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Gender Differences in Indications and Findings of Ambulatory Electrocardiographic Monitoring

May Al-Jorani[a], Moatamn Reda Skuk[b], Haitham Ali Abdullah Al-Sudani[c], Ali AbdulAmeer Al-Mosawi[c], Kasim Abbas Al-Iqabby[c], Zainab Atiyah Dakhil[b,c]

[a] *Al-Mustansiriya College of Medicine, Baghdad, Iraq*
[b] *Al-Kindy College of Medicine/University of Baghdad, Baghdad, Iraq*
[c] *Ibn Al-Bitar Cardiac Centre, Baghdad, Iraq*

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SOUHRN

Kontext: Mezi muži a ženami existují významné rozdíly v elektrokardiografických parametrech. Chybějí však údaje ohledně genderových rozdílů v indikacích a záznamech ambulantního monitorování EKG (AEM), zvláště u populací Středního východu.
Cíl: Naším cílem bylo zkoumat genderové rozdíly ve vstupních EKG záznamech, indikacích a záznamech z AEM u irácké kohorty pacientů s indikací k AEM.
Metody: U každého pacienta byly analyzovány vstupní EKG záznamy; jeho indikace a záznamy z AEM každého pacienta byly zdokumentovány.
Výsledky: Do studie bylo zařazeno 100 jedinců (53 % skupiny tvořili muži, 47 % ženy). U pacientů bylo indikováno buď 24hodinové, nebo 48hodinové AEM. U žen bylo indikováno 48hodinové AEM častěji než u jejich mužských protějšků (19,1 % vs. 18,9 %). Hlavními indikacemi k AEM byly u mužů palpitace (26,41 %), bradykardie (16,98 %) a presynkopa (13,2 %), zatímco u žen to byly palpitace (34,04 %), presynkopa (23,4 %) a synkopa (14,89 %). Vstupní EKG záznam byl normální spíše u žen než u mužů (36,17 % vs. 20,75 %). Předčasné síňové stahy, fibrilace síní (FS), supraventrikulární tachykardie (SVT), komorové tachykardie (ventricular tachycardia, VT) a významné pauzy se vyskytovaly častěji u žen, přičemž předčasné komorové stahy a atrioventrikulární (AV) blokáda I. stupně byly zaznamenávány častěji u mužů.
Závěr: Naše studie zjistila významné genderové rozdíly ve vstupních EKG záznamech, indikacích i záznamech z AEM. Důsledky těchto změn pro péči o pacienty a jejich výsledný zdravotní stav je nutno dále zkoumat.

Keywords:
Arrhythmia
Holter
Sex

ABSTRACT

Background: There are significant differences in electrocardiographic parameters between males and females. However, there is a lack of data regarding the gender-related differences in indications and findings of ambulatory electrocardiographic monitoring (AEM) especially in Middle Eastern population.
Purpose: We sought to investigate the gender-related differences in the baseline ECG findings, indications, and findings of AEM in an Iraqi cohort of patients referred for AEM.
Methods: Baseline ECG was analyzed for each patient, indications, and findings of AEM for each patient was documented.
Results: n = 100 (53% were males and 47% were females). Patients were either referred for 24-hour or 48-hour AEM. Women were referred more for 48 hours AEM than male counterparts (19.1% vs 18.9%). Main indications for AEM referral in males were palpitation (26.41%), bradycardia (16.98%) and presyncope (13.2%) while main indications for AEM referral in females were palpitation (34.04%), presyncope (23.4%), and syncope (14.89%). Baseline ECG was normal in females more than in males (36.17% vs 20.75%). Premature atrial contractions (PAC), atrial fibrillation (AF), supraventricular tachycardia (SVT), ventricular tachycardia (VT) and significant pauses were detected more frequently in females while PVC and first degree heart block were detected more frequently in males.
Conclusion: There are some gender-related differences in baseline ECG, indications, and findings of AEM. Further work is warranted to detect the impact of these changes on management and outcomes.

