface which are woven together to interpret a cohesive electrical activity and in return the functionality of the heart.

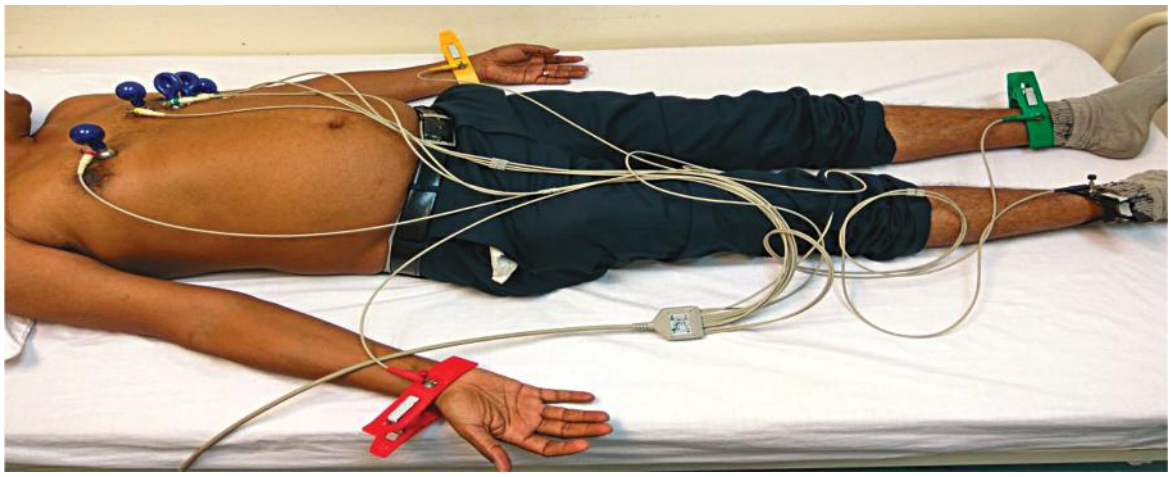

Figure 3 12-lead electrode placement

Limb electrode placements:

RA (Right Arm): Anywhere between the right shoulder and right elbow
RL (Right Leg): Anywhere below the right torso and above the right ankle
LA (Left Arm): Anywhere between the left shoulder and the left elbow
LL (Left Leg): Anywhere below the left torso and above the left ankle

Vertical plane (Frontal Leads):

By using 4 limb electrodes, 6 frontal leads that provide information about the heart's vertical plane

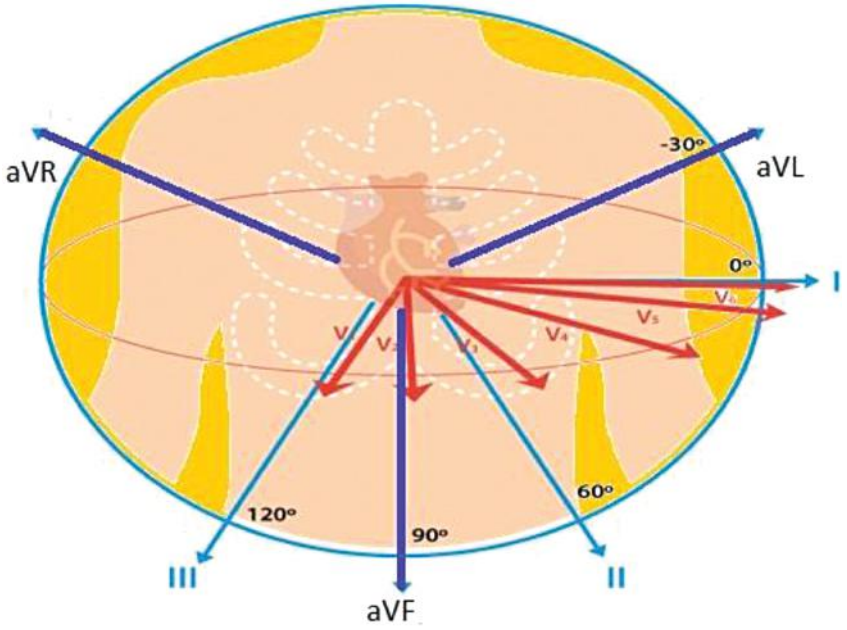

Figure 4 Electrical cardiac axis; mean electrical axis −30° to 90°

Lead I
Lead II
Lead III
Augmented Vector Right (aVR)
Augmented Vector Left (aVL)
Augmented Vector Foot (aVF)

Leads I, II, and III use negative and positive electrodes (as they are bipolar). The augmented leads; aVR, aVL, and aVF use only a positive electrode (as they unipolar).

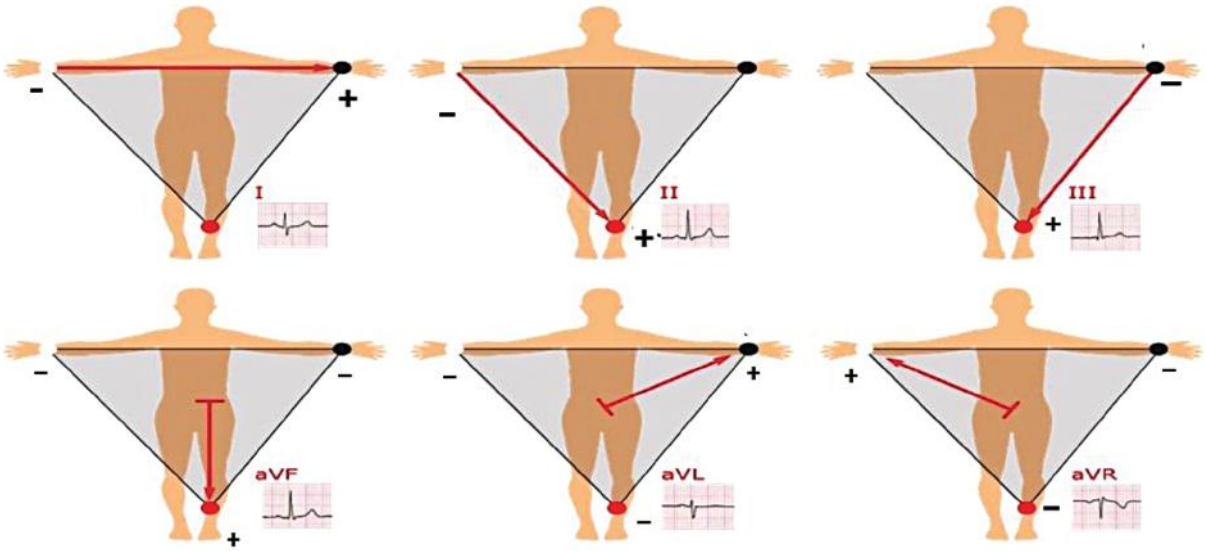

Figure 5 Einthoven Triangle with different lead axes

The Einthoven's triangle explains the basis of 6 frontal leads when there are only 4 limb electrodes.

The principle behind Einthoven's triangle demonstrates the role of individual electrodes RA, LA and LL where they record the electrical activity of the heart in relation to themselves through the aVR, aVL and aVF leads. They also correspond with each other to form lead I (RA to LA), II (RA to LL) and III (LL to LA).

When each lead corresponds with each other, they form an equilateral triangle called Einthoven's triangle. All standard limb leads form an equilateral triangle which is named after Willem Einthoven who pioneered the first practical ECG.

Right foot (RL) is a neutral point and known as point zero where the electrical current is measured. Generally RL does not come up in ECG readings, and is a grounding lead that helps to minimize ECG artefact.

Horizontal Plane (Transverse Leads)

By using 6 precordial or chest electrodes, transverse leads (6) are formed; provide information of heart's horizontal plane: V_1, V_2, V_3, V_4, V_5 and V_6.

Transverse leads are unipolar, they are the active electrodes, needs only a positive electrode. The negative pole of all 6 leads is found at the centre of the heart. This point is called central Wilsons terminal which is maintained at zero. This is calculated with the ECG.

Simonson (1953) has confirmed a decrease in the amplitude of R wave, deviation of axis to the right and ST segment depression in a normal exercising heart.[2] Though it is normal phenomenon in long term exercising heart, decreased R wave amplitude indicates left ventricular dysfunction, coronary vessel obstruction or both.[3, 4] Variability in the R wave amplitude as a result of exercise can be correlated which needs further ECG analysis to differentiate it from a diagnostic ECG of a patient. Postulations are that, correction of ECG measurements from the same ECG record with regard to the heart rates shall improve the diagnostic features of ECG and vector analysis is useful in assessing the haemodynamic functional as of the heart. Based on controversies and gaps, it needs to be further evaluated and a classification of the routine heart ailments with the ECG may help the under graduate medical students to have a thorough knowledge on different ECGs of different pathological conditions.

Determination of Heart Rate (HR) from ECG

On ECG paper horizontal or X-axis represents the time interval and 250 mm is equivalent to 1 second which is 5 large squares. To estimate

the HR, the number of squares in between two successive QRS complex is counted. If the number of squares between two successive QRS is 2, HR is 150/min and if 5, HR is 60 beats per minute.

1. P wave:

It is upright in leads I, aVF and $V_3 – V_6$. Normal duration is less than or equal to 0.11 seconds.

Its polarity is positive in leads I, II, aVF and $V_4 – V_6$; biphasic in lead V_1; negative in aVR. Shape is generally smooth, not notched or peaked.

2. PR interval:

It is between 0.12 and 0.20 seconds.

3. QRS complex:

QRS complex duration is less than or equal to 0.12 seconds, amplitude greater than 0.5 mV in at least one standard lead, and greater than 1.0 mV in at least one precordial lead. Upper limit of normal amplitude is 2.5 – 3.0 mV. Small septal Q waves in lead I, aVL, V_5 and V_6 duration is less than or equal to 0.04 seconds; amplitude is less than 1/3 of the amplitude of the R wave in the same lead. It is represented by a positive deflection with a large, upright R in leads I, II, $V_4 – V_6$ and a negative deflection with a large, deep S in aVR, V_1 and V_2. In general, proceeding from V_1 to V_6, the R waves get taller while the S waves get smaller. At V_3 or V_4, these waves are usually equal. This is called the transitional zone.

4. ST segment:

It is iso-electric, slanting upwards to the T wave in the normal ECG. It may be slightly elevated up to 2.0 mm in some precordial leads. ST segment never depressed greater than 0.5 mm in any lead.

5. T wave:

T wave deflection should be in the same direction as the QRS complex in at least 5 of the 6 limb leads. Normally rounded and asymmetrical, with a more gradual ascent than descent, should be upright in leads $V_2 – V_6$, inverted in aVR. Amplitude of at least 0.2 mV in leads V_3 and V_4 and at least 0.1 mV in leads V_5 and V_6. Isolated T wave inversion in an asymptomatic adult is generally a normal variant.

6. QT interval:

Durations normally less than or equal to 0.40 seconds for males and 0.44 seconds for females.

CLINICAL DIAGNOSIS OF ECG

All the clinical ECGs obtained were original records of the patients who had given their voluntary consent to publish for educational purpose. ECG is an important tool used to diagnose cardiac abnormalities. It is the basis of cardiac conditions. ECG is useful and plays a major significant role in diagnosis.

Mean electrical axis is the average direction of electro-motive force through the ventricle It is also called as cardiac vector. The mean electrical axis in the frontal plane extends between +30° and –110° and in the transverse plane it is between +30° to –30°. When this electrical axis deviates more towards right, it indicates right ventricular hypertrophy generally found in congenital heart diseases, severe pulmonary hypertension, cor-pulmonale, COPD and emboli in the lungs. If left ventricular hypertrophy, the axis is deviated to the left generally found in hypertension, IHD, conduction defects and aortic stenosis.

Arrhythmias

In a normal beating heart, the pacemaker is the Sino-atrial (SA) node, which regularly fires electrical impulse in a rhythmic fashion which

is conducted along the conducting pathways. This yield one cardiac cycle which equals to one beat of the heart with systole and diastole (mechanical event). In arrhythmia the normal conduction pathway is disturbed because of conduction blocks or additional ectopic foci. In an ECG paper, the regularity of electrical event is measured by finding the distance between the successive QRS complexes in a horizontal manner. This aids in measuring the atrial and ventricular rate and rhythm separately. This helps also in estimating the characteristics of ECG waves.

Atrial Fibrillation

Atrial fibrillations can occur because of the diseased sinus node or chaotic atrial contraction or sino-atrial conduction disturbances. The rate in atrial fibrillation is around 300 to 600, and also may not be able to detect the P waves separately in an ECG paper. Atrial fibrillation may or may not be associated with fast ventricular rate depending on the A-V conduction pathway. Atrial fibrillation apart from thromboembloism also can lead to myocardial infarct and cardiac failure.[4]

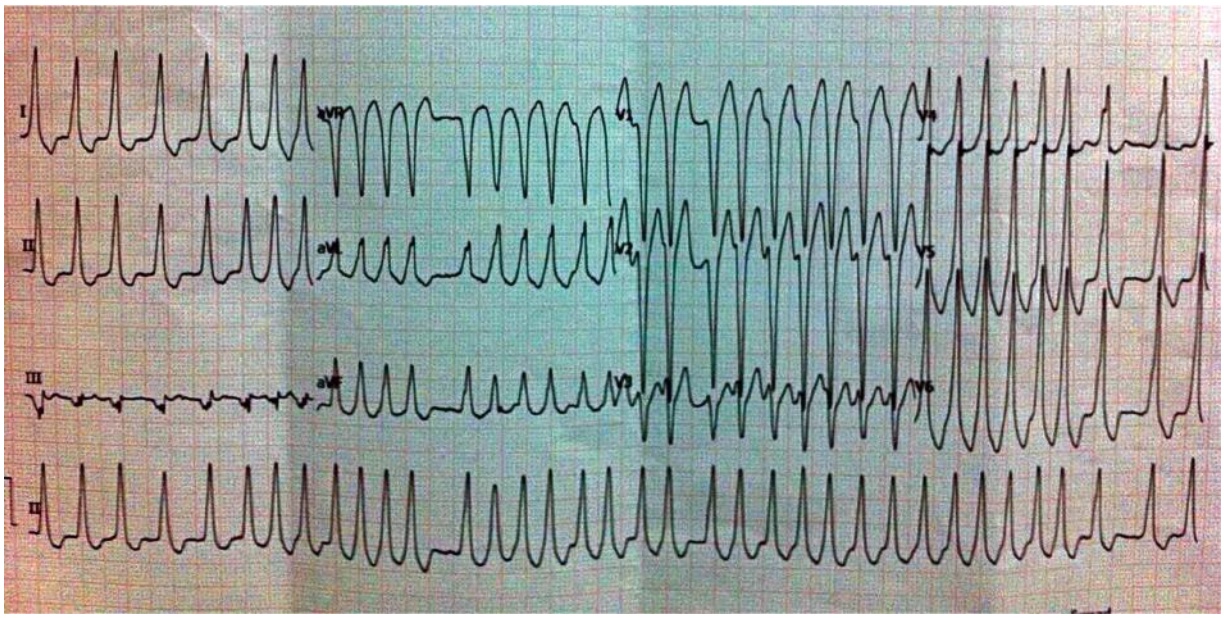

Figure 6 Atrial Fibrillation with fast ventricular response with aberrant conduction: Changing R-R interval, inconspicuous P wave (P wave invisible) and broad QRS complex. This type is commonly seen in rheumatic heart disease, ischaemic heart disease and underlying WPW syndrome, COPD and thyrotoxicosis.

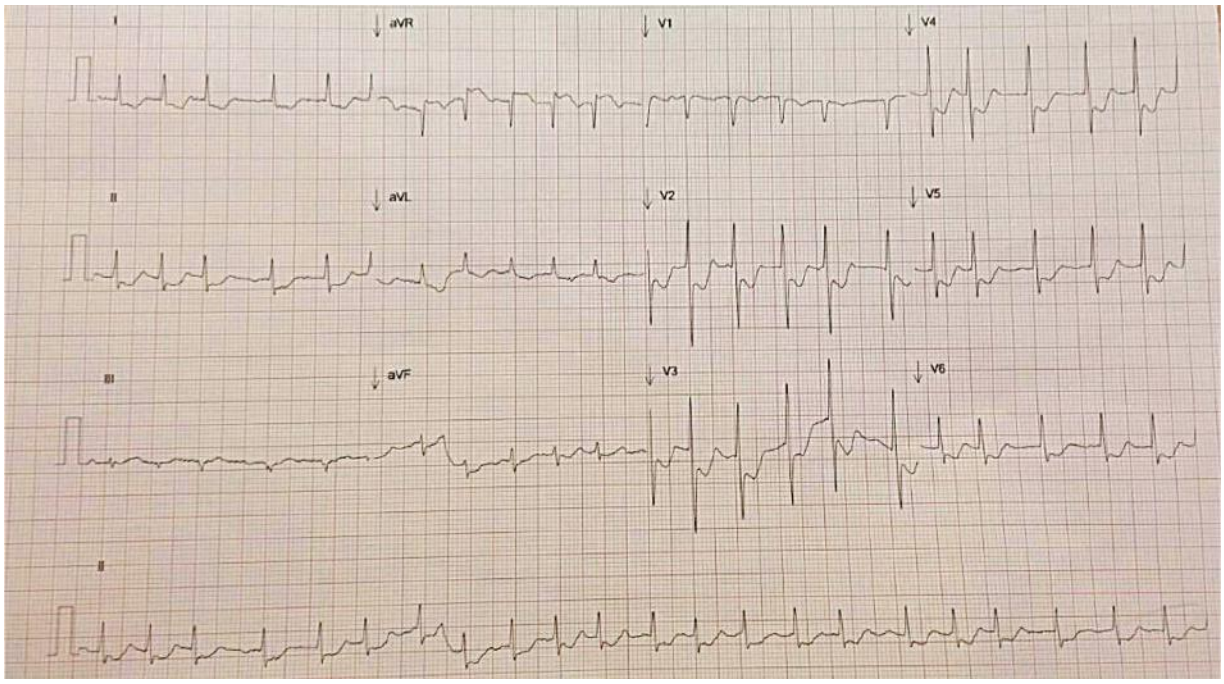

Figure 7 Atrial fibrillation with fast ventricular response

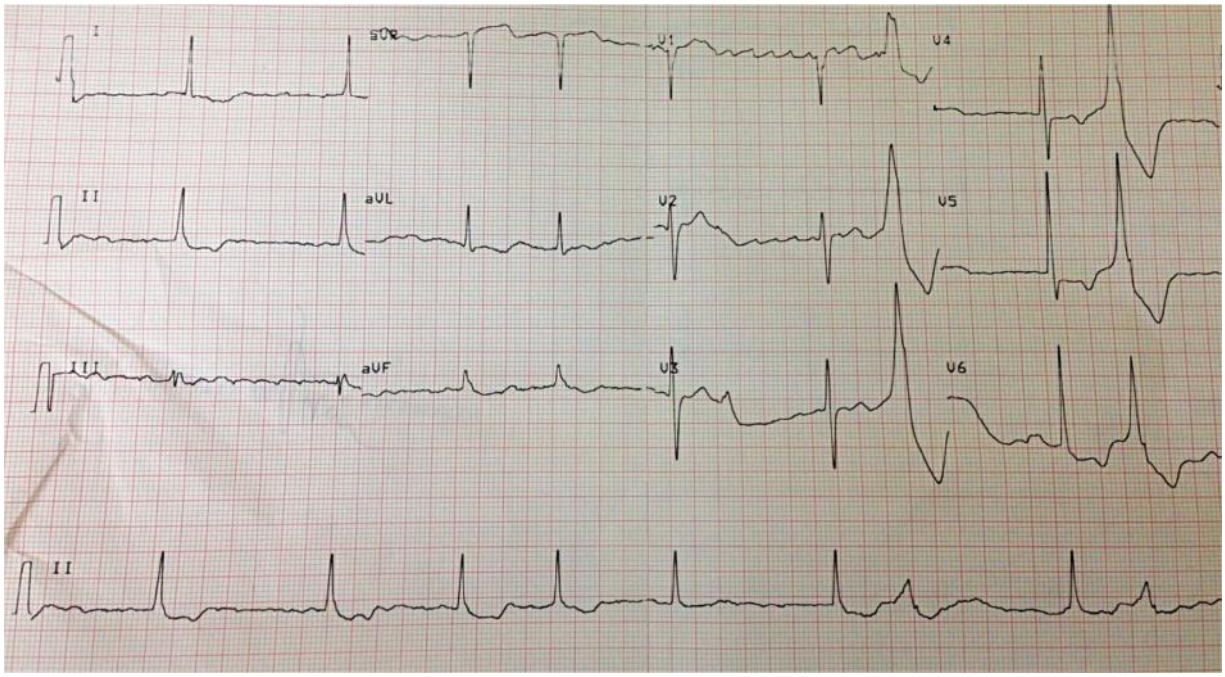

Figure 8 Atrial flutter and fibrillation: Re-entrant circuit within the atria causes atrial contraction at the rate of 250 – 350 causing saw-tooth appearance of the P waves and having variable blocks to the ventricular conduction.

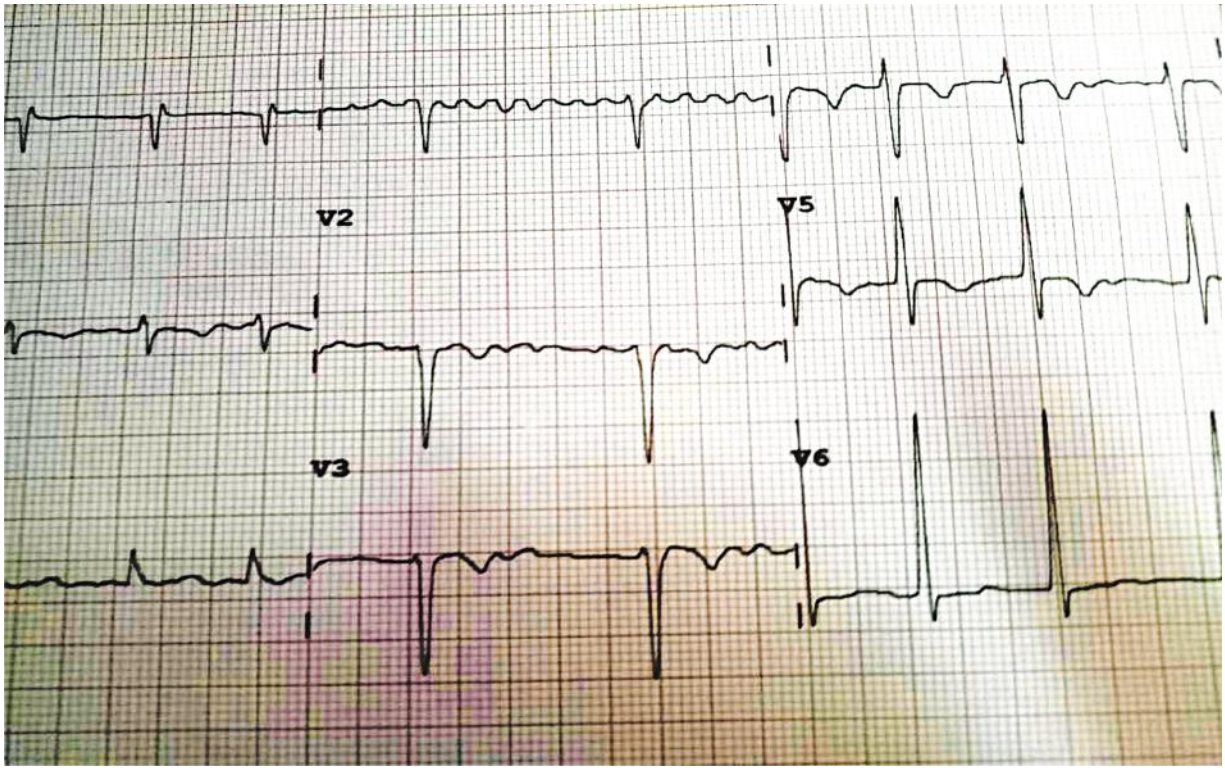

Figure 9 Atrial flutter in V_1 in the form of saw-tooth with atrial rate of more than 300, also seen associated atrial fibrillation with changing R-R interval with occasional ventricular premature beat. It can be seen in rheumatic heart disease, ischaemic heart disease, drug induced and COPD.

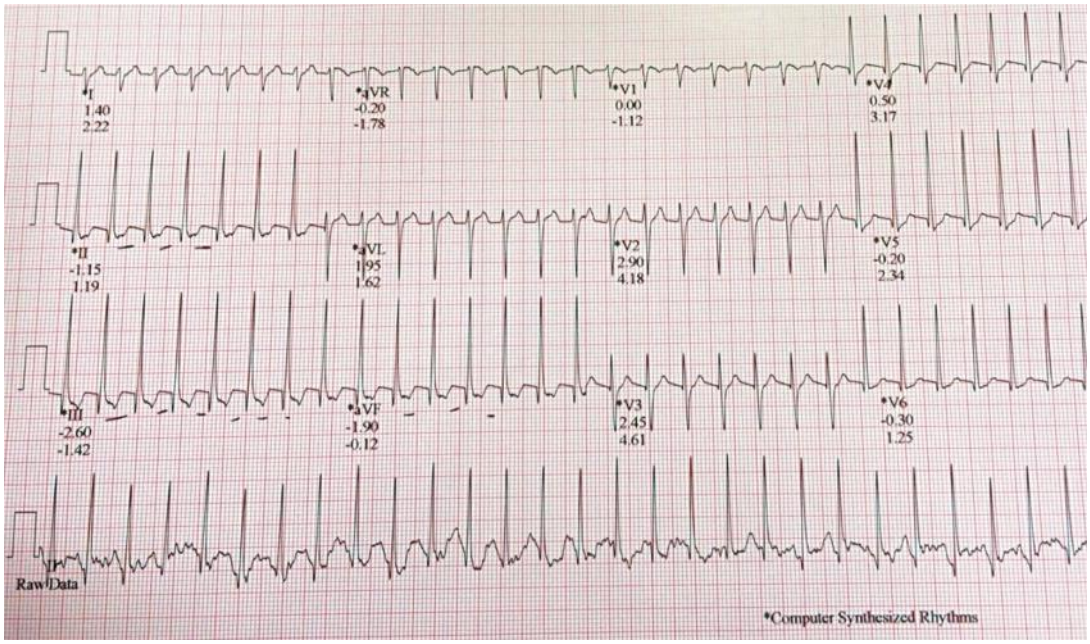

Figure 10 Supra-ventricular tachycardia (SVT)

It is also called paroxysmal supraventricular tachycardia. They are originated above the ventricles. In congenital tricuspid valve dysplasia SVT is common.[6] Atrial and ventricular rate is more than 150/min, narrow complex QRS. It is commonly seen in rheumatic heart disease, IHD, congenital heart disease.