Address: Zainab Atiyah Dakhil, FIBMS Cardiol, FIBMS Med, FABHS Med, DM Med, DM Chest diseases, MBChB, Al-Kindy College of Medicine/ University of Baghdad, Baghdad, Iraq, e-mail: stethoscope.med@gmail.com
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Introduction

Limited data has focused on gender-related differences based on ECG changes of different cardiac events.[1] For example, long duration of QT and QTc intervals have been observed in females more than in males, while the amplitude and duration of QRS are larger in males.[2] These data results from the human hormones and their effects on men's and women's activities and heart conditions.[2] In the first 10 years of life, there is a similarity between male and female ECG parameters. Some alterations can be seen in the adolescent period such as faster resting heart rate (HR) in women[3] and the deviation probability of ST-segment in non-specific patterns in females. In general, racial differences remain sustained in adulthood if there are no cardiovascular diseases.[2] Genetically, the LQT2 genotype in females suggested to progress the elongation of the QT interval associated with cardiac disease risk, in which women with long QT syndrome are characterized by the presence of the LQT2 genotype.[4] Women with this type of syndrome have a higher risk of heart events related to arrhythmia as well as long resting QTc intervals compared to men.[4,5] Some difficulties have been observed in the diagnosis of ischemia correlated with the ECG changes, this is because of the ST-segment dynamic pattern deviation and its lability among women.[6] There is lack of data regarding the gender-related differences in indications and findings of ambulatory electrocardiographic monitoring (AEM) especially in Middle Eastern population. So, we sought to investigate the gender-related differences in the baseline ECG findings, indications, and findings of AEM in an Iraqi cohort of patients referred for AEM.

Method

This prospective cross-sectional study was performed at Ibn Al-Bitar Cardiac Center and collected directly from patients' investigation reports presented at the Holter unit and who were referred for 24 or 48 AEM studies.

This study has been approved by the National Ethical Committee. Statistical analysis has been evaluated using the software SPSS version 28.

Our study evaluated the baseline ECG changes assessed at presentation visit to Holter unit. Indications, and findings of AEM on gender-related basis were assessed and documented.

Results

We recruited 100 patients (53% were males and 47% were females). Mean age of patients was 46.93±18.65 years (47.88±20.65 in males vs 45.85±16.25 in females, p = 0.029). Patients were either referred for 24-hour or 48-hour AEM. Women were referred more for 48 hours of AEM than their male counterparts (19.1% vs 18.9%, p = 0.488). Main indications for AEM referral in males were palpitation (26.41%), bradycardia (16.98%), and presyncope (13.2%) while the main indications for AEM referral in females were palpitation (34.04%), presyncope (23.4%), and syncope (14.89%), see Fig. 1. Baseline ECG was normal in females more than in males (36.17% vs 20.75%), see Fig. 2. Minimum heart rate was 51.1±15.62 BPM (48.94±15.96 in males vs 53.47±15.03, p = 0.64), while maximum heart rate was 129.78±26.14 BPM (129.81±26.63

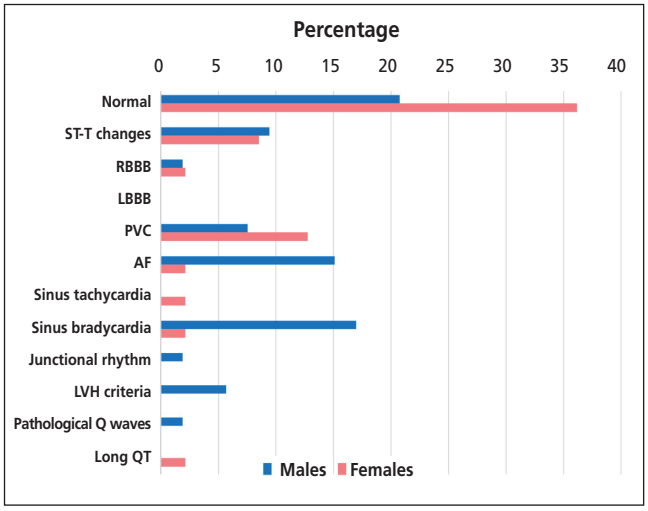

Fig. 1 – Baseline ECG findings according to gender.

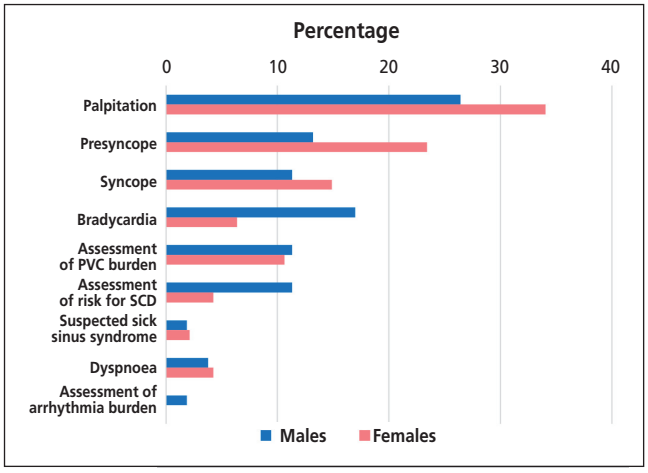

Fig. 2 – Indication of ambulatory ECG monitoring according to gender.

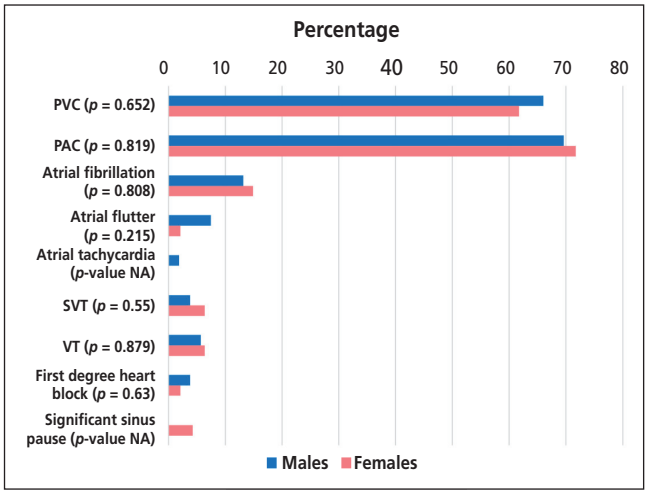

Fig. 3 – Findings of ambulatory ECG monitoring according to gender

in males vs 129.74±25.86, p = 0.914). Mean PR interval for patients was 155.01±26.86 ms (156.15±29.85 in males vs 153.93±23.99, p = 0.381). Mean duration of QRS was 93.1±17.34 ms (97.4±21.3 in males vs 89.1±11.9, p = 0.05) while mean QT interval was 398.01±38.03 ms (390.23±37.32 in males vs 406.17±37.48, p = 0.417). Mean of the longest sinus pause was 2.14±0.58 s (1.99±0.34 in males vs 2.35±0.79, p = 0.034). Premature atrial contractions (PAC), atrial fibrillation (AF), supraventricular tachycardia (SVT), ventricular tachycardia (VT), and significant pauses were detected more frequently in females while premature ventricular contractions (PVC) and first-degree heart block were detected more frequently in males, see Fig. 3.

Discussion

Our study has evaluated the differences in cardiac events between males and females, comparing our results to other studies, we have found associations in some cardiac conditions based on gender disparities. In India,[7] the study has estimated about 19 (7.30%) of males' proportion had sinus bradycardia, which is far from our results (16.98%). Some changes may be different based on time duration and progression. For instance, in a previous study in Sweden that was performed for 20 years, ECG abnormalities were noted in 21% and 43% of females and males, respectively. They found that the follow-up results were different from their prior data. These differences are related to age, hormonal adaptations, population race, and lifestyle modifications.