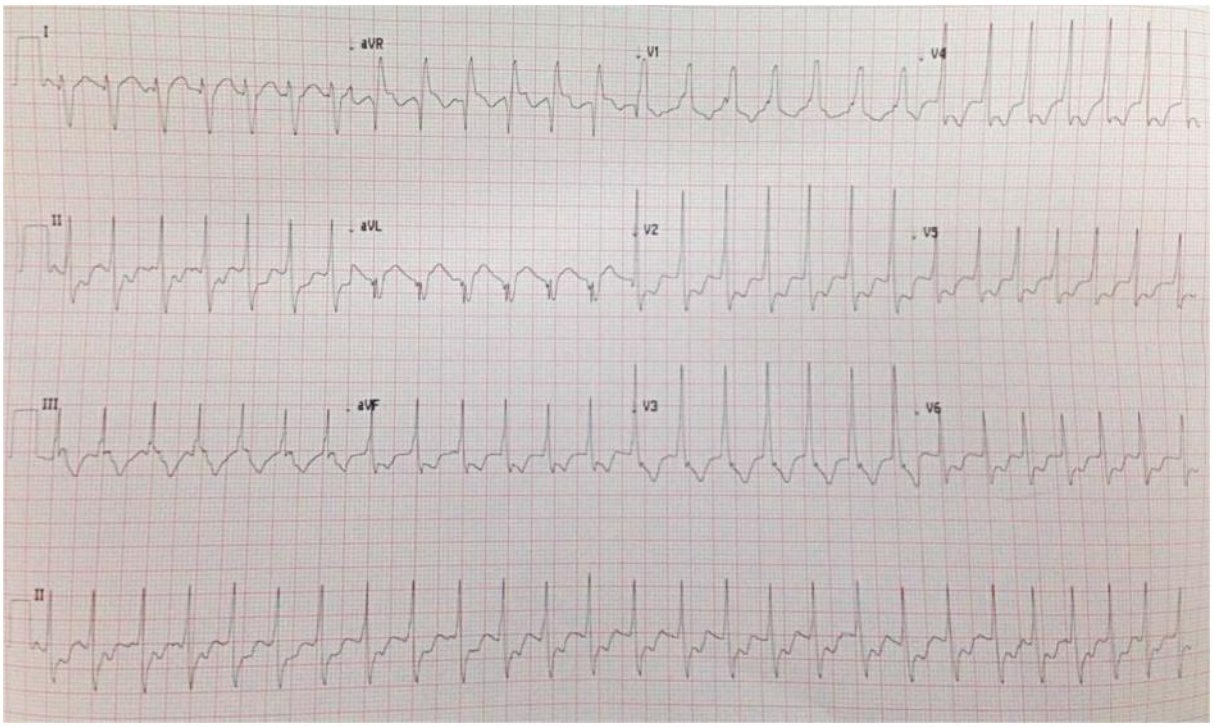

Figure 11 Supraventricular tachycardia (SVT) with aberrant conduction

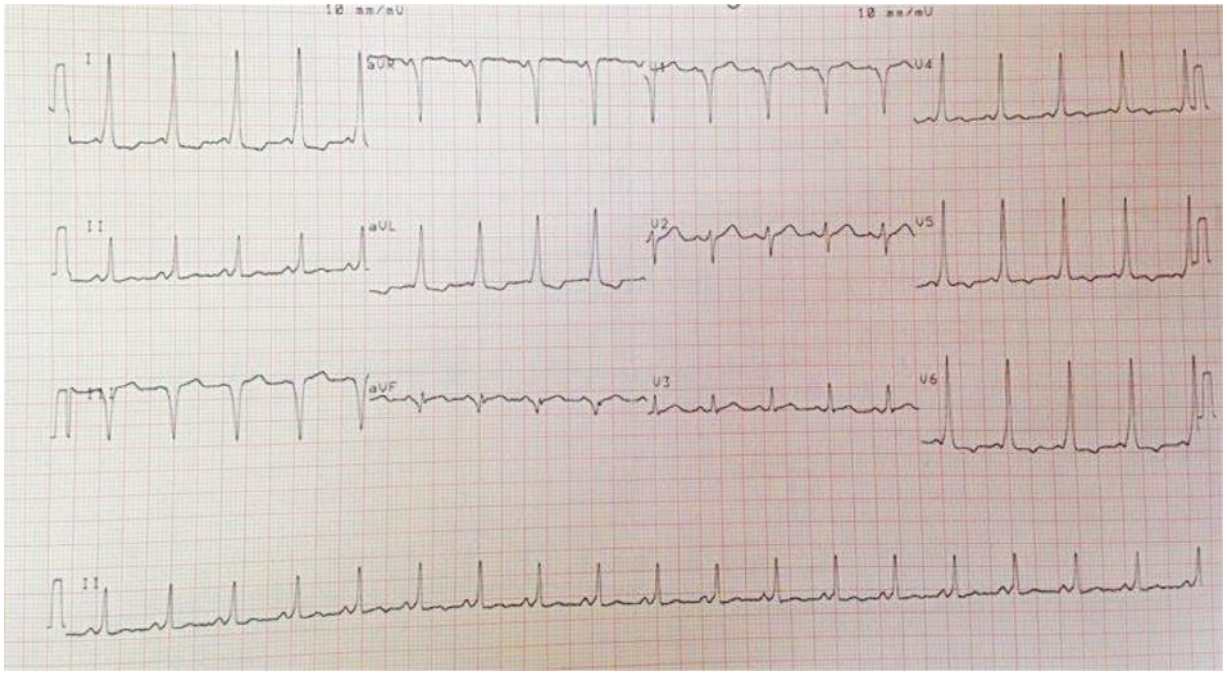

Figure 12 Wolf Parkinson White (WPW) syndrome – Characterized by short P-R interval and slurring of the ascending limb of the R wave, also known as delta wave suggestive of aberrant conduction pathway from atria to ventricle.

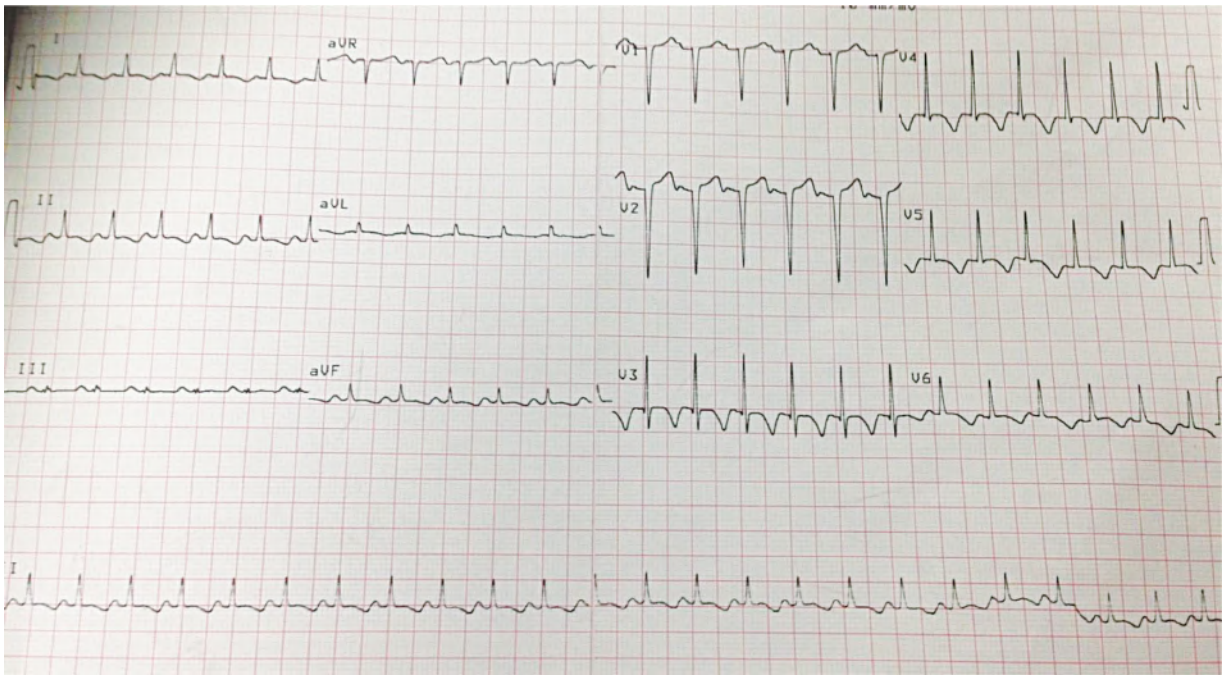

Figure 13 Atrial tachycardia

Ventricular Arrhythmias

They arise from ectopic beats in the ventricles coming successively more than 3 beats considered as runs of ventricular tachycardia. They may come in duplex or triplex and also may be multifocal.

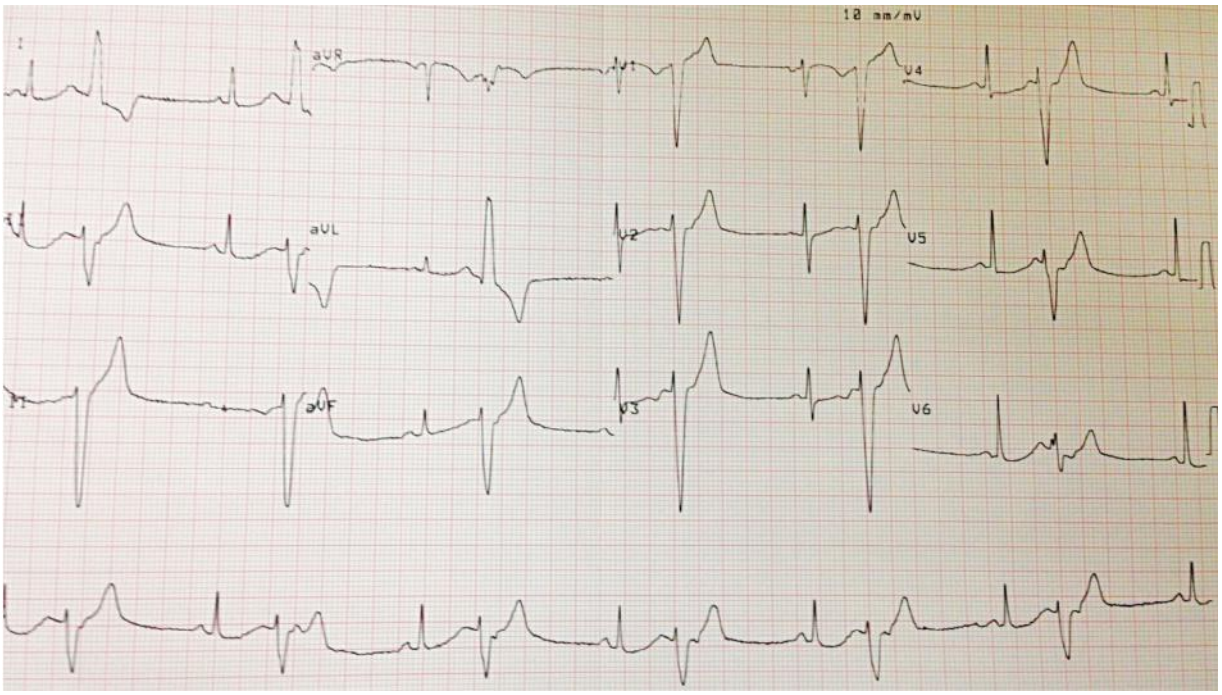

Figure 14 Ventricular bigeminy – ventricular premature beat which is broad and bizarre coming prematurely followed by a pause, featured by a T wave which always opposite to the main QRS complex. This complex may or may not be preceded by P wave. When such beats are coming, alternating with normal sinus rhythm, it is called ventricular bigeminy.

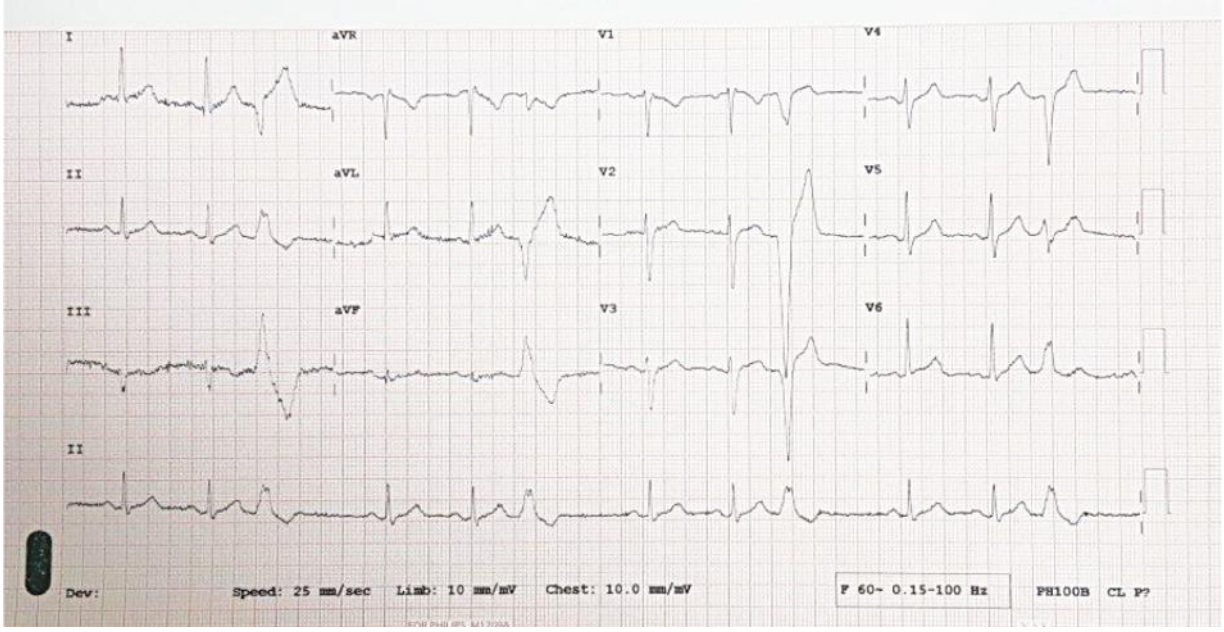

Figure 15 Ventricular trigeminy – It is characterized by ventricular premature complex (VPC) following two successive sinus rhythm. Since the configuration of all VP beats, is same in a given lead, it is called multiple unifocal VP beats when the configuration of the VP beats are changing, it is called multifocal VP beats.

Ventricular bigeminy and trigeminy are commonly seen in IHD, hypertensive heart diseases, congenital heart diseases, drug induced, electrolyte imbalances and excessive smoking, tea or coffee consumption.

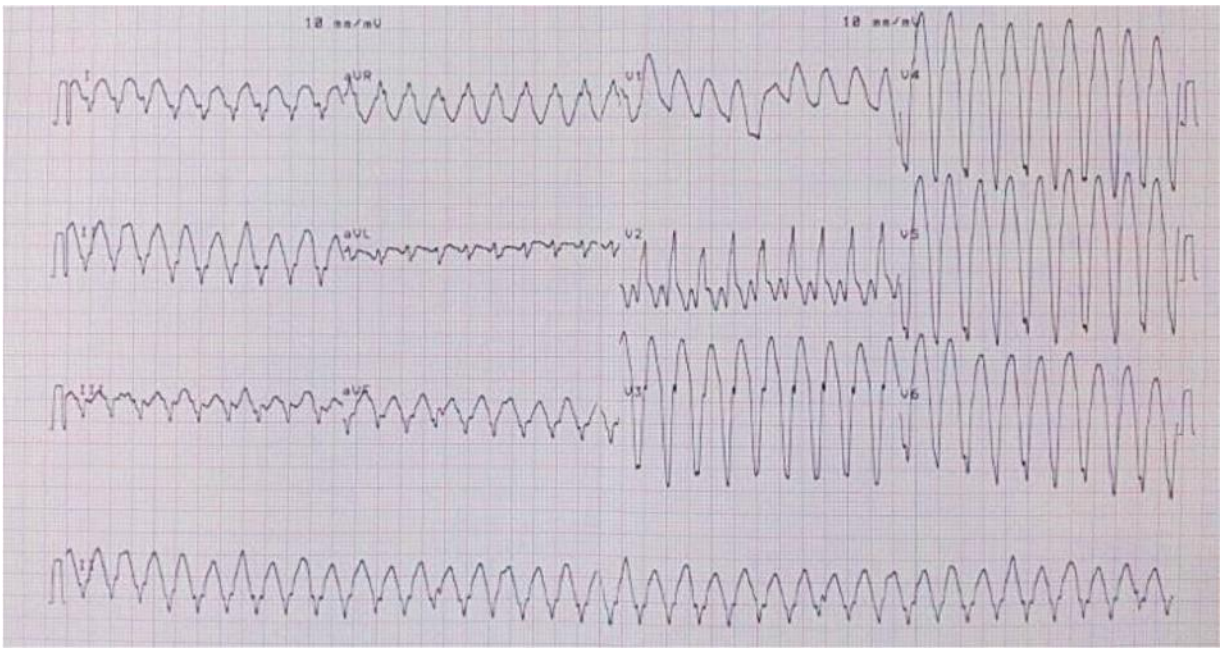

Figure 16 Ventricular tachycardia

Clinically, a serious condition causing faster haemodynamic deterioration with ECG findings of ventricular rate ranging 150 – 200 with broad bizarre QRS complex with changing R-R interval and changing QRS width with polymorphic nature. It may be precipitated by a ventricular premature beat. It should be differentiated from atrial fibrillation with conduction defect.

Brady-arrhythmias

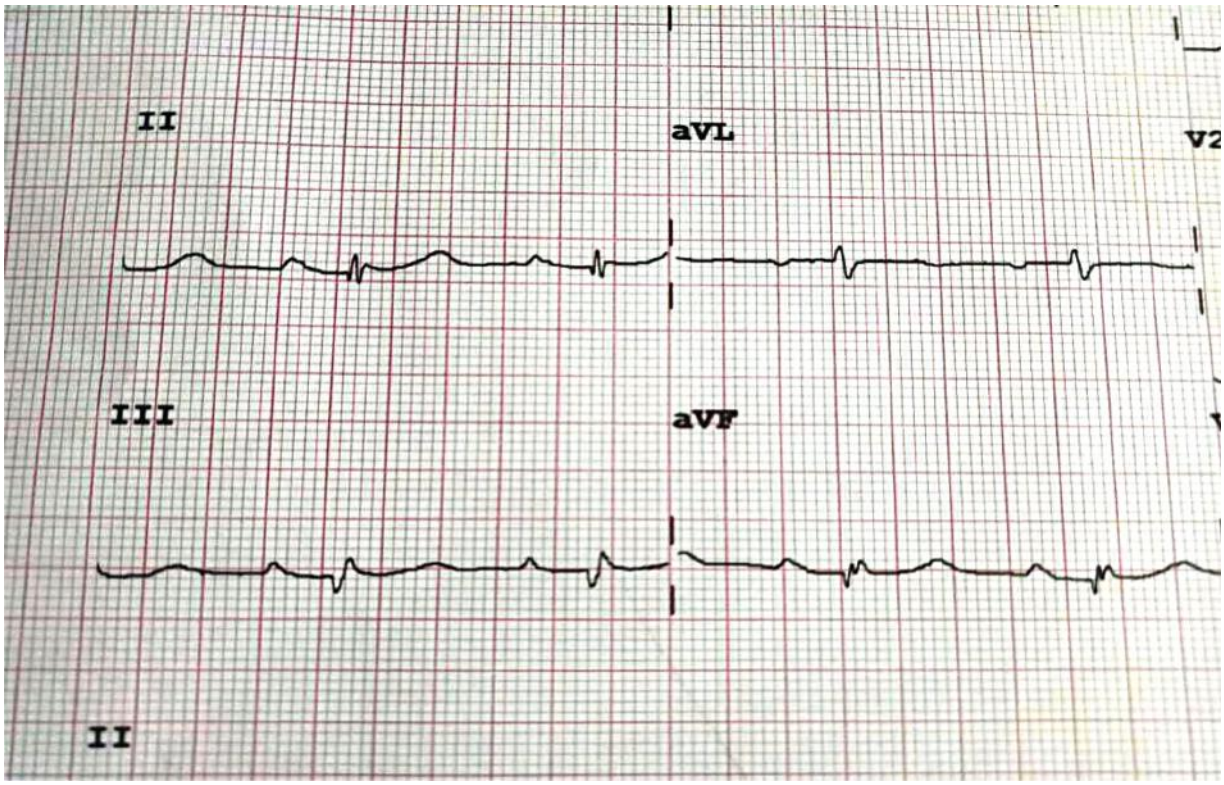

Figure 17 1st degree heart block characterized by prolonged P-R interval more than 0.2 seconds. It is commonly seen in drug induced and degenerative diseases of the conducting system.

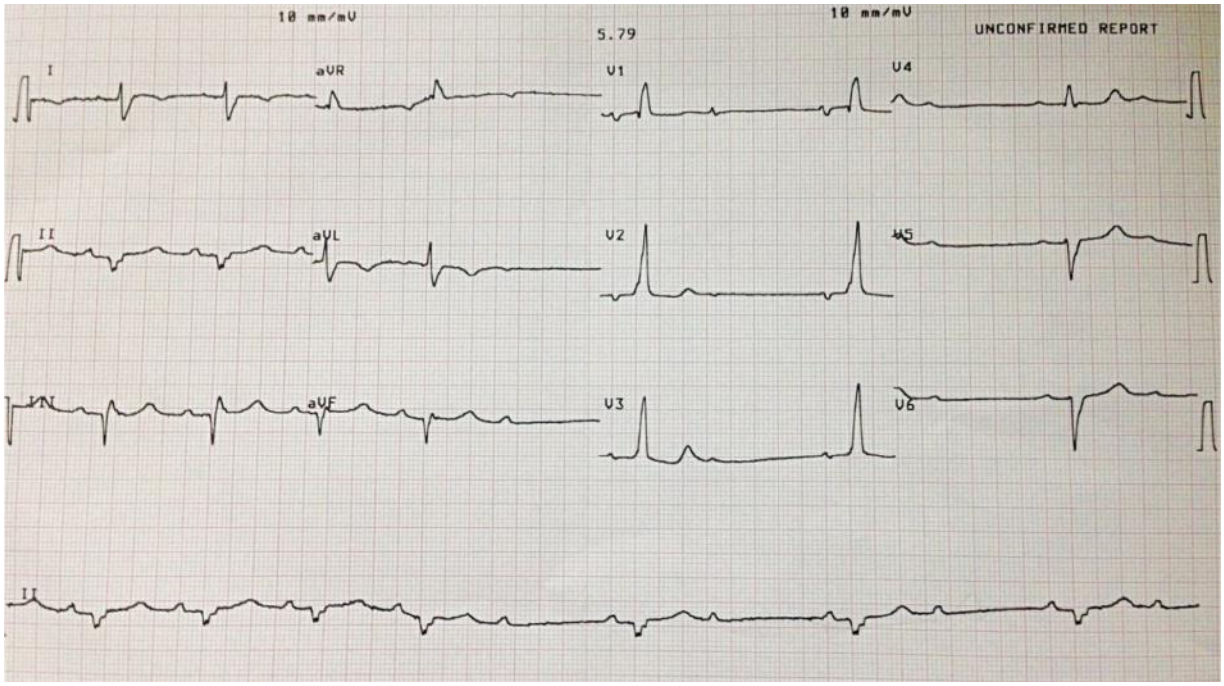

Figure 18 2nd degree heart block – type II, commonly seen with fixed blocks, either every second or third P wave is blocked.

In type I Wenckebach phenomenon, the P-R interval is gradually prolonged in successive beats till one P wave is blocked and the same cycle repeats. Normally seen in rheumatic, ischaemic and hypertensive heart diseases and cardio-myopathies and drug induced.

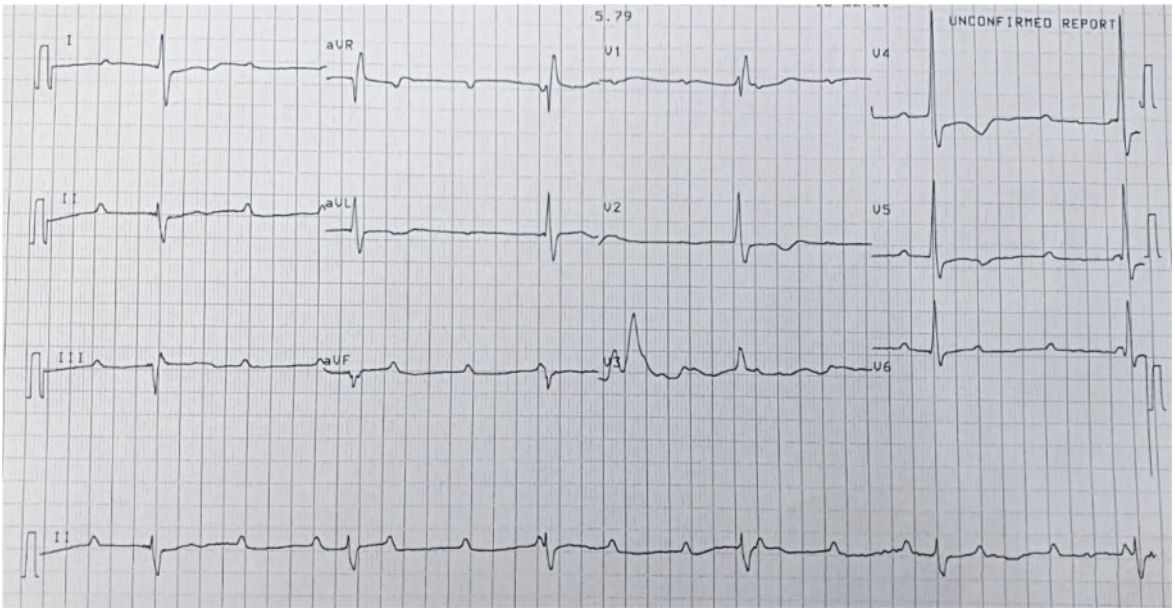

Figure 19 Complete heart block. Also called 3rd degree heart block

P wave is marching through the QRS, no relationship between atrial and ventricular contractions (independently). Commonly seen in IHD, cardio-myopathies, drug induced and electrolyte imbalance.

Pacemaker

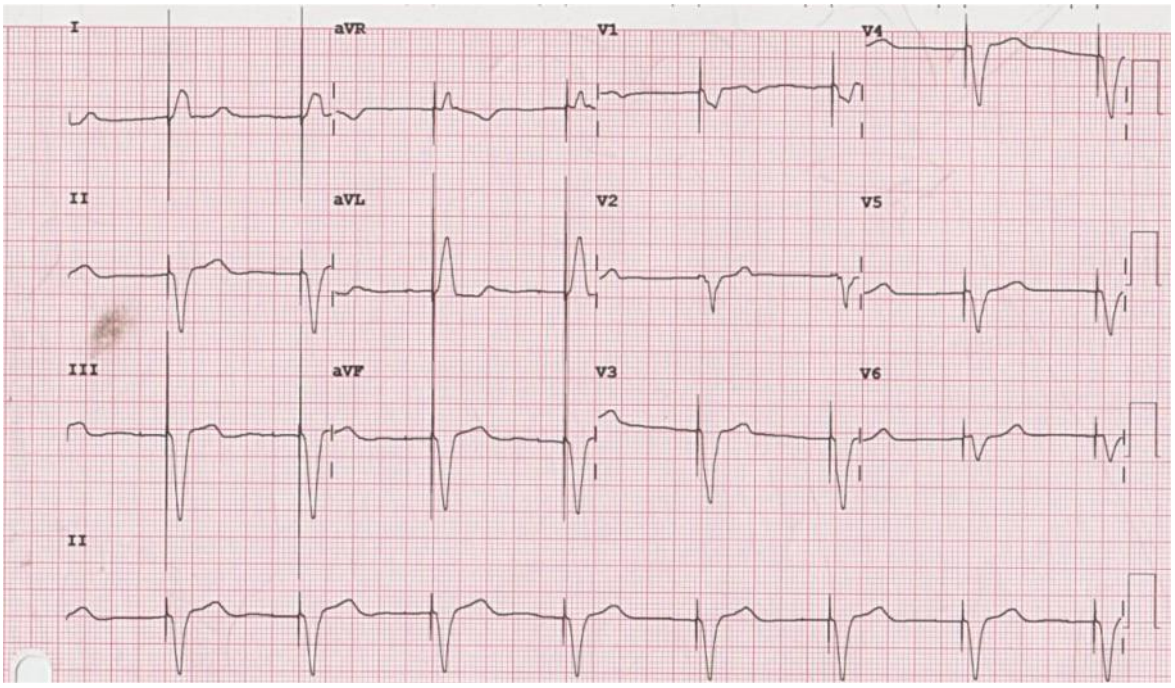

Figure 20 Ventricular pacemaker; indication complete heart block and tri-fascicular block and congenital complete heart block.

Bundle Branch Block

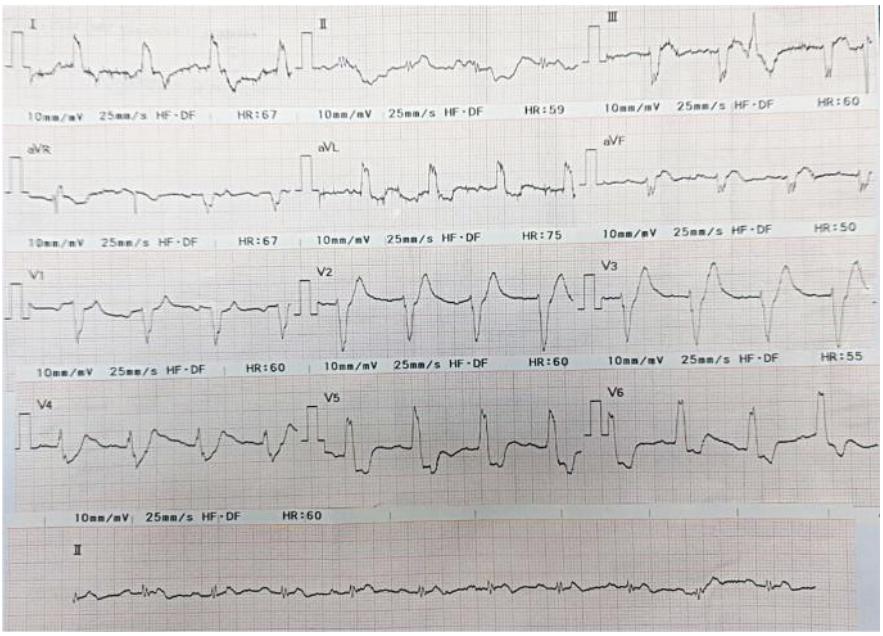

Figure 21 Left bundle branch block: Broad QRS complex with tall R waves in V_5 and V_6 and slurred S wave in V_1 and V_2.

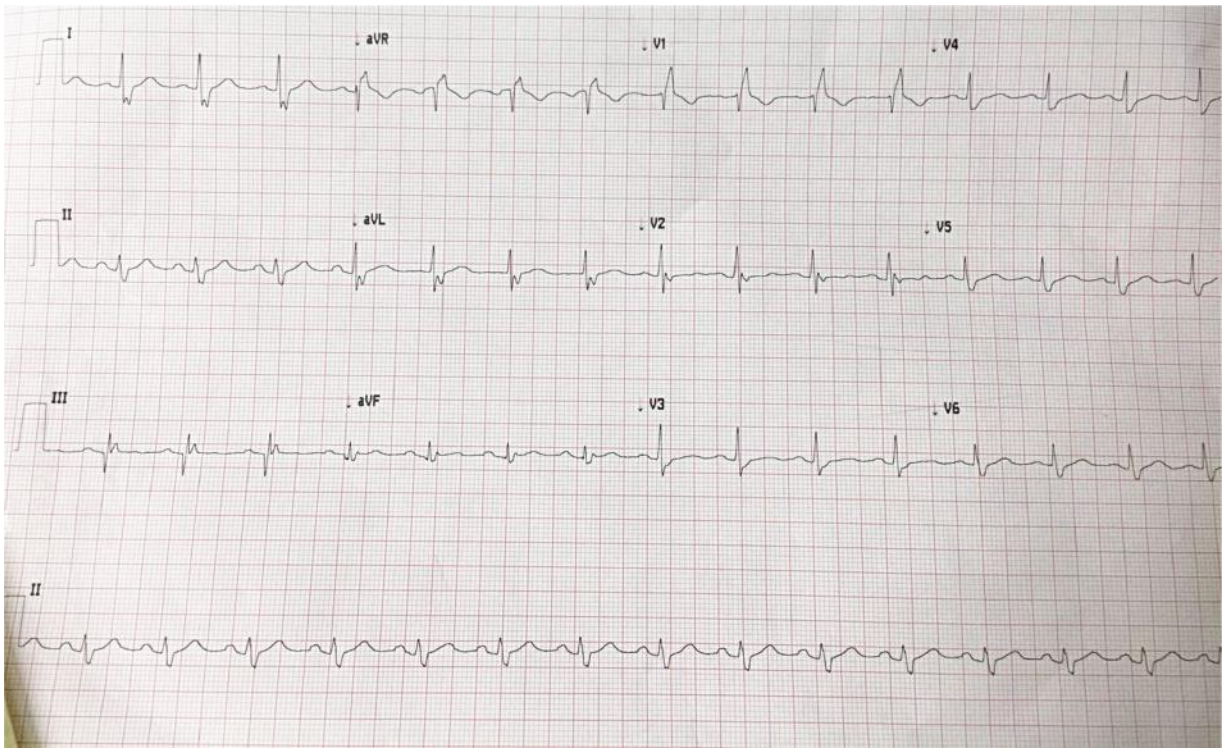

Figure 22 Right bundle branch block: broad QRS, tall R wave in V_1 and slurred S wave in V_5 and V_6 and L_1. It is seen in acute myocardial infarction

ST Segment Abnormalities

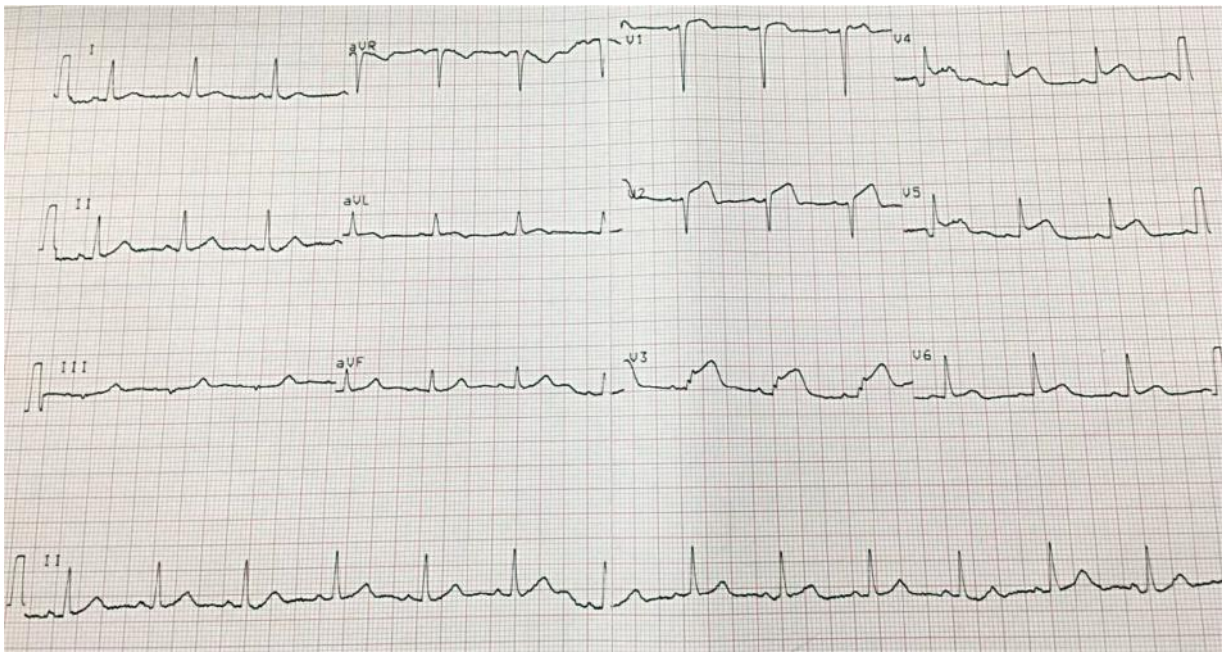

Figure 23 Acute anterior wall infarction characterized by marked ST elevation in V_1, V_2, V_3, V_4 and V_5.

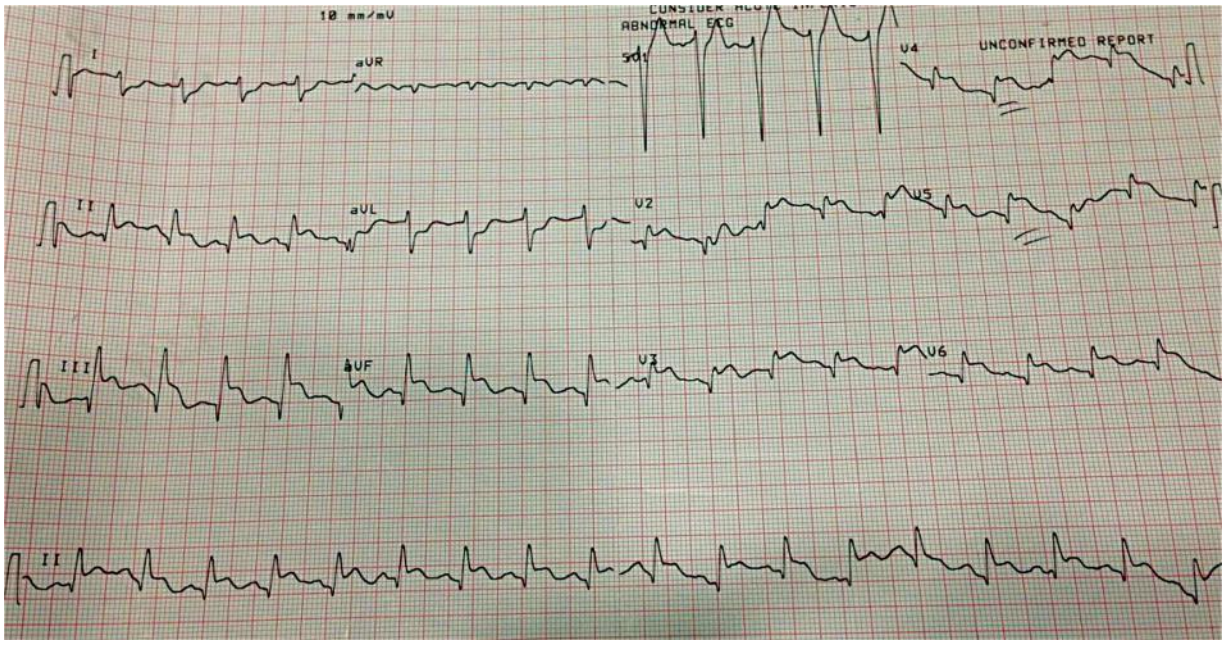

Figure 24 Acute inferior wall infarction with ST elevation in Lead II, Lead III, aVF with reciprocal ST depression in Lead 1 and aVL. Global infarct in view of ST elevation in V_1, V_2, V_3, V_4, V_5 and V_6.

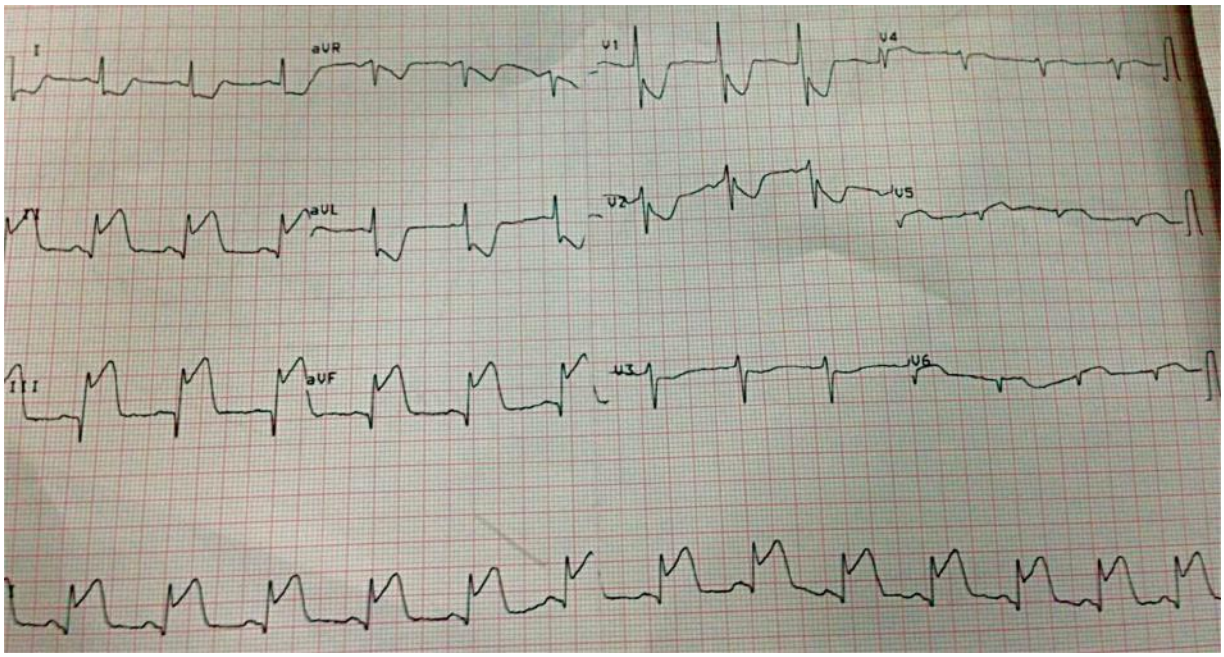

Figure 25 Acute inferio-lateral wall infarction with ST elevation in Lead II, Lead III, aVF and V_5, V_6 reciprocal ST depression in V_1, V_2, Lead I and aVL.

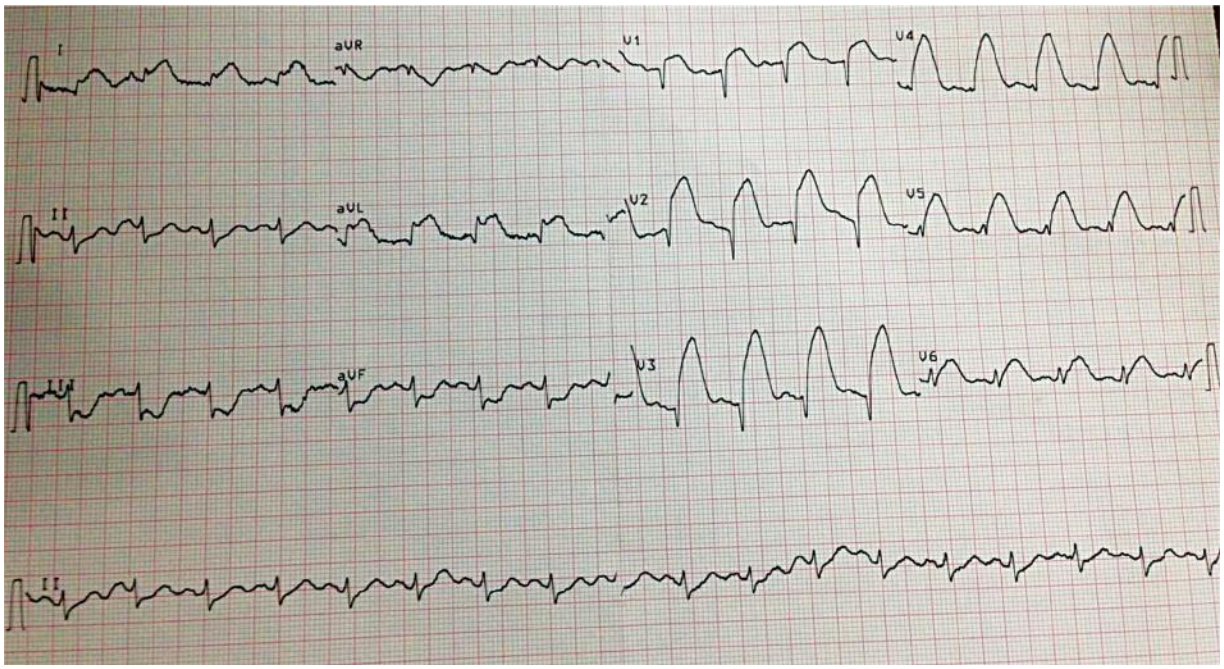

Figure 26 Extensive anterior wall infarction in the form of ST elevation from V_1 to V_6, Lead I and aVL with reciprocal ST depression in inferior wall Lead II, Lead III and aVF.

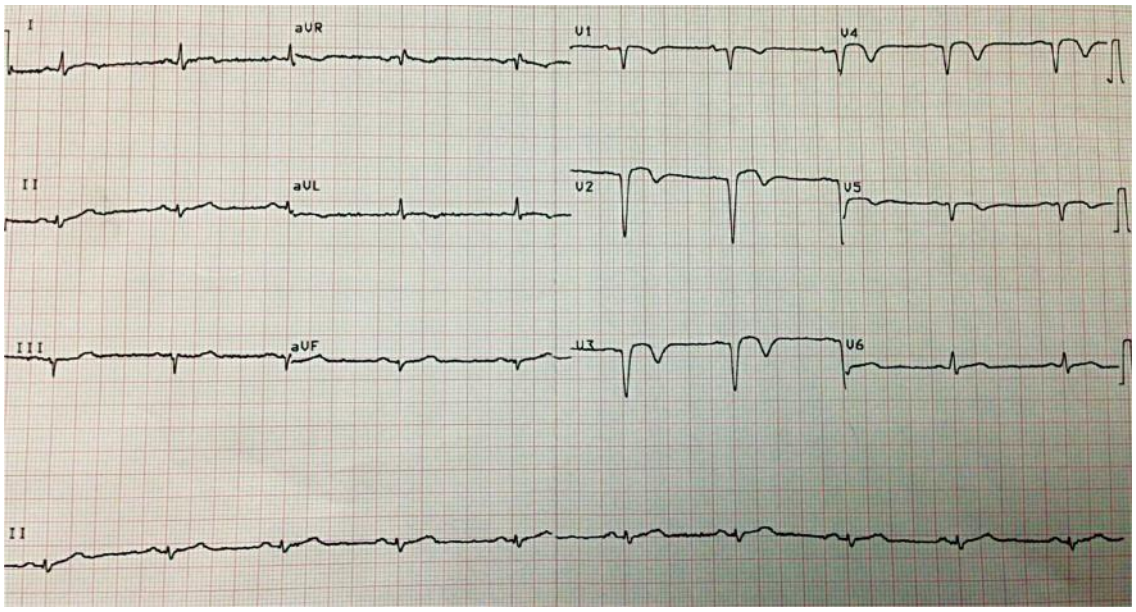

Figure 27 Healed antero-septal infarct in the form of deep Q waves in V_1, V_2 and V_3 with ST segment almost normalizing with T inversion in the same area.

The Cardiac Axis

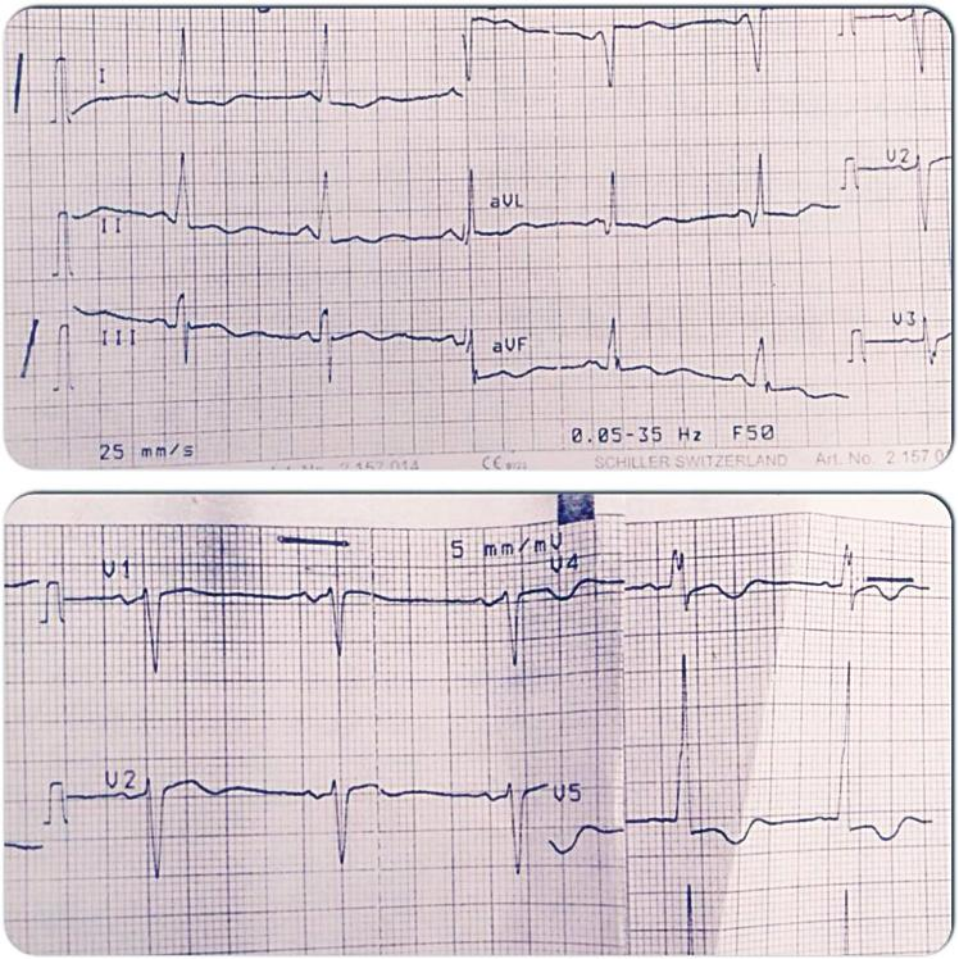

Figure 28 Normal axis – Both Lead 1 and aVF are positive complexes.

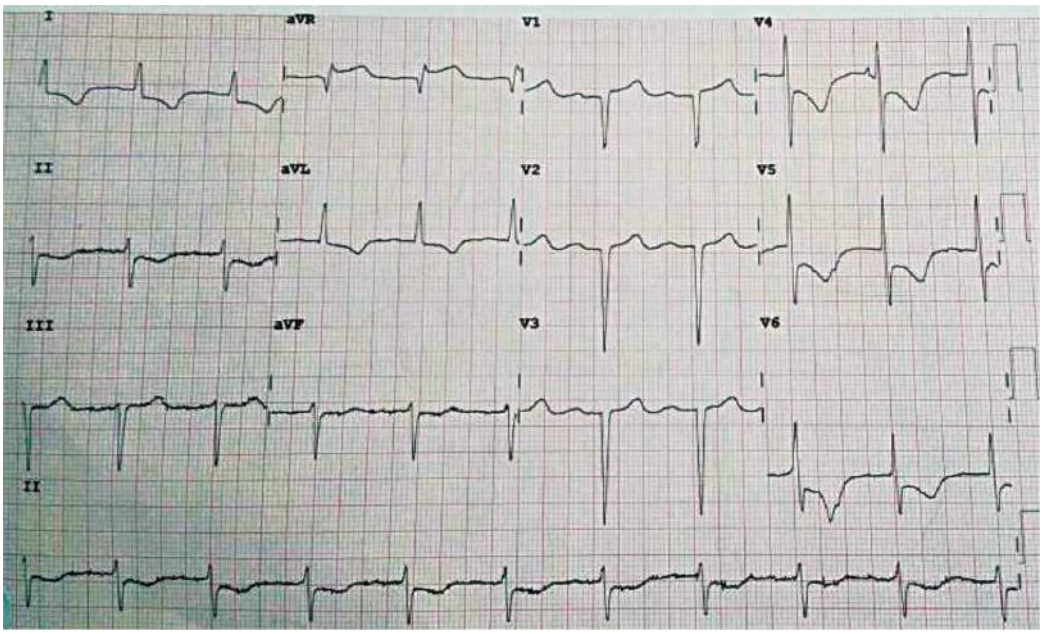

Figure 29 Left axis deviation: aVF negative, Lead 1 positive, can be seen in left anterior hemi-block and hypertensive heart diseases.

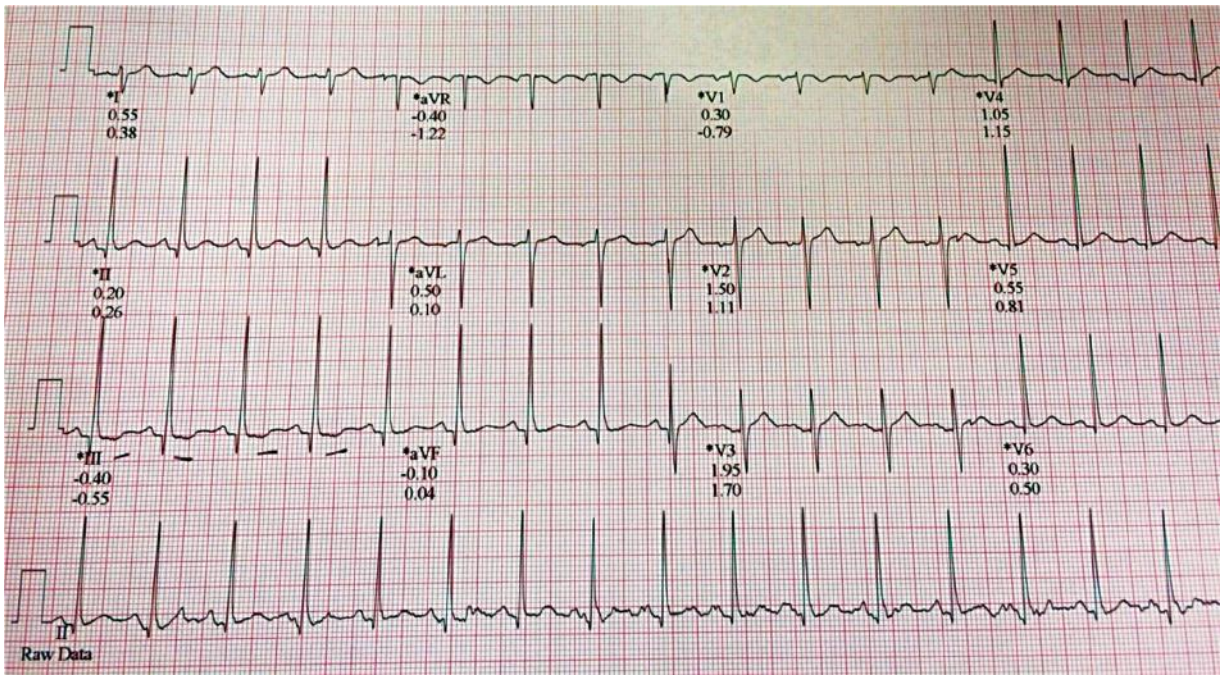

Figure 30 Right axis deviation: Lead 1 negative, aVF positive – right axis deviation is commonly seen in right ventricular hypertrophy, dextrocardia, technical dextrocardia, left posterior hemi-block.