Another study performed in Craiova on athletes[8] found that sinus arrhythmias are more frequent in females than in males (21.8% vs. 12.6%) which resembles our study. The athlete people had left ventricular hypertrophy, in which QRS voltage is significantly higher in male and females athletes (2.6±0.8 vs 2.05±0.5) as well as the duration of QRS (96.1±13.1 vs 86.9±9.4 ms).[8] Our study found a significant difference in gender-based ECG changes, and the results of the previous studies indicated that athlete's people should be included in the screening process in future studies to involve a wide variety of population-related different origins and lifestyles.

A previous study found differences between sex and ECG changes related to circadian rhythm variation. Specifically, the QT dispersion was less in women with lower diurnal variation when compared to men. Another change was the greatest QT dispersion magnitude in men in the hours of early morning, these hours have the more arrhythmic risk for cardiac death. Also, the T-wave peak (Tp) to T-wave end interval (Te) was longer in men but had no circadian difference between genders. In general, there are some correlations and interaction between gender and repolarization that needs further study.[9]

Regarding p-wave amplitude, there are no sex differences between males and females the upper limit is 0.25 mV in the limb leads.[10] Although no significant difference exists between adults and children related to P-wave amplitude, it does between adults and children,[10] with 120 ms and 140 ms in adults and 100 ms and 50 ms in pediatric and children younger than 1 year.[11] Age and sex variation are important to estimate accurate ECG changes in serious cardiac conditions. This means that ECG changes may be related to cardiac weight and body mass, where males' mean left ventricular mass is approximately 116 g while females' is approximately 85 g estimated by CT angiography.[12] This may suggest why QRS voltage is higher in males when compared to females.[10] This data comes from studies to provide different ECG parameters based on sex, age, heart, and body weight.

Although T-wave is not related to age and sex variation, ST-segment amplitude depends on these variations in which young men have high normal ST limits vs females and old men have low ST-amplitude vs young males.[13] These changes are not considered when performing PCI or when noting the ECG changes, but are to be undertaken for automated techniques to evaluate the sensitivity improvements.[14,15]

In our study, we estimated the ECG differences between males and females and observed that palpitation is a common indication between both sexes for 48 h of AEM referral. Although both genders have different proportions (M = 26.41% vs F = 34.04%), palpitations have a higher percentage over other cardiac conditions, and this could direct us to give more attention to healthy and unhealthy people with palpitations.

Presyncope is another common indication for AEM in both genders with significantly different proportions in which it is the third highest indication in males (13.2%) and the second highest indication in females (23.4%). Presyncope is an important event and may be related to hidden serious cardiac or non-cardiac conditions and could be managed correctly if diagnosed earlier. This has directed attention towards the different benefits of the AEM to reduce the differential diagnosis of different systems.

Bradycardia and syncope are among the highest conditions to indicate AEM referral for males and females. Although bradycardia is normal for athletes and syncope may relate to different causes other than cardiac events, both conditions should be evaluated correctly based on sex, age, and the general situation of each subject to investigate the right diagnosis for each condition.

Other conditions have higher proportions in females than in males such as PAC, AF, SVT, VT and significant pauses while normal baseline ECG was more frequent in females than in males (36.17% vs 20.75%), these variations are correlated to hormones, sex, age, body weight, and the heart weight and the health situation in the general population regarding genetic and environmental factors.

A previous study found a prevalence of F : M = 2 : 1 of nodal reentrant SVT using the ECG study[16] the same study has the opposite percentage when the SVT was due to AV nodal reentrant mechanism with accessory pathway circuit (M : F = 2 : 1). Another study estimated the SVT related to exercise in healthy subjects and the proportions were not remarked statistically (men vs women = 6.0% and 6.3%) but the percentage was increasing with age in males more than in females.[17] Our study using the 24–48 h AEM has found that SVT was observed in 3.8% of males and 6.4% of females. This can be due to the hormonal and sex differences which may cause a

significant distance percentage between both genders in our country.