CONCLUSION

An over-all discussion of normal ECG, 12 leads and 12-lead ECG records were discussed. Along with the normal routinely-met abnormal clinical ECG such as atrial fibrillation, ventricular tachycardia, conduction block, arrhythmias and axis deviation cases were presented. This article shall be an educational series that will be useful to every undergraduate medical student for their learning and reflection.

REFERENCES

1. Antiperovitch, Zareba W, Steinberg JS, Bacharova L, Tereshchenko LG, Farre J, Nikus K, Ikeda T, Baranchuk A. (2017). Proposed in-training electrocardiogram interpretation competencies for undergraduate and postgraduate trainees. J Hosp Med 8: E1 – E9.
2. Simonson E. (1953). Effect of moderate exercise on the electrocardiogram in healthy young and middle-aged men. J Appl Physiol 5: 584.
3. Greenberg PS, Ellestad MH, Berge R. (1981). Radionuclide angiographic correlation of the R wave, ejection fraction and volume responses to upright bicycle exercise. Chest 80: 459 – 464.
4. Berman JL, Wynne J, Cohn PF. (1979). Multiple lead QRS changes with exercise testing. Diagnostic value and hemodynamic implications. Circulation 58: 53 – 61.
5. Polovina M, Đikić D, Vlajković A, Vilotijević M, Milinković I, Ašanin M[1], Ostojić M, Coats AJS, Seferović PM. (2017). Adverse cardiovascular outcomes in atrial fibrillation: Validation of the new 2MACE risk score. Int J Cardiol S0167-5273 (17): 34881 – 34887.
6. D Allan, DC Crawford, SK Chita, MJ Tynan. (1986). Prenatal screening for congenital heart disease. Br Med J 292: 1717 – 1719.

Original Article

Knowledge, Attitude and Practice of Contraception by Doctors and Women in Kota Kinabalu, Sabah

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ABSTRACT

Evidence-based data confirm the relationship between an increased availability of effective contraception and reduction in induced abortion rate. In Malaysia, the contraception prevalence rate in 1966 was 8.8 per cent to 52 per cent in 1984, but has levelled off since then. In recent years there has been increasing report of babies 'abandonment' in Malaysia. The aim of this study is to determine the knowledge, attitudes and practices related to contraception among women and doctors in Kota Kinabalu the capital of Sabah, Malaysia. Descriptive and analytical community-based cross-sectional study was used. A total of 240 women and 60 doctors were selected from either private or public clinics. The instrument used was face-to-face interview for the women and self-administered questionnaires for doctors. Analysis was done using SPSS version 21. The doctors (80%) felt that contraception is extremely important, and routinely discuss (63%) with their patients. Oral contraceptive pill (97%) is the most common type of contraceptive available in their clinics. About 68% of doctors surprisingly cited that abstinence plays a major part in their contraceptive advice. The average correct answer by doctors on knowledge is 62%. The women surveyed (98.8%) have heard of contraception. The main reason for using is for spacing of pregnancy and many stopped or did not use because of fear of side effects. Women attending the public clinic appear to know more about female and male sterilization and intrauterine contraceptive device compared to those attending private clinic. Further research is needed to reinforce this study.

Keywords: contraception, knowledge, women

INTRODUCTION

Worldwide, 41 per cent of pregnancies were unintended in 2008.[1] Unintended pregnancies impact adversely upon a woman`s lives in many ways. There are social, economic, cultural and health consequences, and at times even maternal mortality. Among the common outcomes for a mother with unintended pregnancies are; lack or absence of antenatal care and its adverse sequelae as well as missed opportunities for higher educational achievements especially where it involves teenage mothers. Babies born to mothers with unintended pregnancies have been known to be associated with low birth weight and slow cognitive developments.[2] In developing regions, unsafe abortion is the cause of close to 13 per cent of maternal death compared to 4 per cent in developed regions.[3] It accounts for the largest proportion of hospital admission for gynaecological services in developing countries. This will affect the resources in many hospitals. A study by UNFPA/Guttmacher Institute showed that each dollar spent on contraception would reduce total medical spending by $1.40 by cutting down on sums spent on unplanned births and abortions. Availability and access to contraception services can avoid many of the abortion related morbidity and mortality.[4] This fact has become even more important of recent years as many countries have curtailed funding for family planning. There are many studies that offer a strong data linking lower abortion rates or declines in induced abortion with better access to high-quality family planning services and greater contraceptive use.[5, 6, 7] An analysis

by Gilda Sedgh and colleagues showed that abortion rates in the developing countries have remained at high from 39 abortions per 1000 women in in 1990 – 1994 to 37 in 2010 – 2014. The availability of contraception in developed countries shows a significant decline from 46 abortions per 1000 women to 27 during the same period of time.[8]

The World Health Organization fact sheet on contraception showed 225 million unmet needs for contraception in the developing world. The reasons for this include limited choice of method, access, fear of side effects, cultural or religious apposition, users and provider bias and poor quality of available services.[9]

Realizing the importance of this fact, in the 1990's UNFDP organized a series of conferences that emphasizes on reproductive rights as cornerstone of development. The reproductive rights among others include the right to decide the number, timing and spacing of children, the right to voluntarily marry and establish a family and the right to the highest attainable standard of health. The reproductive rights were clarified and endorsed internationally in the Cairo Consensus that emerged from the 1994 International Conference on Population and Development (ICPD). To date, the ICPD has been validated by a series of review.[10]

In Malaysia, family planning services has been available even prior to 1966. There have been changes in the family planning policy in line with the government population policy in 1984 to achieve an ultimate population of 70 million by 2100. The change in policy indirectly affects the emphasis on provision of contraception. The contraception prevalence rate according to the Malaysian Population and Family Survey in 1966 was 8.8 per cent, increased substantially to 36 per cent in 1974 and to 52 per cent in 1984, but has levelled off since then. It was noted that unmet need for modern contraception among Malaysians had increased from 25 per cent in 1988 to 36 per cent in 2004.[11, 12]

The Confidential Enquiries into Maternal Deaths in Malaysia reported that abortion accounts annually for one to nine maternal deaths from 1997 to 2005.[13] There were also an increasing number of babies being abandoned. From 2001 to 2004, the Social Welfare Department recorded 315 cases of abandoned babies, while police statistics revealed about 100 cases a year.[14] Table 1 shows the Royal Malaysian Police Statistic on the number of 'baby dumping' reported in each state from 2005 to 7 April 2010.

Table 1 The number of baby dumping reported in each state from 2005 to 7 April 2010 according to the Headquarters of Royal Malaysian Police (Polis DiRaja Malaysia – PDRM)

States	Number of cases
Selangor	105
Johor	83
Sabah (S, 2007)	65
Sarawak	34
Negeri Sembilan	24
Pulau Pinang	22
Perak	19
Pahang	17
Kedah	17
Kelantan	10
Terengganu	5
Melaka	3
Kuala Lumpur	2
Perlis	1
Total	**407**

This study was embarked with the following hypothesis:

1. Patients lack of knowledge lead to misconception towards contraception subsequently refusal the use of contraception.
2. Doctors lack of knowledge lead to non-provision of contraception, and wrong advice to patients which causes the increase unmet need for contraception.

The objectives were as follows:

1. To find out the prevalence of contraceptive use in women of reproductive age group in Kota Kinabalu, Sabah.
2. To look at the reasons behind the unmet contraceptive needs.
3. To look at doctors' possible contributions towards the unmet needs.
4. To recommend an integrated approach based on the study results to:

a. Increase contraceptive uptake and acceptance by women.
b. Increase doctor knowledge and strengthen contraceptive practice.
c. To contribute to national database regarding contraceptive practice so that government and non-governmental organizations can reliably use these data in shaping future national or locally-based policies.

METHODOLOGY

This study is a descriptive clinic-based cross-sectional study. The study populations selected were women attending the public maternal and child health clinics (Klinik Kesihatan Ibu dan Anak – KKIA) and private general practitioner clinics in Kota Kinabalu, Sabah. The inclusion criteria were all women age between 18 to 45 years old attending maternal and child clinics. Women who have had a hysterectomy are excluded from this study. The study period was for 6 months from November 2014 to April 2015. Systematic sampling method was used for selection of women and study clinics. To calculate the total number of sample, the total population of women age 15 to 49 and the contraception prevalence rate in Malaysia were taken into consideration which was 226,029 (Sabah Census 2010) and 54.5% (1994) respectively. The total sample size was 240. Subjects were equally from public and private clinics which is 120 from each sector. The total sample for doctors was calculated to be 65 based on the expected contraceptive practice of 60% and prevalence rate of 80% with precision of 5%. Fifteen and 45 doctors were selected from public and private clinics respectively.

The questionnaires were designed according to KAP methodology using WHO guidelines to assess knowledge and validated in Malay and English language.[15, 16] Face-to-face interviews were used for patients and self-administered questionnaires for doctors. A training course regarding data collection was conducted for nurses and interviewers. All participants were given subject information sheet regarding the study and signed consent forms. An ethical clearance from health authorities such as Ministry of Health, Sabah and ethical committee of Universiti Malaysia Sabah were obtained.

Statistical analysis used was SPSS version 21. The tests that used were descriptive analysis, frequency, relative frequency for prevalence, and Person Chi-square test for independent sample categorical data analysis, and hypothesis testing for the hypothesis of this study.

Data collected was entered into a Statistical Package for Social Sciences (SPSS) database using a double-punch method and later matched to eliminate possible data entry errors.

RESULTS

Women

A total of 184 women did the survey, 88 and 96 from the public and private sectors respectively. Thirty-seven per cent of the women were of Kadazandusun and Murut (indigenous people) ethnicity, 10% were Malays, and 9% Chinese and 49% stated others as their ethnicity but was not specified further. As for education level, 11% and 59% studied up to primary and secondary schools respectively. There were 19% with tertiary education and 4.5% postgraduate level. Five per cent had no formal education. Ninety-six per cent of the women who did the survey were married.

Almost all the women who did the survey have heard of contraception before (98.8%). They heard it from doctors (39.1%), other health professionals (27.2%), friends (22.8%), media, internet, radio or television (6.5%) and from family (4.35%). The respondents have heard of the contraceptive pills (90%), injectable contraception (87%), condom (81%), intrauterine device (70%) and implants (53%). Only 10% and 7.4% of respondents have heard of intrauterine system and patch respectively. Ninety-seven per cent of the respondents from the public sector and 66.7% from private sector acknowledged that contraception was discussed with them during their clinic visits.

Of all the women who participated in the survey, 87.5% have used contraception before. The most commonly used contraception was the pill (56%), followed by injectable (43.4%), condoms (17.9%), and IUDs (10.5%). Some used lactational amenorrhea method (9.1%), rhythm method (5.6%), implanon (5.1%), done the female sterilization (4.6%), rings (4.2%), male sterilization (2.8%), IUS (2.6%) and a small number (less than 2%) have used the female condom, diaphragm, and patch. They get their contraception mainly from either government or private clinics depending on where the survey was done. A small percentage (10.7) obtained their contraception medication from pharmacies. Of the women surveyed, 24.6% used contraception for less than 6 months, 33.3% used between 6 to 12 months, 27.5% used for two years, 1.4% used for 3 years and 13% used for more than 3 years. Planning for another child was the main reason for stopping the contraception (64.2%), other reasons stated was worried of side effects (20%), not able to tolerate side effects (7%), became pregnant while on contraception (4.5%) and asked to stop by husband (4%). Weight gain was the main concern when it comes to side effects of contraception (85%), other concerns were emotional effect (8.7%), subfertility (4.3%) and less than 1% stated concern over pigmentation and cancer. Of those who never used contraception: 57% stated side effects, 20.3% husband objection, 6.5% against their religion and less than 4% stated because they were advised by health professionals not to take. Almost all (97.5%) think that contraception is important.

There were no significance differences of answers provided by women attending the public and private clinics except on 2 questions. There was significance association between the clinic type and knowledge ($p < 0.001$) and usage ($p = 0.01$) of contraception. Only 0.59% of women attending public clinics have not heard of contraception in contrast to 5.88% from the private clinics. There were only 5.81% of women attending the public clinics who have not used contraception before compared to 17.44% from the private clinics.

Doctors

A total of 35 doctors participated in the survey. More than half; 63% of the doctors' surveyed routinely discussed contraception with their patients and 34% will only discuss upon request. Eighty per cent of the doctors felt that contraception is extremely important to the total well-being of the female patients in the reproductive age group. Almost all (92%) the doctors were comfortable discussing contraception with teenagers or single female patients. Abstinence was always a major part of contraceptive advice for 23% of doctors and 46% of doctors reported that abstinence plays a major part of their contraceptive advice most of the time. Ninety-four per cent of doctors felt that healthcare professionals should initiate contraceptive discussion rather than patient. Among all respondents, 66% of doctors felt contraceptive discussion should be done by doctors and 35% felt that it should be left to nurses. When it comes to barriers to contraception the doctors cited the causes were 36% due to fear of side effects, 27% false belief, 6% husband objections, 18% financial problems and other causes such as patients' attitude and religious reasons. The available type of contraceptive methods in the doctors' practices are IUCD 54%, IUS 3%, injectable 83%, implants 26%, pills 89%, condoms 34%,

patch 9%, ring 6%, lactational amenorrhea 37%, rhythm method 40%, and withdrawal method 20%. The types of contraceptives that doctors will discuss and offer patients were male sterilization 29%, female sterilization 40%, IUCD 69%, IUS 11%, injectable 91%, implants 66%, pills 97%, condoms 57%, patch and ring 6%, LAM 31%, rhythm 29%, and withdrawal method 18%. Sixty-six per cent of doctors routinely assess patient's need for contraception, 83% routinely discuss the Contraceptive and Non-contraceptive benefits of Contraception while 48% only discuss the side effects of contraceptives in their counselling. For complicated cases, 72% will refer to obstetrics and gynaecology (O&G) while 15% will refer to KKIA and only 3% will refer to government hospitals.

The World Health Organization eligibility criteria were used as a basis to assess the doctors' knowledge on contraception.[15, 16] Slightly over half (51%) of the doctors said that the latest a woman can start contraception is within 5 days of LMP. Majority (77%) said that a woman can start oral contraceptive pill (OCP) immediately post abortion or miscarriage. Almost all answered that a woman can have an injectable contraception immediately after another hormonal contraception without waiting for the next menstruation. Only 33% answered that an IUCD cannot be inserted on an amenorrhea woman. In terms of whether antibiotics are needed during copper IUCD insertion, 76% answered yes, 7% no and 17% were unsure. On emergency contraception 46% get the right answer. Sixty per cent of the respondent answered that there is risk of pregnancy when the pill are missed. In terms of what should be done when a woman develops amenorrhea while on injectable, 94% of respondents think counselling is sufficient. When a woman develops heavy bleeding while on injectable, 30% of doctor respondents will treat with Norethisterone, 27% will treat with Ethinylestradiol, 21% with Provera and 21% did not response. When a woman gets pregnant while on IUCD, 42% of doctors will remove it after counselling, 39% will not remove, 18% was unsure what to do. Seventy-seven per cent of doctors answered that breast and pelvic examination is essential and mandatory before prescribing any type of hormonal contraception. On average, 62% of primary healthcare advices and management of contraceptive cases were in compliance with WHO recommendations.

DISCUSSION

This study showed that women are aware of contraception and the main source of information is from health personnel. The contraceptive pill is the main method of contraception; this is in agreement with many published data. The other method that is commonly used is injectable, which is not reported in most published data.[17, 18] Most data reported that the condom is usually the other contraceptive method that is more commonly used. However the findings in this study showed that most women have heard of the pills followed by injectable. The selected public clinics in this study were clinics for women and children (KKIA) whereby the private clinics are general clinics that serve all population, hence contraceptive were discussed more than those private clinics. This also explained the relatively low knowledge and usage of contraception among women attending the private clinics. One of the main reasons for stopping or not using contraceptive was concerned of its side effects. Studies have shown that all contraceptive methods do have some minor side effects but with proper selection will not cause any significance effect on a woman's life. In fact compared to the risk of unintended pregnancy, side effect of any contraceptive methods is minute.[19] Recent data have shown that the most effective contraceptives are the long-acting reversible contraceptive (LARC).[20] However, it is not the most discussed or commonly used methods in this study.

The healthcare professionals have been shown to have a major influence on women's mode of delivery and choice of contraception.[21, 22] This stresses the important role of healthcare professionals in unmet need for contraception. It is surprising that although 94% of doctors

surveyed answered that healthcare professionals should initiate contraceptive discussion, only 63% routinely discussed with patients. Another finding of this study is that 69% of doctors cited that abstinence always or most of the time plays a major part in their contraceptive advice. It was also interesting to note that of the surveyed group of doctors, their advices and management were in average 62% in compliance with WHO recommendations. The findings in this study appear to indicate that some doctors are giving inappropriate contraceptive advice and management. Health personnel play a big role in educating and influencing patients to use contraception. Their lack of knowledge can lead to non-provision of contraception, and wrong advice to patients which caused the increase unmet need for contraception. There is also a need to keep all health personnel involved in giving contraceptive advice to continuously update themselves on recent advances in contraception. This will ensure all women seeking advice receive similar standard information. The findings of this suggest the hypothesis to be correct and achieved partially the objectives due to the limitation of this study.

LIMITATION

The number of subjects who participated in this study was small. The reasons for lack of participation were not clear but it may be the way the subjects were approached by the investigator. Some doctors were not quite happy to be questioned about their knowledge. The lack of participation need to be addressed and further study need to be done to support the findings in this study.

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REFERENCES

1. Singh S, Sedgh G. (1997). The relationship of abortion to trends in contraception and fertility in Brazil, Colombia and Mexico. International Family Planning Perspective 23 (1): 41 – 52.
2. Carson C, Kelly Y, Kurinczuk JJ, Sacker A, Redshaw M, Quigley MA. (2011). Effect of pregnancy planning and fertility treatment on cognitive outcomes in children at ages 3 and 5: Longitudinal cohort study. BMJ 343 (Jul 26, 1): d4473. doi: 0.1136/bmj.d4473
3. World Health Organization (WHO). (2011). Unsafe abortion: Global and regional estimates of the incidence of unsafe abortion and associated mortality in 2008 6th Edition. Geneva: WHO.
4. Singh S, Derroch JE. (2012). Adding it up: Costs and benefits of contraceptive services estimates for 2012. New York: Guttmacjer Institute, UNFPA.
5. Henshaw SK, Singh S, Hass T. (1999). Recent trends in abortion rates worlwide. International Family Planning Perpectives 25 (1): 44 – 48.
6. Rahman M, DaVanzo J, Razzque A. (2001). Do better family planning services reduce abortion in Bangladesh? Lancet 358 (9287): 1051 – 1056.
7. Senlet P, Curtis SL, Mathis J, Raggers H. (2001). The role of changes in contraceptive use in the decline of induced abortion in Turkey. Studies in Family Planning 32 (1): 41 – 52.
8. Fester DG. (2016). Unmet need for abortion and woman-centered contraceptive care. The Lancet 388 (July 16): 258. http://dx.doi.org/10.1016/S0140-6736(16)30452-4
9. World Health Organization. (2012). Family planning. Geneva: WHO.
10. UNFPA. (1995). Summary of the ICPD programme of action. New York: UNFPA.
11. Huang MS, Lim SC. (2012). UNFPA-ICOMP workshop on operationalizing the call for elimination of unmet need for family planning in Asia and the Pacific Region. Bangkok: UNFPA, ICOMP.
12. Huang SL, Lim SC. (2012). Addressing the unmet need for family planning among the young people in Malaysia. Bangkok: UNFPA, ICOMP.
13. Ying NK. (2008). Report on confidential enquiries into maternal deaths in Malaysia 2001 – 2005. Kuala Lumpur: Ministry of Health Malaysia.

14. Ang ES. (2007). Study on safe haven for babies. Kuala Lumpur: National and Family Development Board.
15. World Health Organization. (2015). Medical eligibility criteria for contraceptive use 5th Edition.
16. World Health Organization. (2016). Selected practice recommendations for contraceptive use 3rd Edition.
17. Mosher WD, Jones J. (2010). Use of contraception in the United States: 1982 – 2008. Vital Health Stat 23: 1 – 44.
18. Guttmacher Institute. (2015). Fact sheet: Contraceptive use in the United States.
19. Barr NG, Geffen D. (2010). Managing adverse effects of hormonal contraceptives. Am Fam Physician 82 (12, Dec 15):1499 – 1506.
20. Winner B, Peipert JF, Zhao Q, Buckel C, Madden T, Allsworth JE, Secura GM. (2012). Effectiveness of long-acting reversible contraception. N Engl J Med 366: 1998 – 2007. doi: 10.1056/NEJMoa1110855
21. Johnson S, Pion C, Jennings V. (2013). Current methods and attitudes of women towards contraception in Europe and America. Reproductive Health 10: 7. http://www.reproductive-health-journal.com/content/10/1/7
22. Bitzer J, Gemzell-Danielsson K, Roumen F, Marintcheva-Petrova M, van Bakel B, Oddens BJ. (2012). The CHOICE study: Effect of counselling on the selection of combined hormonal contraceptive methods in 11 countries. Eur J Contracept Reprod Health Care 17: 65 – 78.

Postural Photogrammetry as Promising Tool for Clinical Use: A Reliability Study

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ABSTRACT

Many studies on postural photogrammetry had reported various intra-class correlation coefficients (ICC) across postural variable measurements, however no conclusive solution was given. This reliability and cross-sectional study was done in June 2016 at the Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah. A total of 24 male adult subjects with mean age 28.5 years (± 4.8 years), body mass 24.97 kg (± 3.85 kg) and height 166.6 cm (± 6 cm) were evaluated for standing postural photogrammetry. Four sets of manually digitized posture image files (by 4 raters) were measured and statistically analyzed for inter-rater agreement as well as the influence of image resolution and camera height from the floor on various postural variable measurements. The ICC between 4 raters for all postural variables was excellent (the lowest ICC was 0.940 for Q Angle of the Right Knee measurements). Two-Way ANOVA showed that postural variable measurements were not affected by either image resolution or camera height from the floor. Scrupulous attempts done on standing postural photogrammetry amplified the potential for standing postural evaluation in clinical settings.

Keywords: photogrammetry, standing postural photography, posture

INTRODUCTION

Good posture creates musculoskeletal balance, a condition which would minimize wear and tear on the joints, muscles and ligaments. Conversely, bad or poor posture could be the reflection of the existence of musculoskeletal disorders or the potential risk for future musculoskeletal abnormalities. With those perspectives, an accurate and a reliable body posture evaluation is very important for therapeutic purpose, health promotion, prevention and rehabilitation.

It is a common practice in clinical setting that static human body posture evaluation is done by relying on clinician's subjective visual impression, aided by several simple tools such as plumb line, goniometer, postural grids, ruler, etc. The conventional method as aforesaid has advantages in its simplicity and low cost, however it is believed to have drawbacks with regard to objectivity, ease of recording and reliability.

As a method for evaluation body posture, digital photography combined with computer technology or known as postural photogrammetry,[1] potentially provides several advantages over the conventional method such as: ease of recording, simplicity, time saving, possibility of recording subtle changes, and an accurate measurement as well as higher interrater reliability. Although it possesses great potential advantages and growing acceptance in clinical use, such method nevertheless has some elements that may influence on data reliability, such as image distortion produced by the camera and lens unit, position of the camera as well as the subject, tagging of the anatomical markers, resolution of the captured image, and the digital measurement of postural variables. On the other side, current use of various photographic equipment as well as the evaluating computer software in many postural photogrammetry researches[2 – 12] may give rise to the impression of inherent simplicity within this technique.

However, proper application of this technique might not be very simple, knowing the facts that some validation studies on postural photogrammetry have reported various interrater reliability across postural variables.[7, 8, 10 – 12]

Nowadays, digital photography technology has entered the era of megapixel resolution, the picture quality, sharpness and resolution tend to continue to increase, and it is relatively more affordable as well as user friendly. However, it is still unknown how such advancements would improve the reliability of postural photogrammetry. With utilizing state of the art of imaging and computer technology, combined with careful application of photogrammetry while addressing all possible errors, the present study explored the extent to which the current common available technology would affect the reliability of the standing postural photogrammetry. This study also assessed the effect of camera resolution and camera vertical placement on the measurement of postural variables of standing adults. It is hypothesized that photographic postural measurements will not be affected by image resolution as well as camera height placement.

MATERIALS AND METHODS

Overview and Image Acquisition

This reliability and cross-sectional study was conducted in June 2016. The study population was known healthy subjects who were all male and used to be volunteers for Faculty of Medicine and Health Sciences clinical skill laboratory sessions. The male-only available subjects were related to the local socio norms. From 105 candidates listed (as per May 2016) on the registration book, subjects were randomly called and briefly explained by phone, and the 25 first responders who agreed were invited to join the study. This study required all subjects to expose their upper body, trunk, as well as all the limbs, wearing only tight shorts or tight underwear. The study approval "JKEtika 1/16(9)" was granted by the ethics committee of the Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah (FMHS-UMS). On the time of data acquisition, 24 volunteers showed up. Half number of them was scheduled for morning session, and the rest were for the afternoon session. Briefing about details of the photo session was given at the subject waiting room. All subjects signed the informed consent form, and passed the standing Romberg test as the eligibility criteria for taking part in this study. Mean age of the study sample, body mass and height were 28.5 years (± 4.8 years), 24.97 kg (± 3.85 kg) and 166.6 cm (± 6 cm) respectively.

Data acquisition was carried out at the clinical skill laboratory of the FMHS-UMS. The subjects were called individually into the photo session room. The primary researcher was the only person responsible for the marker placement, in which hemispherical white markers with diameter of 1 cm were affixed on tip of acromio-clavicular joint, tip of spinous process of cervical vertebra VII, anterior superior iliac spine, central of patella, tibial tubercle, and left lateral malleolus of fibula; white paper sticker of diameter of $^{1}/_{2}$ cm was affixed to mark the tragus of the left ear. For the cloth covered body parts, stickers were affixed on clothing. In order to obtain adequate visualization, all necessary arrangements were made, and with bare feet, two anterior and two left lateral standing photos were taken on each subject.

- For the anterior view, right heel of the subject stepping on the floor marks prepared for this view. These marks were located at the right side of a midline (the line which divided equally the right and left field of the image in the camera viewfinder, see Figure 1). Subject was allowed to put his right heel on whichever point he likes, then arranged his left foot at equidistance with the right foot from the midline and standing relax. Subject was instructed to look straight ahead at a vertical line on 8 metre distance wall. Soon after the instruction: "Take a deep breath in and let out", one anterior view photo with camera at high position was taken, then subject was instructed to stand still for few seconds (± 6 seconds as recycle time required by the flash units), and a second anterior view photo

was taken with the camera set at low position. Subsequently, the subject was requested to turn slowly for taking left lateral view photo.

- For left lateral view, the left heel of the subject stepping on the floor marks was prepared for this view. Subject was allowed to put his left heel on whichever point he likes, then arranged his right foot at equidistance with the left foot from a specified line on the floor for this view and standing relax. Subject was instructed to look straight ahead at a vertical line on 8 metre distance wall. Soon after the instruction: "Take a deep breath in and let out", one left lateral view photo with camera at high position was taken, then subject was instructed to stand still for few seconds, and a second left lateral view photo was taken with the camera set at low position.