Relying on hormonal effect, a previous study evaluated the effects of estradiol hormone in premenopausal women, they found no correlation between premature atrial contraction (PAC) and estradiol hormone level, that may explain the non-statistical difference in PAC according to gender in our study.

High frequency < 500 in premature ventricular contraction (PVC) was associated with a higher level of estradiol hormone.[18] We conclude that some hormones can affect specific types of cardiac events and not others. We directed the attention towards the hormonal effects of the previous studies as we focus on women's differences from men in our study. Our study estimated that PVC is 66.0% and 61.7% in males and females, respectively, paying the attention to hormonal effects in the age of premenopausal period especially considering the young patient mean age in our study.

Regarding atrial fibrillation in a previous study,[19] they observed that the prevalence of AF in males is 1.5 times more than in females. While another study[20] found an equivalent number of cases of AF in males and females and they contribute the reason to the long-lasting lifetime of AF in women and hence equalize the situation. Although there is a higher fold (5.4) of AF correlated with cardiac ischemia and high AF incidence postoperative heart surgery in men, there are valvular heart diseases, heart failure, and short survival periods associated with the type of arrhythmias in women.[21] In conclusion of the study (19), the odds ratio (OR) of AF related to death in males is 1.5 and 1.9 in females, hence AF has a higher risk in women than in men. Our results have found that 13.2% of males are presented with AF in the AEM, while 14.9% of females had AF. No large difference is present between both genders but still risky for women based on different health conditions and relying on previous studies, hormonal, and genetic factors.

Cardiovascular diseases tend to appear 10 or 20 years later in females. Therefore, sudden death related to ventricular arrhythmias was reported with a proportion of 3 : 1 in men to women in a previous study.[22] The age above 45 years had the double incidence of sudden death in both genders with 20 years delay in women. Another study found that ischemia is the leading cause of heart arrest in 80% of men survivors and 45% of women survivors referred for an ECG study.[23] Also, MI had raised the proportion of sudden death risk after 10 years from the first infarction episode by 5.3% and 11.9% in females and males, respectively. These differences are that men with a high proportion of sudden death due to ventricular arrhythmias or ischemia contribute to the ischemic heart incidence rate.

AV block tends to occur in a higher percentage in men than that in women, with more recovery time, and more variety in AV block conduction. The longer cycle and the higher incidence of AV block with a high proportion of conduction deficiency of retrograde AV conduction were observed in 23% of males and 11% of females in a previous study.[24] In the same line, the survival rate in women was higher than in men in another study that estimated the mortality rate, especially in complete heart block.[25]

Conclusion

There are some gender-related differences in baseline ECG, indications, and findings of AEM. Further work is warranted to detect the impact of these changes on management and outcomes.

Conflict of interests
None.