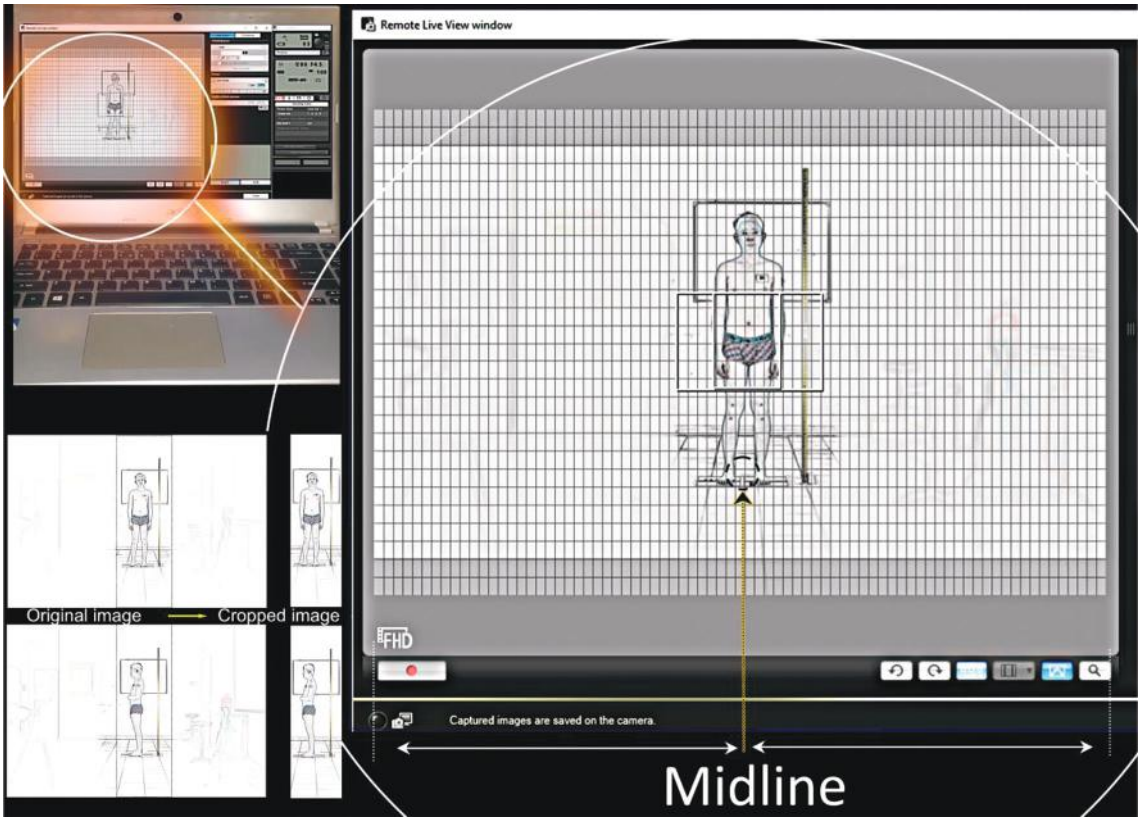


Figure 1 Grid lines and vertical calibration pole used for camera vertical calibration, consistent size of cropping.

Venue Set-up and Equipment

Photo session took place at the briefing hall of the faculty's clinical skill laboratory. One digital SLR full-frame camera, Canon™ D5 Mk II with Canon™prime lens EF 50 mm f/1.8 II, was used as the image capture device. Referring to lens distortion reviews,[13 – 16] the camera and subject were set at 7 metre distance in order to accomodate the image of 1.8 metre tall subject to fit in the area of free image distortion. Next to subject's position to stand, at the left hand side and at the same frontal plane, a 2-metre long vertical calibration pole was positioned securely in place. The camera was connected to Acer™ notebook, and with EOS Utility 2 Version 2.14.20.0 the live view of the image to be taken and the grid lines can be seen through the computer monitor screen. The grid lines with the vertical calibration pole as well as

the hot shoe spirit bubble were used to guide adjusting the camera in horizontal and vertical orientations, so made it in perfect perpendicular to the subject. The camera vertical slider, camera remote shutter release cable, and wireless flash trigger were used to ensure a smooth and stable image capture process. The low position of the camera from the floor was set at 70 cm, while the high position was set at 100 cm. The camera was set to record each image in RAW and JPG modes simultaneously, hence in one time shoot, the image was recorded on large resolution (21 megapixels in RAW mode) and medium resolution (11.1 megapixels in JPG mode). All images were taken at ISO 100, f/4.5, shutter speed 1/80, with the automatic Canon™ lens peripheral illumination correction, and at a fixed focus (auto focusing on first image capture, then switching the lens to MF (manual focusing) mode, and afterward for the rest of photo session no more adjusment was made to the lens focusing ring).

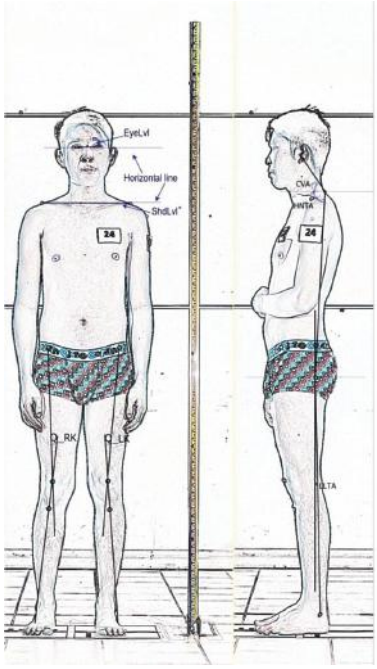
Data Management and Analysis

The principal researcher was responsible for setting up the image capture device, preparing files for digitization by four researcher members and did all the image measurement process and statistical analysis. RAW image files and JPG image files (medium resolution at 11.1 megapixels) were downloaded from camera to the computer, then the RAW files were converted and saved to files (with Digital Photo Professional 4 Version 4.4.30.2 by Canon™) with JPG extension at 21 megapixels (as large resolution) and 5.2 megapixels (as small resolution). Subsequently, with ImageJ 1.51f (Wayne Rasband National institutes of Health, USA) all image files underwent consistent size of cropping to the sides of image, while preserving one third middle working area (see Figure 1, anterior and lateral view). Each rater was responsible for digitization of all 288 cropped image files.

Raters were briefed about digitization process by the main researcher, and thereafter was given 45 minutes time for discussing and familiarizing with imageJ software for digitization. Zoom function was free to use, with encouragement of using the most convenient level for accuracy reason, and raters were given one month time to complete their duty. Every image file was digitized by each rater with consistent sequence, and accordingly the software numbered the point. Measurement process was done by selecting the points to be measured for angle and distance ("centroid" and 3 decimals sensitivity option were selected for ImageJ set measurements). All digitized images were saved in TIFF file and measurement process was carried out after all raters completed their duty. The image of the 2-metre vertical pole at the subject's side was used for calibration during the image measurement process.

Statistical analysis was done using IBM® SPSS® Statistics Vs 21. From the markers on body surface and eye pupils, several postural variables (see Figure 2) were evaluated: eye level, shoulder level, Q angle of the right and left knee, CVA (cranio vertebral angle), HNTA (head on neck trunk angle), LLTA (lower limb on trunk angle). The level of significance was set at $p \leq 0.05$ for all tests, and Shapiro-Wilk test was used to assess normality of the variables. The intraclass correlation coefficient (ICC) two-way mixed model and absolute agreement type were used for interrater test for every kind of image resolution, taken either by camera at high or lower position.

By random selection, the all data derived from digitization done by rater 01 were used to test the effect of image resolution as well camera position on each of the postural measurements. The data were processed with Lavene's test to assess the homogeneity of variances, and Two-Way ANOVA (with R-E-G-W-Q post hoc test for camera resolution, comparing main effects of independent variables and Bonferroni confidence interval adjusment).



Postural Variable:

EyeLvl (Eye level)

ShdLvl (Shoulder level)

Q_RK (Q angle of right knee)

Q_LK (Q angle of left knee)

CVA (Cranio vertebra angle): formed at the intersection of the horizontal line through the spinous process of C7 and a line through the tragus of the ear.

HNTA (Head and neck on trunk angle): formed by a line drawn through the markers at C7 and the tragus of the ear, and the line drawn through the anatomical markers at C7 and the greater trochanter.

LLTA (Lower limb on trunk angle): formed by the line drawn through the anatomical markers placed at the greater trochanter and the ankle (malleolus lateralis), and the vertical line drawn through the greater trochanter.

Figure 2 Postural variable

RESULTS

Data on each of postural variable measurements were assumed as approximately normally distributed, as shown on Shapiro-Wilk test results (p-value > 0.05, Tables 1 and 2 show test results on postural variable measurements derived from images taken by camera at high position and low position respectively). Interrater reliability between 4 raters were excellent across all postural variable measurements as shown on Table 3. Levene's test (see Table 4) shows that error variance of the dependence variable is equal across groups, and Two-Way ANOVA (Table 5), shows no statistical significant effect of image resolution as well as camera height from the floor on the postural variable measurements. There is also no interaction effect of image resolution and camera position on the postural variable measurements.

Table 1 Shapiro-Wilk test results on postural variable – High Camera Position

Variable	Shapiro-Wilk **Sig.	Variable	Shapiro-Wilk **Sig.	Variable	Shapiro-Wilk **Sig.
EyeLvl_Hp_Lr_01	0.436	EyeLvl_Hp_Mr_01	0.187	EyeLvl_Hp_Sr_01	0.490
EyeLvl_Hp_Lr_02	0.262	EyeLvl_Hp_Mr_02	0.763	EyeLvl_Hp_Sr_02	0.198
EyeLvl_Hp_Lr_03	0.735	EyeLvl_Hp_Mr_03	0.473	EyeLvl_Hp_Sr_03	0.370
EyeLvl_Hp_Lr_04	0.656	EyeLvl_Hp_Mr_04	0.797	EyeLvl_Hp_Sr_04	0.201
ShdLvl_Hp_Lr_01	0.481	ShdLvl_Hp_Mr_01	0.390	ShdLvl_Hp_Sr_01	0.508
ShdLvl_Hp_Lr_02	0.420	ShdLvl_Hp_Mr_02	0.479	ShdLvl_Hp_Sr_02	0.402
ShdLvl_Hp_Lr_03	0.471	ShdLvl_Hp_Mr_03	0.407	ShdLvl_Hp_Sr_03	0.590
ShdLvl_Hp_Lr_04	0.549	ShdLvl_Hp_Mr_04	0.558	ShdLvl_Hp_Sr_04	0.418
Q-RK_Hp_Lr_01	0.381	Q-RK _Hp_Mr_01	0.747	Q-RK_Hp_Sr_01	0.660
Q-RK_Hp_Lr_02	0.449	Q-RK _Hp_Mr_02	0.663	Q-RK_Hp_Sr_02	0.671
Q-RK_Hp_Lr_03	0.514	Q-RK _Hp_Mr_03	0.690	Q-RK_Hp_Sr_03	0.787
Q-RK_Hp_Lr_04	0.514	Q-RK _Hp_Mr_04	0.563	Q-RK_Hp_Sr_04	0.703
Q_LK_Hp_Lr_01	0.075	Q_LK _Hp_Mr_01	0.077	Q_LK_Hp_Sr_01	0.194
Q_LK_Hp_Lr_02	0.052	Q_LK _Hp_Mr_02	0.112	Q_LK_Hp_Sr_02	0.165
Q_LK_Hp_Lr_03	0.086	Q_LK _Hp_Mr_03	0.188	Q_LK_Hp_Sr_03	0.189
Q_LK_Hp_Lr_04	0.168	Q_LK _Hp_Mr_04	0.153	Q_LK_Hp_Sr_04	0.198
CVA_Hp_Lr_01	0.700	CVA_Hp_Mr_01	0.498	CVA_Hp_Sr_01	0.252
CVA_Hp_Lr_02	0.692	CVA_Hp_Mr_02	0.513	CVA_Hp_Sr_02	0.634
CVA_Hp_Lr_03	0.708	CVA_Hp_Mr_03	0.459	CVA_Hp_Sr_03	0.519
CVA_Hp_Lr_04	0.486	CVA_Hp_Mr_04	0.698	CVA_Hp_Sr_04	0.594
HNTA_Hp_Lr_01	0.662	HNTA_Hp_Mr_01	0.713	HNTA_Hp_Sr_01	0.554
HNTA_Hp_Lr_02	0.548	HNTA_Hp_Mr_02	0.637	HNTA_Hp_Sr_02	0.764
HNTA_Hp_Lr_03	0.621	HNTA_Hp_Mr_03	0.593	HNTA_Hp_Sr_03	0.693
HNTA_Hp_Lr_04	0.627	HNTA_Hp_Mr_04	0.539	HNTA_Hp_Sr_04	0.754
LLTA_Hp_Lr_01	0.869	LLTA_Hp_Mr_01	0.932	LLTA_Hp_Sr_01	0.943
LLTA_Hp_Lr_02	0.938	LLTA_Hp_Mr_02	0.930	LLTA_Hp_Sr_02	0.908
LLTA_Hp_Lr_03	0.917	LLTA_Hp_Mr_03	0.928	LLTA_Hp_Sr_03	0.950
LLTA_Hp_Lr_04	0.917	LLTA_Hp_Mr_04	0.902	LLTA_Hp_Sr_04	0.948

**** Sig. = Significance = *p*; Statistically significant difference if $p \leq 0.05$**
EyeLvl_Hp*_Lr_01 = Eye level, large resolution by rater 01;
ShdLvl_Hp_Lr_01 = Shoulder level, large resolution by rater 01;
Q_RK_Hp_Lr_01 = Q angle of right knee, large resolution by rater 01;
Q_LK_Hp_Lr_01 = Q angle of left knee, large resolution by rater 01;
CVA_Hp_Lr_01 = Cranio vertebra angle, large resolution by rater 01;
HNTA_Hp_Lr_01 = Head and neck on trunk angle, large resolution by rater 01;
LLTA_Hp_Lr_01 = Lower limb on trunk angle, large resolution by rater 01 ...
02 ~ rater 02; 03 ~ rater 03; 04 ~ rater 04
Mr ~ medium resolution; Sr ~ small resolution; Hp ~ photo taken by camera at High position

Table 2 Shapiro-Wilk test results on postural variable – Low Camera Position

Variable	Shapiro-Wilk **Sig.	Variable	Shapiro-Wilk **Sig.	Variable	Shapiro-Wilk **Sig.
EyeLvl_Lp_Lr_01	0.549	EyeLvl_Lp_Mr_01	0.443	EyeLvl_Lp_Sr_01	0.549
EyeLvl_Lp_Lr_02	0.283	EyeLvl_Lp_Mr_02	0.437	EyeLvl_Lp_Sr_02	0.508
EyeLvl_Lp_Lr_03	0.693	EyeLvl_Lp_Mr_03	0.197	EyeLvl_Lp_Sr_03	0.107
EyeLvl_Lp_Lr_04	0.496	EyeLvl_Lp_Mr_04	0.362	EyeLvl_Lp_Sr_04	0.394
ShdLvl_Lp_Lr_01	0.583	ShdLvl_Lp_Mr_01	0.599	ShdLvl_Lp_Sr_01	0.682
ShdLvl_Lp_Lr_02	0.728	ShdLvl_Lp_Mr_02	0.693	ShdLvl_Lp_Sr_02	0.536
ShdLvl_Lp_Lr_03	0.601	ShdLvl_Lp_Mr_03	0.547	ShdLvl_Lp_Sr_03	0.688
ShdLvl_Lp_Lr_04	0.626	ShdLvl_Lp_Mr_04	0.702	ShdLvl_Lp_Sr_04	0.643
Q-RK_Lp_Lr_01	0.723	Q-RK_Lp_Mr_01	0.641	Q-RK_Lp_Sr_01	0.767
Q-RK_Lp_Lr_02	0.734	Q-RK_Lp_Mr_02	0.895	Q-RK_Lp_Sr_02	0.506
Q-RK_Lp_Lr_03	0.499	Q-RK_Lp_Mr_03	0.628	Q-RK_Lp_Sr_03	0.680
Q-RK_Lp_Lr_04	0.501	Q-RK_Lp_Mr_04	0.536	Q-RK_Lp_Sr_04	0.487
Q_LK_Lp_Lr_01	0.131	Q_LK_Lp_Mr_01	0.476	Q_LK_Lp_Sr_01	0.212
Q_LK_Lp_Lr_02	0.206	Q_LK_Lp_Mr_02	0.307	Q_LK_Lp_Sr_02	0.058
Q_LK_Lp_Lr_03	0.299	Q_LK_Lp_Mr_03	0.244	Q_LK_Lp_Sr_03	0.084
Q_LK_Lp_Lr_04	0.306	Q_LK_Lp_Mr_04	0.051	Q_LK_Lp_Sr_04	0.305
CVA_Lp_Lr_01	0.111	CVA_Lp_Mr_01	0.155	CVA_Lp_Sr_01	0.129
CVA_Lp_Lr_02	0.138	CVA_Lp_Mr_02	0.124	CVA_Lp_Sr_02	0.062
CVA_Lp_Lr_03	0.078	CVA_Lp_Mr_03	0.136	CVA_Lp_Sr_03	0.114
CVA_Lp_Lr_04	0.103	CVA_Lp_Mr_04	0.091	CVA_Lp_Sr_04	0.098
HNTA_Lp_Lr_01	0.514	HNTA_Lp_Mr_01	0.415	HNTA_Lp_Sr_01	0.649
HNTA_Lp_Lr_02	0.741	HNTA_Lp_Mr_02	0.535	HNTA_Lp_Sr_02	0.314
HNTA_Lp_Lr_03	0.701	HNTA_Lp_Mr_03	0.463	HNTA_Lp_Sr_03	0.404
HNTA_Lp_Lr_04	0.706	HNTA_Lp_Mr_04	0.590	HNTA_Lp_Sr_04	0.638
LLTA_Lp_Lr_01	0.832	LLTA_Lp_Mr_01	0.780	LLTA_Lp_Sr_01	0.809
LLTA_Lp_Lr_02	0.871	LLTA_Lp_Mr_02	0.830	LLTA_Lp_Sr_02	0.783
LLTA_Lp_Lr_03	0.838	LLTA_Lp_Mr_03	0.842	LLTA_Lp_Sr_03	0.839
LLTA_Lp_Lr_04	0.858	LLTA_Lp_Mr_04	0.808	LLTA_Lp_Sr_04	0.815

**** Sig. = Significance = *p*; statistically significant difference if $p \leq 0.05$**
EyeLvl Lp**_Lr_01 = Eye level, large resolution by rater 01;
ShdLvl_Lp_Lr_01 = Shoulder level, large resolution by rater 01;
Q_RK_Lp_Lr_01 = Q angle of right knee, large resolution by rater 01;
Q_LK_Lp_Lr_01 = Q angle of left knee, large resolution by rater 01;
CVA_Lp_Lr_01 = Cranio vertebra angle, large resolution by rater 01;
HNTA_Lp_Lr_01 = Head and neck on trunk angle, large resolution by rater 01;
LLTA_Lp_Lr_01 = Lower limb on trunk angle, large resolution by rater 01...
02 ~ rater 02; 03 ~ rater 03; 04 ~ rater 04
Mr ~ medium resolution; Sr ~ small resolution; Lp** ~ photo taken by camera at Low position

Table 3 Interrater reliability findings

Images taken by camera at high position

Variable	ICC (95% CI)	
EyeLvl_Hp_Lr	0.987	(0.976 – 0.994)
ShdLvl_Hp_Lr	0.999	(0.998 – 1.000)
Q_RK_Hp_Lr	0.940	(0.888 – 0.971)
Q_LK_Hp_Lr	0.998	(0.995 – 0.999)
CVA_Hp_Lr	0.999	(0.998 – 1.000)
HNTA _Hp_Lr	0.999	(0.998 – 1.000)
LLTA_Hp_Lr	1.000	(1.000 – 1.000)
EyeLvl_Hp_Mr	0.986	(0.974 – 0.993)
ShdLvl_Hp_Mr	0.999	(0.998 – 0.999)
Q_RK_Hp_Mr	0.997	(0.995 – 0.999)
Q_LK_Hp_Mr	0.996	(0.993 – 0.998)
CVA_Hp_Mr	0.999	(0.998 – 1.000)
HNTA_Hp_Mr	0.999	(0.999 – 1.000)
LLTA_Hp_Mr	1.000	(1.000 – 1.000)
EyeLvl_Hp_Sr	0.986	(0.974 – 0.993)
ShdLvl_Hp_Sr	0.998	(0.997 – 0.999)
Q_RK_Hp_Sr	0.996	(0.992 – 0.998)
Q_LK_Hp_Sr	0.995	(0.990 – 0.997)
CVA_Hp_Sr	0.998	(0.995 – 0.999)
HNTA_Hp_Sr	0.998	(0.996 – 0.999)
LLTA_Hp_Sr	1.000	(0.999 – 1.000)

Images taken by camera at low position

Variable	ICC (95% CI)	
EyeLvl_Lp_Lr	0.990	(0.982 – 0.995)
ShdLvl_Lp_Lr	0.999	(0.999 – 1.000)
Q_RK_Lp_Lr	0.998	(0.997 – 0.999)
Q_LK_Lp_Lr	0.998	(0.997 – 0.999)
CVA_Lp_Lr	0.999	(0.999 – 1.000)
HNTA_Lp_Lr	0.999	(0.999 – 1.000)
LLTA_Lp_Lr	1.000	(1.000 – 1.000)
EyeLvl_Lp_Mr	0.990	(0.980 – 0.995)
ShdLvl_Lp_Mr	0.999	(0.998 – 1.000)
Q_RK_Lp_Mr	0.998	(0.996 – 0.999)
Q_LK_Lp_Mr	0.997	(0.994 – 0.998)
CVA_Lp_Mr	0.999	(0.998 – 1.000)
HNTA_Lp_Mr	0.999	(0.998 – 1.000)
LLTA_Lp_Mr	1.000	(1.000 – 1.000)
EyeLvl_Lp_Sr	0.986	(0.975 – 0.994)
ShdLvl_Lp_Sr	0.998	(0.997 – 0.999)
Q_RK_Lp_Sr	0.997	(0.994 – 0.998)
Q_LK_Lp_Sr	0.995	(0.990 – 0.997)
CVA_Lp_Sr	0.998	(0.997 – 0.999)
HNTA_Lp_Sr	0.998	(0.997 – 0.999)
LLTA_Lp_Sr	1.000	(0.999 – 1.000)

Hp = High camera position
Lp = Low camera position
Lr = Large resolution
Mr = Medium resolution
Sr = Small resolution
ICC = Intraclass correlation coefficients
CI = Confidence interval

Table 4 Levene's test of equality of error variances[a]

Dependent variable	F	df 1	df 2	Sig.
EyeLvl_Rater01	0.282	5	138	0.922
ShdLvl_Rater01	0.061	5	138	0.998
Q_RK_Rater01	0.120	5	138	0.988
Q_LK_Rater01	0.030	5	138	1.000
CVA_Rater01	0.027	5	138	1.000
HNTA_Rater01	0.010	5	138	1.000
LLTA_Rater01	0.051	5	138	0.998

Tests the null hypothesis that the variance of the dependent variable is equal across groups.
a. Design: Intercept + Resolution + Cam_position + Resolution*Cam_position

Table 5 Two-Way ANOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	0.096	2	0.048	0.008	0.992	0.000
Cam_position	1.643	1	1.643	0.261	0.610	0.002
Resolution*Cam_position	0.483	2	0.241	0.038	0.962	0.001

Dependent Variable: ShdLvl_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	0.008	2	0.004	0.001	0.999	0.000
Cam_position	0.174	1	0.174	0.051	0.822	0.000
Resolution*Cam_position	0.022	2	0.011	0.003	0.997	0.000

Dependent Variable: Q_RK_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	3.372	2	1.686	0.059	0.943	0.001
Cam_position	0.344	1	0.344	0.012	0.913	0.000
Resolution*Cam_position	2.594	2	1.297	0.045	0.956	0.001

Dependent Variable: Q_LK_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	0.231	2	0.115	0.006	0.994	0.000
Cam_position	0.349	1	0.349	0.017	0.897	0.000
Resolution*Cam_position	0.102	2	0.051	0.002	0.998	0.000

Dependent Variable: CVA_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	0.417	2	0.208	0.008	0.992	0.000
Cam_position	15.476	1	15.476	0.560	0.455	0.004
Resolution*Cam_position	0.143	2	0.072	0.003	0.997	0.000

Dependent Variable: HNTA_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	0.342	2	0.171	0.005	0.995	0.000
Cam_position	26.548	1	26.548	0.751	0.388	0.005
Resolution*Cam_position	0.168	2	0.084	0.002	0.998	0.000

Dependent Variable: LLTA_Rater01

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Resolution	9.375E-006	2	4.688E-006	0.000	1.000	0.000
Cam_position	0.059	1	0.059	0.018	0.894	0.000
Resolution*Cam_position	0.005	2	0.002	0.001	0.999	0.000

DISCUSSION

The ultimate goals of postural photography technique or known as postural photogrammetry[1, 17] are accurate measurement results which lead to correct interpretation of the postural images. Recording accuracy, by the same token is believed to benefit clinicians and clients. Since currently no gold standard of how the best to conduct postural photogrammetry, then sensible decisions about certain areas have to be taken. Digital SLR camera Canon™ 5D Mk II with Canon™ EF-50 mm f1.8-II lens was chosen as image capture device. The image capture device selection was based on two aspects, namely: practical thinking and serious consideration on photographic expert reviews about the camera and lens. Some aspects such as common resolution of digital camera currently available in the market, availability of the supporting software for this research, versatility for use in research, compatibility with the currently available computer system and affordability have been carefully considered.

The ImageJ 1.51f [18, 19] as a Java-based image processing program was chosen for image measurement due to several reasons: its capability to handle big image size, macros and Java plugins extensibility as well as availability as public domain, and relatively user friendly. Throughout this study, macro programming had been used for batch cropping the whole images, automatic measurement for the digitized points

as well as saving the measured images (with the line drawn between points). With batch cropping, all images underwent same size of cropping, and eventually same size of digital images were provided for digitizing and measuring. With automatic measurement, the possibility of human error had been minimized and the automatic post processing saved-measured images allowing cross-checking when necessary.

Interrater reliability, irrespective of the image resolution for all postural variables were excellent. These findings were expected and similar to the results of study done by Codarin et al.[20] which had studied the influence of image resolution of 3, 5, and 10 megapixels. Prior to that, Mota et al.[6] had reported that set of measurements for postural assessment did not suffer global effects of the image resolution (3.2 megapixels vs 12.1 megapixels). However, this study had evaluated multiple angles which distributed across the whole body of standing adults, in contrast to the study on inanimate object done by Codarin and Mota. In addition, all of the 24 male subjects were randomly selected. Excellent interrater reliability findings of all postural variables using this method would provide more confidence to its use. Nonetheless, some other researchers had reported various results across the postural variables.[7, 10 – 12] Without clear cut explanation on those variability findings, the use of postural photogrammetry even might be confronted with more fundamental questions such as why the phenomenon occurs, how accountable it is for clinical use and research, is there any justifiable anticipation need to be done, and perhaps much more. It is absolutely necessary for researchers and users to overcome the many possible sources of error in order to have an acceptable validity and reliability of this method. In fact, postural photogrammetry technique has been used due to practical reasons, cost effective, and its high value for mass and field setting study, health promotion and rehabilitation. It has been used for recording the impact of school bags on the spine of developing children, measuring spine curvature for scoliosis follow-up, and evaluating impact of temporo-mandibular joint problems to head positioning.[2,17, 21 – 26]

This study found not only excellent ICC across all postural variable measurements but also a much stronger, and a more homogenous results compared to findings from other studies. From images taken with high camera position, the lowest ICC was found for Q angle measurements of the right knee: 0.940 (95% CI: 0.888 – 0.971), while from images taken with low camera position, the lowest ICC was found for eye level measurements: 0.986 (95% CI: 0.975 – 0.994). Ruivo,[7] Sacco,[8] Ferreira,[10] Niekerk,[11] Nguyen[12] reported ICC ranging from 0.88 – 0.96, 0.85 – 0.92, 0.21 – 0.97, 0.78 – 0.99, and 0.64 – 0.99 respectively. The recommendations on the above facts were due to the implementation of stringent protocols and appropriate photography and computer technology in this study had prevented some significant potential errors to emerge.

The use of the full-frame digital SLR camera Canon 5D Mk II was particularly based on its potential to produce the best possible image,[27 – 31] while the fixed focal lens was selected due to its fixed capture field. It was believed that variability in capture field as could occur with the use of zoom lens would impair the accuracy of image measurement. One camera and one single lens for the whole image data collection could reduce variability related to the equipment. The lens used in this study though cheap in price, yet having good reputation as a sharp lens.[13, 32 – 34] As an ideal thought, the image capture device (camera body and lens) must be able to produce distortion free, clear and detailed image from head to toe, and having consistent good quality of image from one capture to another. In order to minimize error due to variability on equipment set-up, all images had been captured in a single set-up, and with a “fixed focus” lens. Subsequently, errors could arise from the later phase when computer system taking its role. As the system consisting of hardware, software and brainware[35] then every item should be well managed and identified as source of error. All possible errors on this domain had been mitigated by using one dedicated notebook computer (Acer V5-431-987B4G50Mass, RAM 8 GB with Windows 10

64 bit OS), one Dell USB 3-button optical mouse MS 111 with 1000 dpi resolution, and Dell(R) E 2014H as second computer monitor screen (at 1600 × 900 resolution). Since digitization was done manually, it reasonably could be affected by the image quality, clarity and contrast of computer monitor, reliability of the computer input peripheral, operator or the rater and the image measurement software. For eye comfort, meeting accuracy expectation and uniformity reasons, the second monitor screen had been mandatory to be used during the digitization process. The image files for digitization had been handled very carefully as explained above under section "Data Management and Analysis". The stable and reliable computer hardware, with all reasonably selected peripherals were essential to the excellent interrater agreement. For the brainware, all raters although new to imageJ software, were senior persons in their respective field and had been active computer user for routine daily job for more than 20 years. It is assumed that the brainware component had contributed greatly to the agreement between raters due to the fact that cursor movement within a 1 cm distance (diameter of the body marker) on the image contributed greatly to the translation of the digital (X, Y) coordinate. Similar to this, Ferreira[17] suggested that computer experience and exposure rate to computer science as well as the age of raters were contributed to the level of agreement.

Standing Romberg test (1 minute) as eligibility criteria for this study was to ensure that the subject would be able to stand still during the duration of the image capture session. Since it was required a 6-second waiting time from first to second capture for the same subject (for flash unit recycling time), then subject's inability to stand still would be an important source of error in identifying the influence of camera position on the measurement results. Repeated image capture as a source of error when assessing the influence of image resolution on measurement was eliminated since only a single capture was done for having 3 kinds of image resolution. Digital Photo Professional 4 Version 4.4.30.2, the genuine photo application made by Canon™, was used to process and convert the image file to the required resolution as if produced by the camera itself. With this photo application software, taking repeated photos at different resolutions were not necessary.

The larger the image resolution, the bigger the zooming level possible during the digitization process. The assumption that bigger zooming level would increase interrater reliability was not proven in this study, since Two-Way ANOVA shows that image measurements were not statistically affected by the resolution. Perhaps the limit of accuracy had been reached with the smallest image resolution used in this study, therefore a larger resolution no longer provide chance for improvements. Camera height placement was also not proven to be a variable to affect the image measurements. This finding occurred due to two possible conditions: firstly, subjects were significantly able to maintain their still position during the 6 seconds time, secondly, the image capture device had produced accurate and consistent images either at high or low camera positions. It was also found that resolution and camera position as independent variables having no interaction one to another.

The longer the camera distance from the subject, the more resolution needed in order to record the good quality of target image.[36 – 38] Since the camera was put at a longer distance (7 metre) compared to the studies done by Codarin[19] and Mota[6], then the posture image was examined at resolution of 5.2, 11.1, and 21 megapixels; a much bigger resolution compared to any of the researchers ever done before. In this study, 5.2 megapixels (as the smallest recordable resolution by Canon™ 5D Mk II) seemed appropriate for standing postural photogrammetry. The lens distortion area was the main limiting factor for camera placement, either on vertical (high and low) or horizontal (distance) dimension.

The most crucial part of postural photogrammetry was the marker placement, which neither the target to test nor to evaluate for its validity by this study. However some research had reported the validity of marker placement by palpation bony surface with reference to the bone position on radiograph. Niekerk et al.[11] reported the Pearson correlation *r* values ranging from 0.67 to 0.95. Furlanetto et al.[21] found no significant differences between the points ($X^2 = 9.366$, $p = 0.404$). In any case, it was assumed that marker placement is an expert dependent matter.

Limitation

The small number of sample as well as the male-only subject in this study may be part of the limitations, in which the statistical results cannot with fully confident generalized to adult population, however this study has showed that sensible decision about the method of the image acquisition, equipment selection and computer software could improve the quality of postural variable measurement.

The findings might be inherent with the equipment and software used in this research. The excellent ICC findings across all postural variable measurements were not a direct justification for clinical use, since questions can still arise from either body marker placement, or image measurement software accuracy. Further validation study on those issues is needed.

CONCLUSION

This study has recorded postural image of 24 standing male adults with a very strict protocol, utilizing state of the art of imaging and computer technology, and rigorously examined the total of 288 postural images. Excellent interrater reliability across all postural variables of standing adults opens up opportunities for a new standard on how to apply postural photogrammetry and concurrently amplify its potential for standing postural evaluation in clinical settings. Neither resolution nor vertical position of camera from the floor affect the postural measurements. This study would contribute to the betterment of standing postural photogrammetry.

REFERENCES

1. Postural Assessment by Photogrammetry. ClinicalTrials.gov. A service of the U.S. National Institutes of Health. https://clinicaltrials.gov/ct2/show/study/NCT00848159
2. McEvoy MP, Grimmer K. (2005). Reliability of upright posture measurements in primary school children. BMC Musculoskeletal Disorders 6: 35. doi: 10.1186/1471-2474-6-35.
3. Penha PJ, Amado João SM, Casarotto RA, Amino CJ, Penteado DC. (2005). Postural assessment of girls between 7 and 10 years of age. Clinics 60 (1): 9 – 16.
4. Ramprasad M, Alias J, Raghuveer AK. (2010). Effect of backpack weight on postural angles in preadolescent children. Indian Pediatrics 47 (575, July 17).
5. Hough R, Nel R. (2013). Intra-rater reliability of the posture analysis tool kit. South African Journal of Occupational Therapy 43 (1, April).
6. Mota YL, Mochizuki L, Carvalho GA. (2011). Influence of the camera resolution and distance in the measures made by the Postural Assessment Software (Sapo). Rev Bras Med Esporte 17 (5–Set/Out).
7. Ruivo RM, Correia PP, Carita AI. (2015). Intrarater and interrater reliability of photographic measurement of upper-body standing posture of adolescents. Journal of Manipulative and Physiological Therapeutic 38 (1, Jan): 74 – 80.
8. Sacco ICN, Picon AP, Ribeiro AP, Sartor CD, Camargo-Junior F, Macedo DO, Mori ETT, Monte F, Yamate GY, Neves JG, Kondo VE, Alberti S. (2012). Effect of image resolution manipulation in rearfoot angle measurements obtained with photogrammetry. Brazilian Journal of Medical and Biological Research 45: 806 – 810.
9. Bustillo K, Low E. (2008). Measurement error between a Goniometer and the NIH ImageJ Program for measuring quadriceps angle. The Internet Journal of Allied Health Sciences and Practice 6 (2, April).
10. Ferreira EAG, Duarte M, Maldonado EO, Burke TN, Marques AP. (2010). Postural assessment software (PAS/SAPO): Validation and reliability. Clinics 65 (7): 675 – 681.

11. Niekerk SM, Louw Q, Vaughan C, Grimmer-Somers K, Schreve K. (2008). Photographic measurement of upper-body sitting posture of high school students: A reliability and validity study. BMC Musculoskelet Disord 20: 9 – 13.
12. Nguyen AD, Boling MC, Slye CA, Hartley EM, Parisi GL. (2013). Various methods for assessing static lower extremity alignment: Implications for prospective risk-factor screenings. Journal of Athletic Training 48 (2): 248 – 257.
13. http://www.the-digital-picture.com/Reviews/Lens-Distortion.aspx?FLI=0&FLIComp=0&Lens=105&Camera=453&LensComp=967
14. https://www.dpreview.com/reviews/canon-50-1p8-ii-c16/4
15. http://www.kenrockwell.com/canon/lenses/50mm-f18.htm.
16. http://lenstests.com/reviews/canon-ef-50mm-f1.8-ii-page-2
17. Romao PLS, Rodrigues AR, Costa VM, Nascimento NF, Pimentel MH, Manrique GA. (2015). Photogrammetric analysis of posture and associated risk factors in school-aged children and adolescents. Revista de Enfermagem Referência Journal of Nursing Referência, Série IV - n.° 7 - Oct./Nov./Dec.: 31 – 40.
18. https://imagej.nih.gov/ij/features.html
19. https://imagej.nih.gov/ij/docs/guide/user-guide.pdf
20. Codarin GF, Felicio LR, Coelho DM, Olivera AS. (2012). Analysis of angular reading distortions of photographic images. Rev Bras Fisioter, São Carlos 16 (4, July/Aug), 309 – 313.
21. Furlanetto TS, Candottib CT, Comerlatoc T, Loss JF. (2012). Validating a postural evaluation method developed using a Digital Image-based Postural Assessment (DIPA) software. Computer Methods and Program in Biomedicine 108: 203 – 212.
22. Paušić J, Pedišić Ž, Dizdar D. (2010). Reliability of a photographic method for assessing standing posture of elementary school students. Journal of Manipulative and Physiological Therapeutics July/August: 425 – 431.
23. Chansirinukor W, Wilson D, Grimmer K, Dansie B. (2001). Effects of backpacks on students: Measurement of cervical and shoulder posture. Australian Journal of Physiotherapy 47: 110 – 116.
24. Shivananda, Sasidhar, Yakub S, Babu M. (2013). Analysis of cervical and shoulder posture in school children using back pack experimental study. International Journal of Physiotherapy and Research 2: 36 – 41.
25. Cota Aroeira RM, Leal JS, Eustáquio de MeloPertence A. (2009). Computerized photogrammetry protocol on the angular quantification of scoliosis. Proceedings of COBEM 2009, 20th International Congress of Mechanical Engineering. November 15 – 20.
26. Iunes DH, Carvalho LCF, Oliveira AS, Bevilaqua-Grossi D. (2009). Craniocervical posture analysis in patients with temporomandibular disorder. Rev Bras Fisioter 13 (1): 89 – 95.
27. http://www.mdavid.com.au/photography/apscversusfullframe.shtml
28. http://www.kenrockwell.com/tech/full-frame-advantage.htm
29. http://www.techradar.com/how-to/photography-video-capture/cameras/full-frame-dslr-do-you-really-need-one-1320838
30. http://www.premiumbeat.com/blog/full-frame-vs-cropped-sensors-how-much-does-it-really-matter/
31. http://www.picture-thoughts.com/photography/camera-basics/camera-classification.html
32. http://www.the-digital-picture.com/Reviews/Canon-EF-50mm-f-1.8-II-Lens-Review.aspx
33. http://digital-photography-school.com/why-a-50mm-lens-is-your-new-best-friend/
34. http://photography.tutsplus.com/articles/introducing-the-wonderful-world-of-50mm-prime-lenses--photo-1422
35. http://www.kalope.com/pengertian-komputer-konsep-tri-tunggal-hardware-software-dan-brainware/
36. http://reedhoffmann.com/advantages-of-high-resolution/
37. https://photographylife.com/advantages-and-disadvantages-of-low-vs-high-resolution-cameras
38. https://photographylife.com/the-benefits-of-a-high-resolution-sensor.

Original Article

Factors Affecting the Prescribing Pattern of Non-steroidal Anti-Inflammatory Drugs at Outpatient Departments in Government and Private Polyclinics in Kota Kinabalu, Sabah

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ABSTRACT

The main objective of this study was to obtain information regarding the effects of educational and socio-economic status of the patients on the prescribing pattern of non-steroidal anti-inflammatory drugs (NSAIDs) by the qualified medical personnel in the outpatient departments (OPDs) of two selected polyclinics in Kota Kinabalu, Sabah, Malaysia. A total of 200 selected patients (100 from each polyclinic) attending the OPDs were interviewed using a questionnaire. Again data were collected, photocopied and later analyzed. Educated and higher income group of patients mostly attended in a Private Polyclinic (PPC) whereas less educated and lower income group of patients generally attended UMS Polyclinic (UPC). This was reported as a probable reason for the wide variations in the prescribing pattern with respect to pharmacological sub-classes of NSAIDs in the OPDs of two polyclinics. The present results strongly support that probable reason. The number of patients taking NSAIDs before coming to hospital was more in PPC compared to UPC. They were influenced by pharmacists, friends and doctor's advice given previously. In conclusion, it may be mentioned that overall prescribing pattern of NSAIDs among two polyclinics is rational.

Keywords: NSAIDs, prescribing pattern, socio-economic status

INTRODUCTION

Patients have been using drugs for a long time to cure or control diseases and symptoms. Drugs can either do good or harm to the users. 'The desire to take medicines is perhaps the greatest feature that distinguishes humans from animals'.[1] Indiscriminate use of drugs also can endanger patients' lives. Drug therapy therefore requires knowledge, judgment, skill and wisdom, but above all a sense of responsibility.[1]

Irrational prescribing has further complicated the drug use problem. Numerous studies done at developed and developing countries, describe it as a pattern consisting of polypharmacy, use of drugs that are not related to the diagnosis, irrational use of antibiotics and self-medication, with many drugs taken in insufficient quantities.[2] Rational prescribing is therefore one important aspect of rational use of drugs.

One of the most widely used and abused drugs all over the world are painkillers. Fever and pain are usually the early symptoms of most of the inflammatory diseases. From the very beginning of human civilization, man has been trying to find the way of controlling these symptoms and maintaining good health. The introduction of non-steroidal anti-inflammatory drugs (NSAIDs) was a landmark event and soon these drugs became the most widely-used medication not only for the relief of pain and fever but also for their anti-inflammatory effect.[3]

Like most drugs, they are double-edged swords. So, sporadic consumption of NSAIDs may subside the symptoms for time being but the actual pathology may sometimes not only be hindered but also be aggravated, complicated and even turn to fatality in some cases.[4, 5]

It was shown that analgesics with no or minimal anti-inflammatory effects became the most commonly prescribed NSAIDs in the OPD of UPC. On the contrary, analgesics with potent anti-inflammatory effects became the most commonly prescribed NSAIDs in PPC.[6]

The main aim of this study was to obtain information and clarify the effect of educational and socio-economic status of the patients on the prescribing pattern with respect to pharmacological subclasses of NSAIDs by the medical prescribers in the OPDs of some selected polyclinics in Kota Kinabalu, Sabah.

METHODOLOGY

Materials and Methods

This is a prospective cross-sectional (descriptive) study. The study was carried out in outpatient departments of two selected polyclinics in Kota Kinabalu, Sabah, namely: UMS Polyclinic (UPC) and a private polyclinic (PPC). Duration of study period was one year (August 2015 to July 2016).

Study Design

A total of 200 patients (100 from each polyclinic) attending OPDs were selected for an in-depth interview. After obtaining their consent, they were interviewed using a questionnaire containing educational and socio-economic condition of the patient. The patients having prescriptions that did not contain NSAIDs were excluded. The information were obtained and analyzed in order to find out their educational and socio-economic status (occupation as socio-economic status) and whether any NSAIDs was taken for the illness before coming to polyclinic and if yes, under whose advice.

Sample Size and Data Analysis

Sample size was determined as per guideline of WHO/DAP.[7] Sample size for patients was 100 from OPD of each polyclinic in this study. They were interviewed using a questionnaire. Data were analyzed by using percentage. As it was a descriptive study statistical analysis was not done.

RESULTS

Educational Status

The educational status of study population attending in UPC was below SPM level (60%) followed by SPM (17%), STPM (14%), graduate (9%) and postgraduate (0%). On the other hand, the educational status of patients in PPC was graduate level (40%) followed by STPM (22%), SPM (20%), postgraduate (12%) and below SPM level (6%) (see Figure 1).

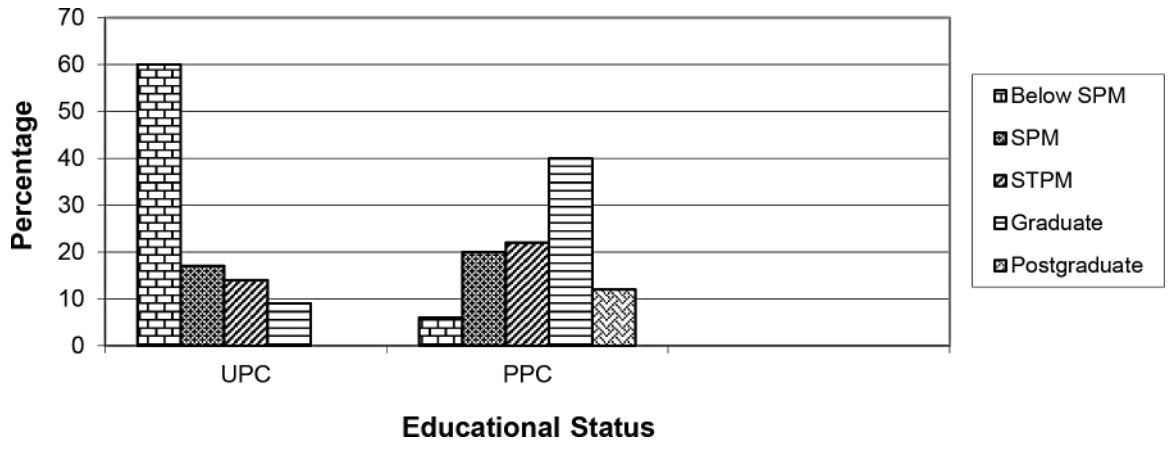

Figure 1 Educational status of the patients attending UPC and PPC

Socio-economic Status

The socio-economic status (occupation as socio-economic status) of patients included in the study in UPC was labourer (40%), followed by unemployed (22%), service (16%), housewife (9%), business (8%) and others (5%). The predominant occupation of patients in PPC was service (64%) followed by labourer (8%), housewife (2%), unemployed (0%), business (23%) and others (3%) (see Figure 2).

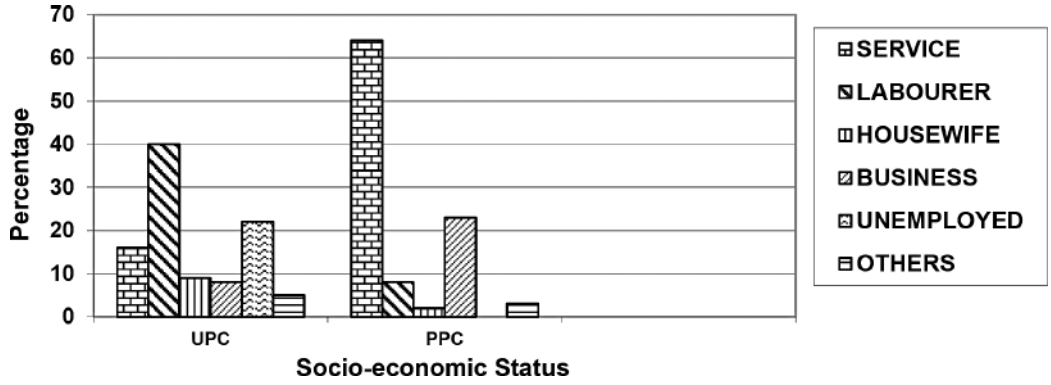

Figure 2 Socio-economic status of the patients attending UPC and PPC

Number of Patients

The number of patients taking NSAIDs before coming to OPD were 20% in UPC and 50% in PPC.

Source of Advice

The source of advice for taking NSAIDs before coming to UPC was pharmacist (60%) followed by friends or relative (14%), previously advised by the doctor to purchase the NSAIDs for the same complaint (20%) and others (6%). On the other hand, the source of advice for patients in PPC was doctor's advice given previously (70%) followed by friends or relative (19%), pharmacist (6%) and others (5%) (see Figure 3).

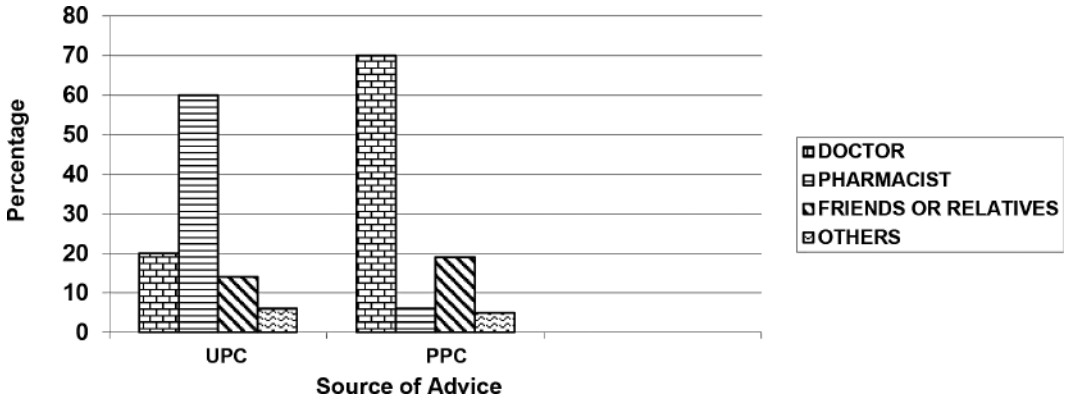

Figure 3 Source of advice given to patients taking NSAIDs before coming to OPDs

DISCUSSION

The main objective of this study was to elucidate the effect of educational and socio-economic status of the patients on the prescribing pattern of NSAIDs by the qualified medical personnels in the outpatient departments of two selected polyclinics in Kota Kinabalu, Sabah.

It was observed that educated and higher income group of patients mostly attended OPDs in PPC whereas less educated and lower income group of patients generally attended UPC. This was probably responsible for the substantial variations in the prescribing pattern with respect to pharmacological sub-classes of NSAIDs in the medical OPDs of two polyclinics. Analgesics with no or minimal anti-inflammatory effects were the most commonly prescribed NSAIDs in the medical OPDs of UPC, whereas analgesics with potent anti-inflammatory effects were the most commonly prescribed NSAIDs in the same OPD of PPC.[6] Possibly, the reason behind it was that educated with higher income group of patients were familiar with the name of analgesics having no or minimal anti-inflammatory effects like paracetamol, ibuprofen, etc. So, the medical prescribers of PPC might have prescribed costly analgesics with potent anti-inflammatory effects to satisfy those patients and cure the patients more quickly. On the other hand, comparatively less educated and less income group of patients those who generally attended in the medical OPDs of UPC received prescriptions containing analgesics with no or minimal anti-inflammatory effects as they were very cheap and mostly available in this polyclinic. The present results strongly suggest that educational and socio-economic status of the patient may have some effects on the prescribing pattern particularly with respect to pharmacological sub-classes of NSAIDs in the medical OPDs of two polyclinics. Analgesics with no or minimal anti-inflammatory effects have lower incidence of adverse effects particularly in the gastrointestinal tract, especially with paracetamol and ibuprofen at low dose.[8, 9]

Moreover, the prescribers in the medical OPD of PPC had to prescribe additional drugs than those of the prescribers of UPC to counter the adverse effects of NSAIDs. Consequently, the cost of prescribed NSAIDs per prescription and ultimately the cost of total drugs per prescription became more expensive in the medical OPD of PPC compared to UPC although the clinical indications for prescribing NSAIDs were almost identical in those polyclinics.[6] In South Africa, investigators observed that analgesic agents represented 12.3% of total number and 14.2% of total cost of products prescribed.[10]

The number of patients taking NSAIDs before coming to hospital were more in PPC compared to UPC. They were influenced by pharmacists, friends or relatives and doctor's advice given previously on the basis of their educational and socio-economic status.

In conclusion, it may be said that the overall prescribing pattern of NSAIDs among two polyclinics is rational. However, appropriate educational intervention can be designed for rational prescribing to improve the quality of healthcare.

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REFERENCES

1. Bennett PN, Brown MJ. (2008). Topics in drug therapy. In: Clinical Pharmacology (10th Edition). New York: Churchill Livingstone p. 5 – 31.
2. Hogerzeil HV. (1988). Promoting rational prescribing: An international perspective. In: Chowdhury RR. International Experience in Rational Use of Drugs. The College of Public Health, Chulalongkoron University, Bangkok, Thailand. p. 1 – 2.
3. Fernandez UR, Pedregal GM, Torrecila RMT. (2008). Development of NSAIDs prescription indicators based on health outcomes. Eur J Clin Pharmacol 64 (1): 61 – 70.
4. Chan FK, Graham DY. (2004). Prevention of non-steroidal anti-inflammatory drug gastrointestinal complications-review and recommendations based on risk assessment. Aliment Pharmacol Ther 19 (10): 1051 – 1061.

5. Targownik LE, Thomson PA. (2006). Gastroprotective strategies among NSAID users: Guidelines for appropriate use in chronic illness. Can Fam Physician 52 (9): 1100 – 1005.
6. Md. Shamsur Rahman, David Matanjun, Mohammad Tauffik Mohd Noor, Fairrul Kadir, Nur Asikin. (2014). Prescribing pattern of non-steroidal anti-inflammatory drugs at outpatient departments in government and private polyclinics in Sabah state. Borneo Journal of Medical Sciences (BJMS) 8: 21 – 26.
7. WHO/DAP. (1993). How to investigate drug use in health facilities. p. 25 – 31
8. Bennett PN, Brown MJ. (2004). Inflammation, arthritis and nonsteroidal anti-inflammatory drugs. In: Clinical Pharmacology 9th Edition. New York: Churchill Livingstone. p. 279 – 298.
9. Bhartiy SS, Shinde M, Nandeshwar S, Tiwari SC. (2008). Pattern of prescribing practices in the Madhya Pradesh India. Kathmandu Univ Med J (KUMJ) 6 (1): 55 – 59.
10. Truter I. (1997). Patterns of analgesic prescribing in a South African primary care setting. J.Clin Pharm Ther 22: 33 – 37.