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References

1. Mieszczanska H, Pietrasik G, Piotrowicz K, et al. Gender-related differences in electrocardiographic parameters and their association with cardiac events in patients after myocardial infarction. Am J Cardiol 2008;101:20–24.
2. Moss AJ. Gender differences in ECG parameters and their clinical implications. Ann Noninvasive Electrocardiol 2010;15:1–2.
3. Rautaharju PM, Zhou SH, Wong S, et al. Sex differences in the evolution of the electrocardiographic QT interval with age. Can J Cardiol 1992;8:690–695.
4. Sauer AJ, Moss AJ, McNitt S, et al. Long QT syndrome in adults. J Am Coll Cardiol 2007;49:329–337.
5. Schwartz PJ, Crotti L, Insolia R. Long-QT syndrome: from genetics to management [published correction appears in Circ Arrhythm Electrophysiol. 2012 Dec;5(6):e119-20]. Circ Arrhythm Electrophysiol 2012;5:868–877.
6. Greenland P, Xie X, Liu K, et al. Impact of minor electrocardiographic ST-segment and/or T-wave abnormalities on cardiovascular mortality during long-term follow-up. Am J Cardiol 2003;91:1068–1074.
7. Sachin Khane R, Surdi AD. Gender differences in the prevalence of electrocardiogram abnormalities in the elderly: a population survey in India. Iran J Med Sci 2012;37:92–99.
8. Corîci OM, Mirea-Munteanu O, Donoiu I, et al. Gender-Related Electrocardiographic Changes in Athletes. Curr Health Sci J 2018;44:29–33.
9. Mayuga KA, Thattassery E, Taneja T, et al. Circadian and gender effects on repolarization in healthy adults: a study using harmonic regression analysis. Ann Noninvasive Electrocardiol 2010;15:3–10.
10. Macfarlane PW. The Influence of Age and Sex on the Electrocardiogram. Adv Exp Med Biol 2018;1065:93–106.
11. O'Connor M, McDaniel N, Brady WJ. The pediatric electrocardiogram. Part I: Age-related interpretation. Am J Emerg Med 2008;26:221–228.
12. Fuchs A, Mejdahl MR, Kühl JT, et al. Normal values of left ventricular mass and cardiac chamber volumes assessed by 320-detector computed tomography angiography in the Copenhagen General Population Study. Eur Heart J Cardiovasc Imaging 2016;17:1009–1017.
13. Macfarlane PW. Age, sex, and the ST amplitude in health and disease. J Electrocardiol 2001;34(Suppl):235–241.
14. Macfarlane PW, Hampton D, Clark EN, et al. Evaluation of age and sex dependent criteria for ST elevation myocardial infarction. Computers in Cardiology;2007:293–296.
15. Clark EN, Sejersten M, Clemmensen P, Macfarlane PW. Automated electrocardiogram interpretation programs versus cardiologists' triage decision making based on teletransmitted data in patients with suspected acute coronary syndrome. Am J Cardiol 2010;106:1696–1702.

16. Rodriguez LM, de Chillou C, Schläpfer J, et al. Age at onset and gender of patients with different types of supraventricular tachycardias. Am J Cardiol 1992;70:1213–1215.
17. Maurer MS, Shefrin EA, Fleg JL. Prevalence and prognostic significance of exercise-induced supraventricular tachycardia in apparently healthy volunteers. Am J Cardiol 1995;75:788-792. doi:10.1016/s0002-9149(99)80412-3
18. Bernal O, Moro C. Arritmias cardiacas en la mujer [Cardiac arrhythmias in women]. Rev Esp Cardiol 2006;59:609–618.
19. Benjamin EJ, Wolf PA, D'Agostino RB, et al. Impact of atrial fibrillation on the risk of death: the Framingham Heart Study. Circulation 1998;98:946–952.
20. Feinberg WM, Blackshear JL, Laupacis A, et al. Prevalence, age distribution, and gender of patients with atrial fibrillation. Analysis and implications. Arch Intern Med 1995;155:469–473.
21. Tsougos E, Korakas E, Kolovos V, et al. The Effects of Different Hormones on Supraventricular and Ventricular Premature Contractions in Healthy Premenopausal Women. Medicina (Kaunas) 2021;57:1154.
22. Kannel WB, Wilson PW, D'Agostino RB, Cobb J. Sudden coronary death in women. Am Heart J 1998;136:205–212.
23. Albert CM, McGovern BA, Newell JB, Ruskin JN. Sex differences in cardiac arrest survivors. Circulation 1996;93:1170–1176.
24. Liu S, Yuan S, Kongstad O, Olsson SB. Gender differences in the electrophysiological characteristics of atrioventricular conduction system and their clinical implications. Scand Cardiovasc J 2001;35:313–317.
25. Brunner M, Olschewski M, Geibel A, et al. Long-term survival after pacemaker implantation. Prognostic importance of gender and baseline patient characteristics. Eur Heart J 2004;25:88–95.