Original Article

The Pyramid Counteracts Chronic Prenatal Restraint-stress Effects on the Milestones, Anthropometry, and Body, Brain and Adrenal Gland Weights of Pups in Rats

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ABSTRACT

Prenatal exposure to chronic stress during critical periods of foetal development produces depression, attention and learning deficits, hormonal imbalances and affects the brain. The effect of prenatal restraint-stress on the postnatal developmental milestones, anthropometric measurements, and the body, brain and adrenal gland weights of the pups were examined and compared with the unrestrained control and the restrained group under the pyramid at postnatal day 10 and 21. Pregnant rats were restrained (9h/day) from gestation day 7 until parturition. Results showed significant delay in the milestones by one day in the restraint control (RC) compared to the unrestrained normal control (NC), while pups of the restrained pyramid (RP) group did not show the delay. Significant decreases in the anthropometric measurements, body and brain weights in RC group were observed at both postnatal days, while the RP group results matched with the NC group. Significant increase in the adrenal weights was found in the RC group compared to NC group and not the RP group. Results suggest prenatal restraint-stress definitely hampers the developmental milestones, anthropometric measurements, and body and brain weights of the young offspring. Results suggest, pyramid environment counteracts and protects the deleterious effects of chronic prenatal stress.

Keywords: anthropometry, milestones, prenatal stress, pyramid

INTRODUCTION

Any disruption of the maternal environment during gestation leads to behavioural changes in the offspring. Studies have shown that stress during gestation can induce early and long-lasting effects on neurobehavioural development of the pups. Zaneta et al. reported high maternal cortisol levels to impact the foetal growth particularly in the male offspring.[1] Earlier reports[2 – 11] show effects of prenatal stress on cognitive, behavioural and psychosocial aspects to be mostly mediated by the effects of maternal stress on the structure and function of the foetal brain. Earlier research[10, 11] has shown the significant effect of prenatal stress on the CA3 hippocampal pyramidal neurons as well as the beneficial effects of the pyramid environment. However, there is very little information on the effect of gestational stress on the overall postnatal developmental milestones, anthropometric measurements, and body and brain weights in the rats.[12] This research focused on the effect of prenatal stress outside and under a wooden pyramid on the postnatal development of the offspring at postnatal day 10 and 21.

MATERIALS AND METHODS

Sprague Dawley rats weighing 180 – 250 g were used in the study. Pregnant rats were housed in polypropylene cages (25 × 47.5 × 20 cm) individually. The environmental conditions were controlled at 23 ± 2°C, 50 ± 5% RH on a 12:12 h light/dark cycle. They were allowed to food and water *ad libitum*. All procedures were performed in accordance with the guidelines of National Institute of Health Guide for Care and Use of Laboratory Animals,[13] and the study was approved by the Animal Experiments Ethics Committee of the Institution. All efforts were made to minimize the suffering and number of animals. Food pellets were purchased from Cargill Farm Animal Food Product which consisted of 16% protein, 2.5% crude fat, 18% crude fibre, 13% moisture, 0.75% calcium and 0.45% phosphorus.

Prenatal Stress (PS)

The pregnant rats were randomly divided into normal control (NC), restrained (stressed) control (RC) and restrained (stressed) under the pyramid (RP) groups. The RC and the RP groups were exposed to restraint stress in a wire-mesh restrainer (L = 15 cm; W = 7 cm; H = 7 cm) for nine hours per day from gestation day 7 until parturition.[10 – 11] The NC group of pregnant rats was left unstressed in their home cages. Pups (n = 10/group) born to these respective mothers were the subjects of the study. At birth pups were housed with their respective mothers until postnatal day 10 and 21. However, they were observed every day for the development of the milestones. The animals of all the groups were weighed on postnatal days (PND) 10 and 21, euthanized and the brain and adrenal glands were dissected out and weighed (Figure 1).

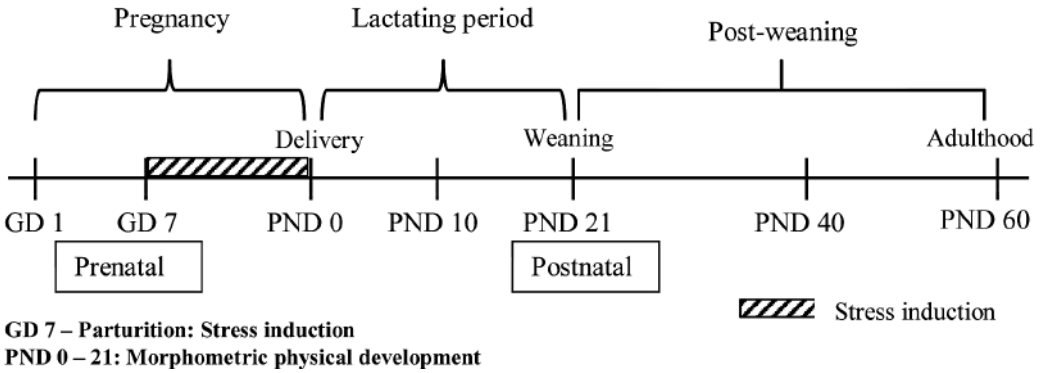


Figure 1 Periods of prenatal and postnatal development in the rat

Pyramid Model

This consisted of a wooden pyramid-shaped model, locally fabricated having the dimensions of height 30", base 45" and the sides 41.5". Holes were drilled on all sides for ventilation and a glass window on one side for observation. The four sides had an angle of 51° to the base and met at the apex of the pyramid as reported earlier.[8, 10 – 11, 14 – 15]

Pyramid Housing

The pyramid was aligned to face the four cardinal north, south, east and west directions. It was placed to face in the true magnetic north-south axis to provide the maximum beneficial effects as earlier reported.[8, 10 – 11, 15] Pregnant rats were restrained in the wire-mesh restrainers and placed on an elevation at one-third the height (10 inches) from the base of the pyramid to attain the maximum effect of the pyramid environment.[8, 14]

Statistical Analysis

Data obtained were analysed using one-way ANOVA and Bonferroni test with SPSS version 17 software. $p < 0.005$ was considered significant. Results are expressed as the mean ± SE.

RESULTS

The results are expressed as mean ± SEM. There was a delay in the developmental milestones in the restrained control group compared to the unrestrained group; while the group restrained under the pyramid did not show the delay. The body weights and brain weights of pups prenatally exposed to restraint significantly decreased compared to the unrestrained controls at postnatal day 10 and 21 respectively. However, no such change was observed in the pups born to mothers restrained under the pyramid but the results compared well with the unrestrained control group at both the postnatal days. Adrenal glands on the other hand showed a significant

increase in weight in the restrained group of pups while the weights of the adrenals of the pups restrained under the pyramid were closer to the unrestrained control group.

Developmental Milestones

The appearance of fur, opening of the eye and ear as well as detachment of the pinna were observed and compared. There was a delay by one day in all the four milestones observed in the restrained group compared to the unrestrained control group which was significant ($p < 0.003$), while there was no difference in the pyramid restrained group but compared well with the unrestrained control group (Table 1).

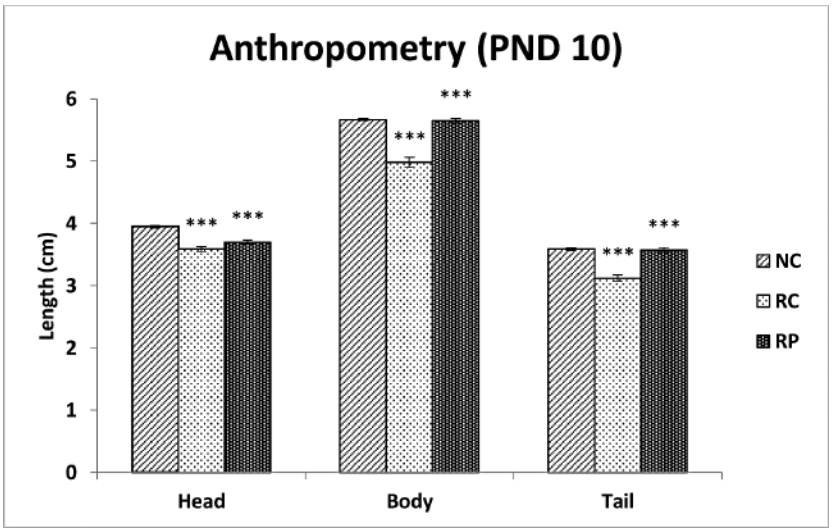
Table 1 Effect of chronic restraint-stress on the day of appearance of developmental milestones (in days)

Milestone (day)	NC ($n = 10$)	RC ($n = 10$)	RP ($n = 10$)	ANOVA	
				F	*p*
Appearance of fur	5.10 ± 0.18	6.00 ± 0.21	5.00 ± 0.21	**7.51**	**0.003*** **
Detachment of pinna	5.30 ± 0.21	6.20 ± 0.20	5.10 ± 0.18	**8.75**	**0.001*** **
Opening of the ear	15.20 ± 0.20	16.20 ± 0.20	15.10 ± 0.23	**8.26**	**0.002*** **
Opening of the eyes	16.00 ± 0.21	17.00 ± 0.21	15.90 ± 0.18	**0.17**	**0.001*** **

Notes:
Values are mean ± SE from 10 rats/group
***ANOVA $p < 0.003$]

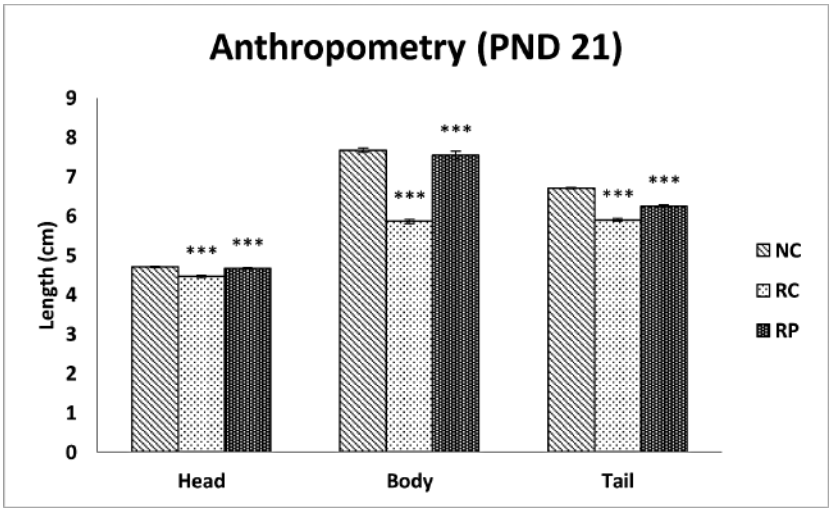
Anthropometry

Anthropometric measurements of the lengths of the head, body and tail were also compared at postnatal day 10 and 21 among the groups. Once again there were significant ($p < 0.003$) decreases in the head, body and tail lengths in the RC groups compared to the unrestrained NC group, while the results of the group restrained under the pyramid (RP) compared well with the unrestrained NC controls but was significantly increased compared to the RC group (Figures 2 and 3).



[NC = Normal unrestrained control; RC = Restrained control outside; RP = Restrained under the pyramid. Values are mean ± SE from 10 rats/group; ***ANOVA, $p < 0.001$]

Figure 2 Effect of chronic restraint-stress on anthropometric measurements at postnatal day (PND) 10

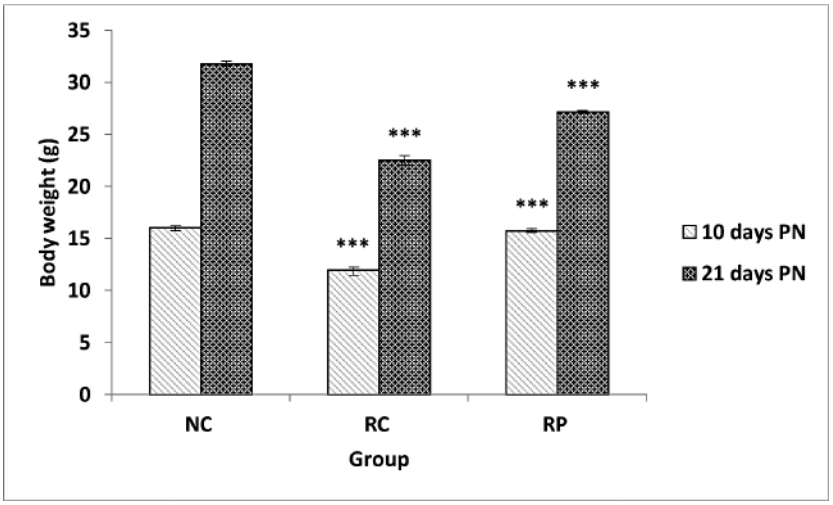


[NC = Normal unrestrained control; RC = Restrained control outside; RP = Restrained under the pyramid. Values are mean ± SE from 10 rats/group; ***ANOVA, $p < 0.001$]

Figure 3 Effect of chronic restraint-stress on anthropometric measurements at postnatal day (PND) 21

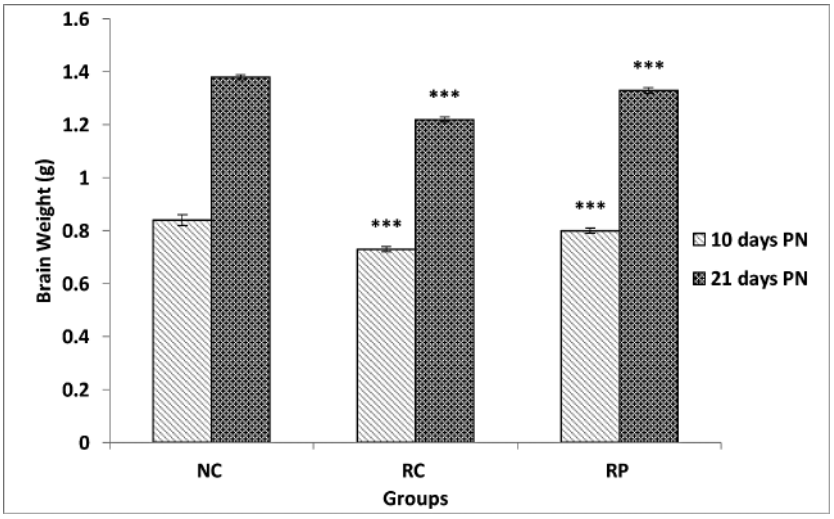
Body and Brain Weights

The RC group of animals showed a significant reduction in their body weights at PND 10 (11.94 ± 0.29; $p < 0.001$) and PND 21 (22.47 ± 0.47) compared to NC group (16.01 ± 0.22 and 31.77 ± 0.26; $p < 0.001$) respectively. On the other hand the RP group of animals' body weights were significantly higher compared to the RC group (15.72 ± 0.23 and 27.16 ± 0.13) but similar to those of the unrestrained NC group at both PND 10 and 21 respectively (Figures 4 and 5).



[NC = Normal unrestrained control; RC = Restrained control outside; RP = Restrained under the pyramid. Values are mean ± SE from 10 rats/group; ***ANOVA, $p < 0.001$]

Figure 4 Effect of chronic restraint-stress on the body weight on postnatal day (PND) 10

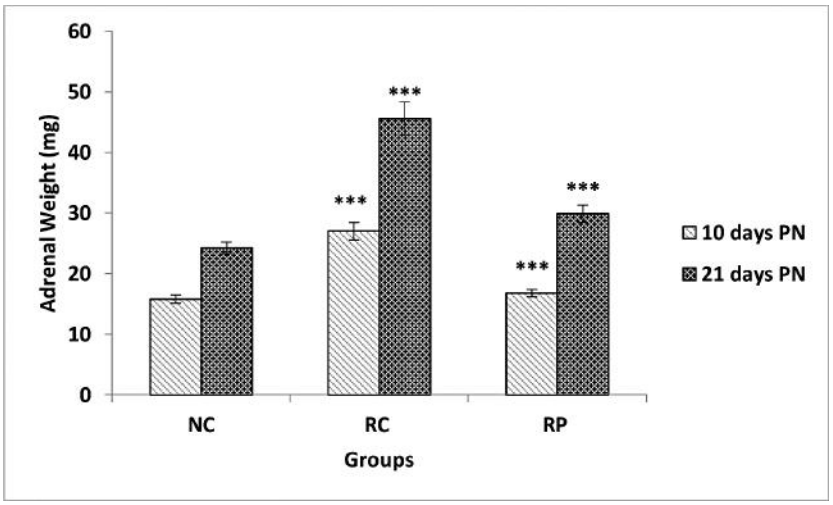


[NC = Normal unrestrained control; RC = Restrained control outside; RP = Restrained under the pyramid. Values are mean ± SE from 10 rats/group; ***ANOVA, $p < 0.001$]

Figure 5 Effect of chronic restraint-stress on the brain weight on postnatal day (PND) 21

Adrenal Gland Weights

Weights of the adrenal glands were used as an indicator of the stress. The restrained RC group adrenal glands weighed significantly ($p < 0.001$) more (27.01 ± 1.42) compared to the unrestrained NC group (15.81 ± 0.70), while the restrained-pyramid (RP) group adrenals (16.80 ± 0.56) were closer to those of the unrestrained NC group at PND 10. Similar trend was also seen at PND 21 (Figure 6). When compared with the RC group the adrenal weights of the RP group were significantly reduced at both the ages.



[NC = Normal unrestrained control; RC = Restrained control outside; RP = Restrained under the pyramid. Values are mean ± SE from 10 rats/group; ***ANOVA, $p < 0.001$]

Figure 6 Effect of chronic restraint-stress on the adrenal gland weight on postnatal day (PND) 10 and postnatal day (PND) 21

DISCUSSION

Though stress is essential and triggers homeostatic mechanisms to combat, chronic stress is found to be deleterious to the well-being. Gestation period is vulnerable to various external stimuli, such as stress. It affects the postnatal development of the central nervous system inducing neurological deficits as reported earlier,[16 – 20] report prenatal continuous light exposure, a form of stress to have adverse behavioural effects leading to increased chronic oxidative stress and altered gene expression. On the other hand, other researchers[21 – 23] have shown that environmental enrichment during gestation effectively prevents behavioural deficits and abnormal structure of synapses in prenatal stressed offspring.

Results of the offspring were compared between the unrestrained control, restrained control and those restrained under a wooden pyramid. The offspring of the stressed group of rats showed a significant delay in the opening of the eyes and ears growth of fur, and detachment of the pinna compared to the control group. However, these changes of delay were not seen in the stressed groups under the wooden pyramid. In fact the results were similar to the unstressed control group. In other words, the animals did not show evidence of stress when kept under the pyramid. These results are in agreement with the results on the corticosterone levels and the dendritic branching of the CA3 hippocampal neurons under similar conditions reported earlier.[10 – 11]

Dancause et al. have reported prenatal stress results in shorter long bones in adulthood, independently of effects on overall body size.[24] The present study adds to a growing body of evidence suggesting prenatal stress is a risk factor for not only poor linear growth of bones as earlier reported,[23, 25] but also the overall postnatal physical development of the pups. Maternal stress retards foetal development in rats with delay in the postnatal milestones. Results of the present study also suggest that the geometric shape of the pyramid and the energy within reduces or ameliorates the effects of restraint stress. Results of the present study compare well with previously reported results on the plasma levels of corticosterone and dendritic arborisation of CA3 neurons in the hippocampus[10, 11] and the effect seen on the oxidative stress parameters.[26] Seckl et al. state that the excess maternal cortisol (corticosterone in rodents), is typically changed by the foetal-

placenta into the inactive form (cortisone), which reaches the foetus in high concentrations and is responsible for the alterations in the foetal development and growth.[27]

CONCLUSION

Stress and the environment in which it is experienced have deleterious effects on the overall physical development, the foetus being most vulnerable during gestation. Effects are seen on the development of the offspring born to the mothers stressed during gestation. The current results also suggest that the pyramid's geometric shape helps reduce stress and its deleterious effects. However, it will be interesting to explore whether the pyramid environment can reverse the effects of chronic stress. Further studies on analysis of the quality and quantity of energy developed within the pyramid structure should help us better understand how such environment acts as an anti-stressor.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare regarding the study described in this article and in the preparation of the article.

ACKNOWLEDGEMENTS

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REFERENCES

1. Zaneta M, Alan BF, Christopher WK. (2012). Maternal cortisol disproportionately impacts fetal growth in male offspring: Evidence from the Philippines. Am J Hum Bio 24: 1.
2. Rao BSS, Madhavi R, Sunanda, Raju TR. (2001). Complete reversal of dendritic atrophy in CA3 neurons of the hippocampus by rehabilitation in restraint stressed rats. Current Science 80: 653.
3. Fujioka A, Fujioka T, Ishida Y, Maekawa T, Nakamura S. (2006). Differential effects of prenatal stress on the morphological maturation of hippocampus neurons. Neuroscience 141: 907.
4. Kawamura T, Chen J, Takahashi T, Ichitani Y, Nakahara D. (2006). Prenatal stress suppresses cell proliferation in the early developing brain. NeuroReport 17: 1515.
5. Kraszpulski M, Dickerson PA, Salm AK. (2006). Prenatal stress affects the developmental trajectory of the rat amygdala. Stress 9: 85.
6. Lemaire V, Lamarque S, Le Moal M, Piazza PV, Abrous DN. (2006). Postnatal manipulation of the pups counteracts prenatal stress-induced deficits in hippocampal neurogenesis. Biol Psychiatry 59: 786.
7. Michelsen KA, van den Hove DL, Schmitz C, Segers O, Prickaerts J, Steinbusch HW. (2007). Prenatal stress and subsequent exposure to chronic mild stress influence dendritic spine density and morphology in the rat medial prefrontal cortex. BMC Neurosci 8: 107.
8. Bhat S, Rao G, Murthy KD, Bhat PG. (2007). Influence of alignment of the pyramid on its beneficial effect. Indian J Exptl Biol 45: 455.
9. Arnaud C, Laplante DP, Vaillancourt C, King S. (2010). Prenatal stress and brain development. Brain Res Rev 65: 56.
10. George MC. (2013). Effects of prenatal stress on the rat offspring's hippocampal CA3 neurons and the influence of pyramid environment: A morphological and biochemical study. Master's thesis, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia.
11. Murthy KD, George CM, Ramasamy P, Mustapha AZ. (2013). Housing under the pyramid reduces susceptibility of hippocampal CA3 pyramidal neurons to prenatal stress in the developing rat offspring. Indian J Exptl Biol 51: 1070.

12. Dom`enec JS, Montserrat, Maria LA, Mercedes G, Victoria L, Jos´e LD. (2006). Exposure of pregnant rats to uranium and restraint stress: Effects on postnatal development and behavior of the offspring. Toxicology 228: 323.
13. Garber JC, Barbee RW, Clayton LA, Donovan JC, Kohn DF, Lipman NS, Locke P, Melcher J, Quimby FW, Turner PV, Wood GA, Wurbel H. (2011). Guide for the care and use of laboratory animals 8th edition. Washington DC: The National Academic Press.
14. Schul B, Pettit E. (1975). The secret power of pyramids. New York: CBS Publications.
15. Bhat S, Rao G, Murthy KD, Bhat PG. (2010). Alterations in stress parameters in rats housed in a pyramid model: Seasonal variations. Int J Pharma Bio Sci 1. http://www.ijpbs.net/issue-2/168.pdf
16. Solano ME, Jago C, Pincus MK, Arck PC. (2011). Highway to health; or how prenatal factors determine disease risks in the later life of the offspring. J Reprod Immunol 90: 3.
17. Bale TL. (2011). Sex differences in prenatal epigenetic programming of stress pathways. Stress 14: 348.
18. Gerecke KM, Kishore R, Jasnow A, Quadros-Menella P, Parker S, Kozub FJ, Lambert KG, Kinsley CH. (2012). Alteration of sex-typical microanatomy: Prenatal stress modifies the structure of medial preoptic area neurons in rats. Dev Psychobiol 54: 16.
19. Mychasiuk R, Gibb R, Kolb B. (2012). Prenatal stress alters dendritic morphology and synaptic connectivity in the prefrontal cortex and hippocampus of developing offspring. Synapse 66: 308.
20. Voiculescu SE, Duc DL, Roşca AE, Zeca V, Chiţimuş DM, Arsene AL, Drăgoi CM, Nicolae AC, Zăgrean L, Schöneberg T, Zăgrean AM. (2016). Behavioral and molecular effects of prenatal continuous light exposure in the adult rat. Brain Res 1650: 51.
21. Morley-Fletcher S, Rea M, Maccari S, Laviola G. (2003). Environmental enrichment during adolescence reverses the effects of prenatal stress on play behaviour and HPA axis reactivity in rats. Eur. J Neurosci 18: 3367.
22. Veena J, Srikumar BN, Raju TR, Shankaranarayana Rao BS. (2009). Exposure to enriched environment restores the survival and differentiation of new born cells in the hippocampus and ameliorates depressive symptoms in chronically stressed rats. Neurosci Lett 455: 178.
23. Li M, Wang M, Ding S, Li C, Luo X. (2012). Environmental enrichment during gestation improves behaviour consequences and synaptic plasticity in hippocampus of prenatal-stressed offspring rats. Acta Histochem Cytochem 45: 157.
24. Dancause KN, Cao XJ, Veru F, Xu S, Long H, Yu C, Laplante DP, Walker CD, King S. (2012). Brief communication: prenatal and early postnatal stress exposure influences long bone length in adult rat offspring. Am J Phys Anthropol 149: 307.
25. Fontanetti PA, Nervegna MT, Vermouth NT, Mandalunis PM. (2014). Prenatal exposure to continuous constant light alters endochondral ossification of the tibiae of rat pups. Cells Tissues Organs 200: 278.
26. Bhat S, Rao G, Murthy KD, Bhat PG. (2006). Housing in pyramid counteracts neuroendocrine and oxidative stress caused by chronic restraint in rats. eCAM 4: 35.
27. Seckl JR, Holmes MC. (2007). Mechanism of disease: Glucocorticoids, their placental metabolism and foetal "programming" of adult pathophysiology. Nat Clin Pract Endocrinol Metab 3: 479.

Case Report

A Rare Cause of Proximal Thigh Discomfort and Weakness with Type 2 Diabetes Mellitus

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ABSTRACT

Diabetic amyotrophy also known as Bruns-Garland syndrome is diabetic neuropathy subtype affecting the lumbosacral nerve roots and peripheral nerves. There is an ongoing debate on the pathophysiology behind this condition whether is it ischaemic, metabolic (hyperglycaemia) or inflammatory. A 36-year-old man with uncontrolled diabetes mellitus complained of unprovoked weight lost and right proximal thigh discomfort with weakness for one week duration. In neurological examination, his right hip flexion was at medical research council (MRC) grade 3, right hip extension MRC grade 4, his knee and ankle flexion and extension are normal (MRC grade 5). The muscle tones and reflexes were normal. Sensation and proprioception were intact bilaterally. Nerve conduction study (NCS) showed markedly reduced amplitude of the compound muscle action potentials and sensory nerve action potentials, while conduction velocities show only mild slowing. He was started on a course of oral prednisolone 10 mg daily and improved gradually. At three months follow-up, his right lower limb power has recovered fully and he can walk without any assistance. Diabetic amyotrophy was confirmed by suggestive clinical features supported by electrophysiological findings of the affected nerves. This condition is due to metabolic derangement and vasculopathy or immune mediated nerve injury. So, the healthcare providers should be aware about this rare complication of diabetes.

Keywords: diabetic amyotrophy, Bruns-Garland syndrome, diabetic lumbosacral radiculoplexus neuropathy, diabetes mellitus type 2

INTRODUCTION

Diabetic amyotrophy is a rare form of diabetic neuropathies affecting mostly type 2 diabetic mellitus patients.[1] The typical clinical features include sudden, asymmetric, focal onset of pain following by weakness involving the proximal leg, with associated autonomic failure and weight loss.[2] This condition can progress over months to years and is followed by partial to complete recovery. Some patients with diabetic amyotrophy can develop symmetrical weakness. In most cases, the symptoms and signs progress to affect the opposite limb and in the distal legs.[2] There are reported cases of foot drop or disturbing neuropathic pain that can persist for years.[1] In the series of 33 patients cited earlier, 48 per cent required wheelchair assistance at a certain point of their illness.[2] There is no proven effective treatment for diabetic amyotrophy available according to a systemic review published in 2012.[3] There are some studies which suggest that targeting treatment employing immune suppression helps in clinical improvement. Such therapies include oral prednisolone, intravenous methylprednisolone, intravenous immune globulin, cyclophosphamide and plasma exchange.[3]

CASE PRESENTATION

A 36-year-old man with type 2 diabetes for 6 years presented with uncontrolled diabetes due to non-adherence to his medications. His previous oral hypoglycaemic agents were tablet metformin 1 g bd and tablet gliclazide 160 mg bd. Baseline HbA1c was 9 – 10% and he

was not keen for insulin therapy previously. He also reported unprovoked weight lost and right proximal thigh discomfort with weakness for one week duration with no predisposing trauma events. His sugar was controlled with subcutaneous actrapid 22 units tds and insulatard 40 units during his inpatient stay. Neurological examination revealed that his right hip flexion was at medical research council (MRC) grade 3, right hip extension MRC grade 4, his knee and ankle flexion and extension are normal (MRC grade 5). The left lower limb power proximal and distally were MRC grade 5. The tones of both lower limbs were normal, reflexes are 1+ bilaterally at both knee and ankle. Sensation and proprioception were intact bilaterally. Plantar reflexes normal bilaterally. Neurological examination of his upper limbs and cranial nerves were normal.

Spine X-rays were normal. Nerve conduction study (NCS) showed markedly reduced amplitude of the compound muscle action potentials and sensory nerve action potentials, while conduction velocities show only mild slowing (Figures 1 – 4). On the motor conduction (Figures 1 and 2), the amplitudes are reduced more pronouncedly in the lower limbs than upper limbs. After commencing on a course of steroids and the repeat motor conduction NCS after show improved action potential.

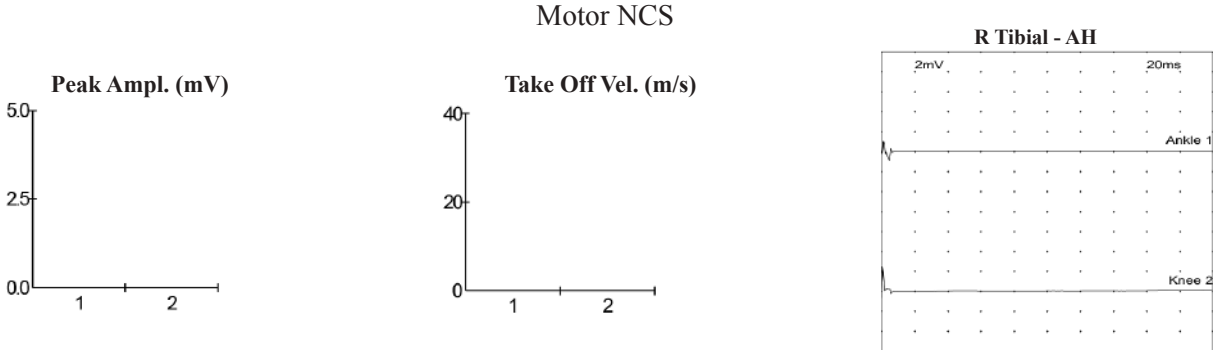


Figure 1 Right Tibial – AH (initially, before starting treatment**)**

After commencing on a course of steroids and the repeat NCS after show improved action potential in the NCS recording:

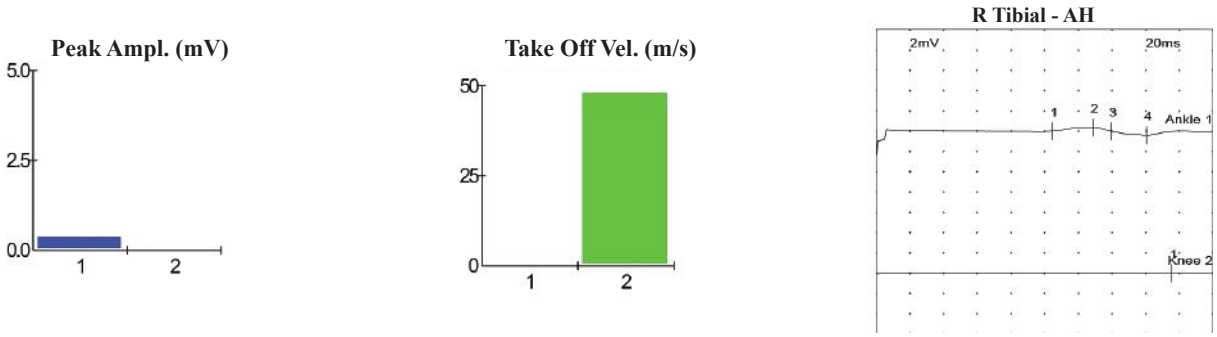


Figure 2 Right Tibial – AH (repeated NCS after treatment)

On sensory conduction (Tables 1 – 2, Figures 3 and 4), minimal amplitudes are seen before and after treatment in the upper limbs. There are no signals detected on the lower limbs sensory NCS study before and after treatment.

Table 1 Sensory NCS for right ulnar at wrist level

Nerve / Sites	Rec. Site	Latency (ms)	Peak Ampl. (μV)	Distance (cm)	Velocity (m/s)
R Ulnar – Digit V					
Wrist	V	1.30	0.61	12	92.2

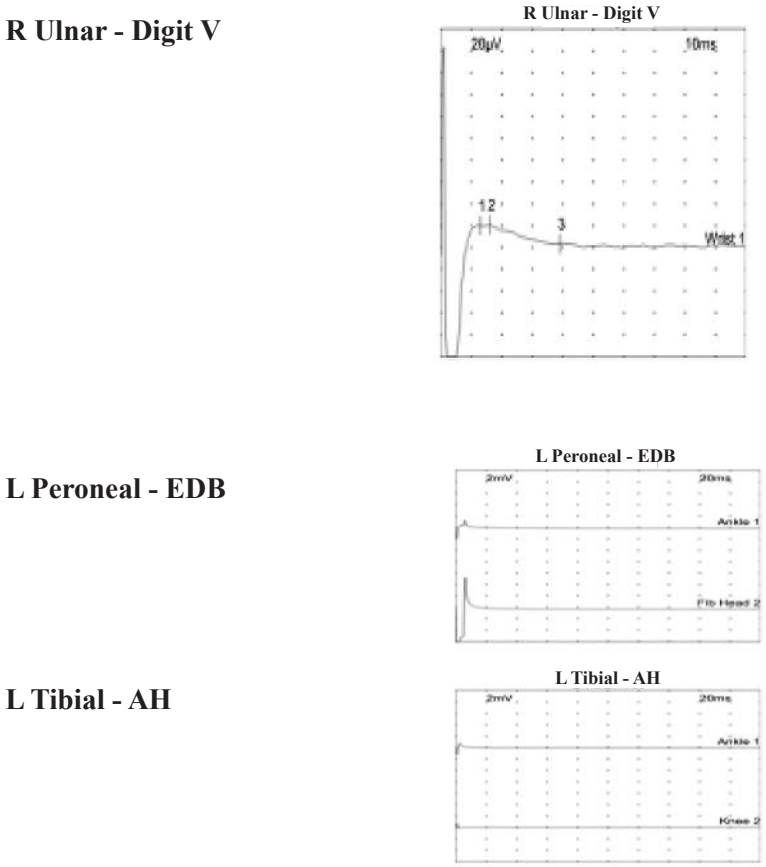
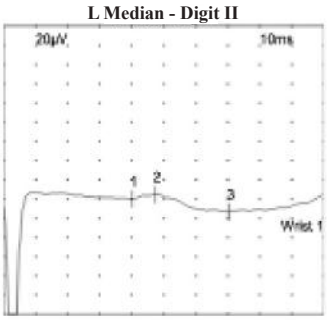


Figure 3 Right ulnar at wrist level before commencing on treatment. The lower limbs sensory NCS conducted failed to pick up any signals.

Table 2 Sensory NCS for left median and right ulnar at wrist level

Nerve / Sites			Rec. Site	Latency (ms)	Peak Ampl. (μV)	Distance (cm)	Velocity (m/s)
L Median – Digit II							
Wrist			II	4.01	4.7	16	39.9
R Ulnar – Digit V							
Wrist	V	6.98	6.0	14		20.1	

L Median - Digit II



R Ulnar - Digit V

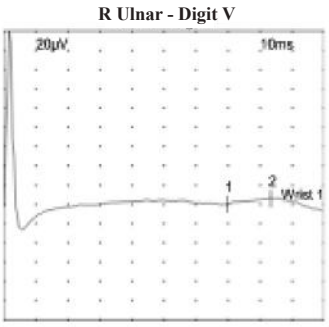


Figure 4 Left median and right ulnar at wrist level after commencing on treatment. Unable to detect any signals from the lower limbs nerves sensory NCS.

On F waves (Table 3, Figures 5 and 6), the F waves showed improvement after treatment in both upper and lower limbs. The repeated NCS after treatment showed improvement in both the motor conduction action potential and F waves of the lower limbs. This NCS shows predominantly axonal peripheral neuropathy which improved with treatment.

Table 3 F waves

Nerve	Min F Lat (ms)	Max F Lat (ms)	Mean F Lat (ms)
R Tibial – AH	63.28	70.89	65.64

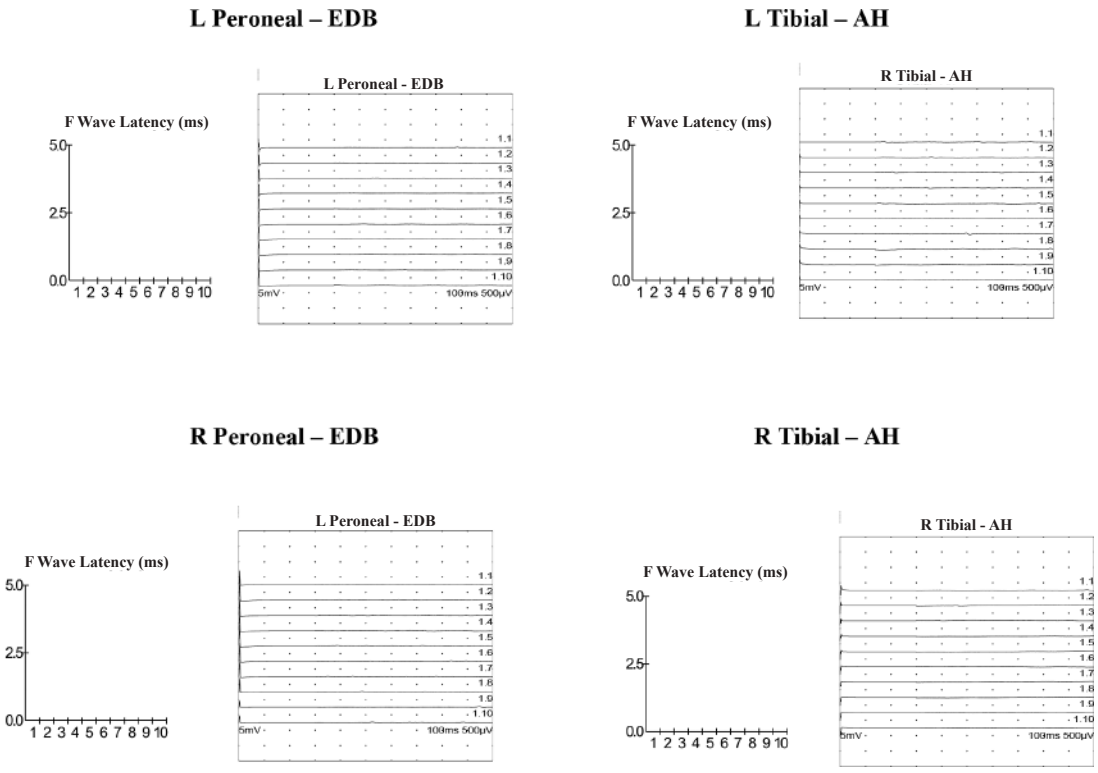


Figure 5 F waves recorded before starting treatment

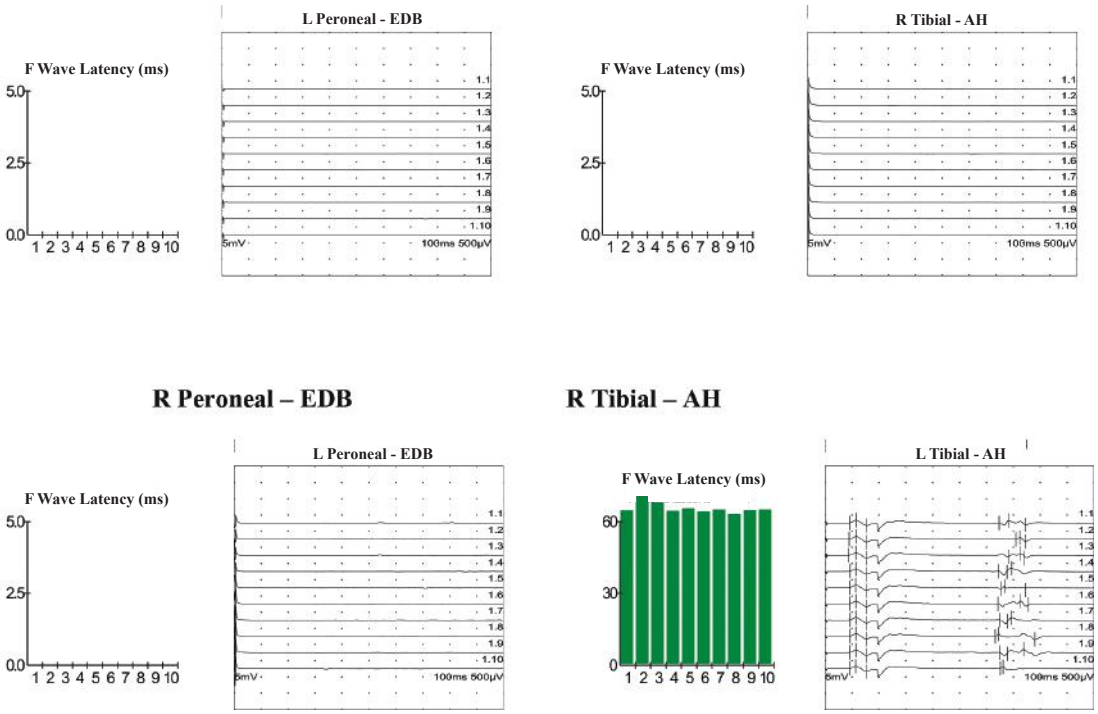


Figure 6 Repeated F waves after treatment showed remarkable improvement in action potential captured

MRI whole spine done was normal. He was started on a course of oral prednisolone 10 mg daily. After one week of treatment, he was able to ambulate with walking frame in the ward. He was under the care of dedicated rehabilitation team. He was subsequently discharged with oral prednisolone 10 mg daily and was given a neurology clinic appointment. At three months follow-up, his right lower limb power has recovered fully and he can walk without any assistance. Oral prednisolone was stopped after 3 months of treatment. His glycaemic control has been optimized and his latest HbA1c has reduced to 7%.

DISCUSSION

Diabetic amyotrophy also known as Bruns-Garland Syndrome or diabetic lumbosacral radiculoplexus neuropathy is a rare subtype of diabetic neuropathies affecting the lumbosacral plexus and its nerve roots.[1] Patient with this condition presented initially with acute to subacute onset of lower limb proximal muscle pain followed by weakness which is often asymmetry.[4] Occasionally, the thoracic nerve roots and brachial plexus may be involved giving rise to thoracic wall pain and proximal upper limbs pain as well as weakness respectively.[4] The aetiology for diabetic amyotrophy is not known despite being in existence for over a century. The proposed mechanism for this condition is due to metabolic derangement and vasculopathy.[5] However this proposal has fallen out of favour as most affected patients have relatively controlled diabetes mellitus. Recent studies have indicated that immune mediated nerve injury has a stronger basis for the mechanism of diabetic amyotrophy yet all the studies were of small scaled without a randomised control method.[5] This has led to the usage of immunosupressants in the treatment of diabetic amyotrophy.[4]

In the case illustrated, the diagnosis of diabetic amyotrophy was confirmed by suggestive clinical features supported by electrophysiological findings of the affected nerves. The patient initially presented with right proximal thigh discomfort and weakness which progresses for a week. This presentation is typical of diabetic amyotrophy. His HbA1c was documented at 9% suggesting that his diabetic was uncontrolled but not to the severe extent. There was no explainable cause, for instance preceding trauma, to explain his symptom. Electrophysiological study in the form of nerve conduction study showed reduced compound muscle action potential of the femoral nerves consistent with reduced velocity of the sensory potential consistent with axonal neuropathy, thus supporting the clinical diagnosis.[6] There was also subclinical abnormality of the apparently normal left lower limbs to suggest asymmetrical nerve involvement further pointing towards diabetic amyotrophy.

The patient showed dramatic improvement after a course of oral steroid and aggressive rehabilitation for three months. The observed improvement is expected for diabetic amyotrophy. Some investigators reported that the expected mean time recovery was three months and complete recovery was achieved by 18 months in a case series of 27 diabetic amyotrophy patients.[7]

CONCLUSION

Diabetic amyotrophy is a rare cause of proximal thigh weakness and discomfort in type 2 diabetic patient. This case report will help to create awareness among healthcare providers regarding diabetic amyotrophy.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

CONSENTS

Written informed consent was obtained from the patient to publish the case. A copy of written consent is available for review by the Chief Editor.

REFERENCES

1. Barohn RJ, Sahenk Z, Warmolts JR, Mendell JR. (1991). The Bruns-Garland syndrome (diabetic amyotrophy). Revisited 100 years later. Arch Neurol 48: 1130.
2. Dyck PJ, Norell JE, Dyck PJ. (1999). Microvasculitis and ischemia in diabetic lumbosacral radiculoplexus neuropathy. Neurology 53: 2113.
3. Chan YC, Lo YL, Chan ES. (2012). Immunotherapy for diabetic amyotrophy. Cochrane Database Syst Rev 13 (6): CD006521. doi: 10.1002/14651858. CD006521.pub3.
4. Minal J, Bhanushali, Suraj Ashok Muley (2008). Review Article: Diabetic and non-diabetic lumbosacral radiculoplexus neuropathy, Neurology India October-December, 56: 420 – 425.
5. Dyck PJ, Windebank AJ. (2002). Diabetic and nondiabetic lumbosacral radiculoplexus neuropathies: new insights into pathophysiology and treatment. Muscle Nerve 25: 477 – 491.
6. Coppack SW, Watkins PJ. (1991). The natural history of diabetic femoral neuropathy. Q J Med 79: 307 – 313.
7. Zochodne DW, Isaac D, Jones C. (2003). Failure of immunotherapy to prevent, arrest or reverse diabetic lumbosacral plexopathy. Acta Neurol Scand 107: 299.

Case Report

A Very Extensive Ludwig's Angina

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ABSTRACT

Ludwig's angina is a grave, fatal cellulitis usually occurs in adults. If it is diagnosed early along with immediate treatment planning can save a life. In this case, it is a widespread dental infection which extends to the neck and chest, therefore elevation of floor of mouth which causes respiratory obstruction. Airway protection techniques along with proper parenteral antibiotics and meticulous surgical drainage are the mainstay of treatment in a case of advanced staged Ludwig's angina.

Keywords: Ludwig's angina, odontogenic infection, surgical decompression

INTRODUCTION

A great German surgeon, Wilhelm Friedrich Von Ludwig in 1836 first described Ludwig's angina which is a rapidly progressing gangrenous cellulitis causing oedema of soft tissue of floor of mouth and neck.[1]

It presents with an acute onset and affecting submandibular, submental and sublingual spaces bilaterally which impede the airway.[2]

Usually, it starts with an infection from the second or third lower molar teeth spreading to the submandibular space, then to the sublingual space, first ipsilaterally, then contralateral submandibular space.[3] Submental space is involved via lymphatic spread. Sublingual space can also be involved first then progress to submandibular space. From sublingual space infection can spread posteriorly in a cleft between hyoglossus and genioglossus muscles causing oedema of the glottis leading to airway obstruction.[2]

Causes of Ludwig's angina includes odontogenic infections from second or third lower molar teeth, osteomyelitis, submandibular gland sialoadenitis, compound fracture of the jaw, penetrating infection from floor of mouth, sialolithiasis and tongue piercings.[4]

Predisposing factors are extraction of teeth, systemic illness (diabetes, alcoholism, AIDS, organ transplantation, trauma).[5] In children it can occur without any cause.

Typical clinical presentation of Ludwig's angina is swelling on the floor of mouth, dysphagia, malaise, fever, pain, and inability to swallow saliva. Stridor indicates immediate airway obstruction. Airway obstruction is due to elevation of floor of mouth, oedema of the glottis and posterior displacement of the tongue. Due to presence of swelling and oedema of glottis, it becomes difficult to anaesthetize the patient. Mortality can be prevented by immediate management of airway, removal of source of infection, surgical decompression and aggressive use of antibiotics.[6]

CASE PRESENTATION

A 50-year old male patient was admitted to the hospital with the complaints of pain, difficulty in swallowing, inability to open mouth, ulceration in neck area, respiratory distress for two days following extraction of left lower second molar tooth with foul smell from wound for 8 days.

On physical examination, he was toxic and had respiratory distress. His random blood sugar was 18 mmol/L on admission.

His mouth opening was 1.5 cm interincisal distance and revealed drainage of pus at left lower second molar tooth area and gauze packing in the neck wound, swelling extended up to mid chest level (Figure 1).

Figure 1 Ludwig's angina showing huge swelling in the neck

The patient was diagnosed with Ludwig's angina and immediate drainage of abscess was scheduled. A written consent about tracheostomy was taken. Patient's blood pressure was monitored from time to time, intravenous cannulation was done, and patient was infused with normal saline. In the operating room, 10 per cent viodine solution was used for scrubbing. Infected gauze that was in situ was removed and under local anaesthesia with 2% lignocaine with adrenaline, surgical drainage was performed. Pus was collected and sent for culture and sensitivity. Tracheostomy was avoided.

Figure 2 Wound gaps in the neck and chest after controlling infection

The culture sensitivity report yielded growth of *Pseudomonas spp.* Colony count was profuse. Intravenous doses of meropenem, metronidazole and gentamycin were prescribed. Vigorous dressing was performed twice daily for infection control (Figure 2). Patient's blood sugar was controlled with short acting insulin according to sliding scale. Steroid injection was used eight hourly to prevent laryngeal oedema. As haemoglobin decreased to 9 g/dl, two units of whole blood were transfused and the patient was kept in a propped up position. After two weeks, vacuum compression therapy was started and when healthy granulation tissue appeared, skin grafting was planned to cover the neck wound area (Figure 3). He was cured completely with the above treatment.

Figure 3 After skin grafting, patient was able to move his neck properly

DISCUSSION

Ludwig's angina is an infection which rapidly extends to the upper neck causing brawny bilateral indurations.[7] It also presents with pain, trismus, tongue elevation, fever and dysphagia. Asphyxia is a complication of Ludwig's angina caused by oedema of soft tissue of neck. Death can occur due to acute airway obstruction during interventions. Anxiety, cyanosis and stridor are the late signs of airway obstruction which is an indication of immediate airway intervention.[8]

Blind nasal intubation can cause catastrophic bleeding, airway oedema, laryngospasm and aspiration. Therefore, immediate tracheostomy could be a life-saving procedure in this case.[9]

β-Haemolytic Streptococcus, anaerobic organism, *peptostreptococcus*, pigmented bacteroids, *Streptococcus viridans* (40.9%), *staphylococcus aureus* (27.3%) and *staphylococcus epidermidis* (22.7%) are the causative agents. Antibiotics such as intravenous penicillin G, metronidazole and clindamycin are used prior to obtaining culture and antibiogram results.[10]

In this case, culture sensitivity report yielded growth of *Pseudomonas spp.* Colony count was profuse. Intravenous doses of meropenem, metronidazole and gentamycin were prescribed with good result. Steroids were also given to maintain airway.[11]

Some authors also recommend gentamycin.[11, 12] Recent case reports advocated the use of intravenous steroids which potentially avoided the need for airway management.[13, 14] In this case, the patient was doing well till the last follow up.

CONCLUSION

It is important to diagnose Ludwig's angina in the early stage of the disease, when it is easy to manage. In advanced cases, however, securing the airway and meticulous surgical drainage are paramount.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this case.

CONSENTS

Written informed consent was obtained from the patient to publish the case. A copy of written consent is available for review by the Chief Editor.

REFERENCES

1. Candamourty R, Venkatachalam S, Babu MR, Kumar GS. (2012). Ludwig′s angina – an emergency: A case report with literature review. J Nat Sci Biol Med 3: 206 – 208.
2. Seward GR, Malcolm H, David AM. (1987). Killey and Kay′s outline of oral surgery, part 1, 2nd edition. Bristol: Wright. p. 139 – 140.
3. Gbolahan OO, Olowookere S, Aboderin A, Omopariola O. (2012). Ludwig′s angina following self-application of an acidic chemical. Ann Ibadan Postgrad Med 10: 34 – 37.
4. Saifeldeen K, Evans R. (2004). Ludwig′s angina. Emerg Med J 21: 242 – 243.
5. Duprey K, Rose J, Fromm C. (2010). Ludwig′s angina. Int J Emerg Med 3: 201 – 202.
6. Kaluskar S, Bajaj P, Bane P. (2007). Deep space infections of neck. Indian J Otolaryngol Head Neck Surg 59: 45 – 48.
7. Spitalnic SJ, Sucov A. (1995). Ludwig's angina: Case report and review. J. Emerg Med 13: 499 – 503.
8. Ovassapian A, Tuncbilek M, Weitzel EK, Joshi CW. (2005). Airway management in adult patients with deep neck infections: A case series and review of the literature. Anesth Analg 100: 585 – 589.
9. Iwu CO. (1990). Ludwig's angina: A report of seven cases and review of current concepts in management. Br J Oral Maxillofac Surg 28: 189 – 193.
10. Linder HH. (1986). The anatomy of the fasciae of the face and neck with particular reference to the spread and treatment of intraoral infections that have progressed into adjacent fascial spaces. Ann Surg 204: 705 – 714.
11. Har-El G, Aroesty JH, Shaha A, Lucente FE. (1994). Changing trends in deep neck abscess. A retrospective study of 110 patients. Oral Surg Oral Med Oral Pathol 77: 446 – 450. [PubMed]
12. Kurien M, Mathew J, Job A, Zachariah N. (1997). Ludwig's angina. Clin Otolaryngol Allied Sci 22: 263 – 265. [PubMed]
13. Saifeldeen K, Evans R. (2004). Ludwig's angina. Emerg Med J 21: 242 – 243. [PMC free article] [PubMed]
14. Spitalnic SJ, Sucov A. (1995). Ludwig's angina: Case report and review. J Emerg Med 13: 499 – 503. [PubMed]

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