Discussion
Discussion

The present study which aimed at analyzing the ECG changes of elderly persons above the age of 60 years was done in and around the Raipur district. It included males and females randomly selected, from both rural and urban areas.

All the findings associated with the electrocardiographic changes in these elderly persons were tabulated and analyzed in detail.

Sex wise analysis:

The present study included 1000 elderly persons above the age of 60 years from rural and urban areas in Raipur district. Sex wise analysis of the population was done. In this study there were 49.1% males in the rural areas and 50.9% were females. In the urban areas there were 48.8% males and 51.2% females.

It appeared on observation that there was a slight female predominance over the males in the elderly population in both rural and urban areas.

According to census data of 2001, the population of Chhattisgarh is 20,795,956. Out of this population 30,09,042 reside in the Raipur district. Thus our sample of elderly persons represents 0.03% of the population of Raipur district (census 2001). The number of males in this district is 1520024 and number of females is 1489018. This shows that the numbers of males are more than that of females in the census study (Census 2001).

But in our study, the reverse pattern of male and female distribution was observed. In our study the females predominated slightly over males.

Thus it appears that longevity in females is more than males in elderly age groups above 60 years.

Similar has been suggested in a review of studies on sex differentials in mortality by Waldron I 1986, which showed that females lived longer than
males. This difference was explained by gender differences in health related behaviour, exposure to occupational hazards and possibly due to greater susceptibility of males to stresses socially and economically (Waldran I, 1986).

In a life table estimation of survivorship, expressed in percentages, the value for males at the age of 65 years was 78.4 and that for females in the same age group was 86.5. Similarly at the age of 85 years the value for males was 18.5 and that for females was 36.6 (OPCS, 1992).

This is in consistency with the findings in our study. The other factors like males going out for work during working hours, females being more sick than males and that they tend to seek attention may also be responsible for this male and female distribution.

On statistical analysis, however it was found that this difference between the number of males and females in the study group was insignificant.

Age wise analysis:

In the 1000 elderly persons studied, an age wise analyses was done of the whole population and of the males and females separately. It was seen that maximum number of persons were in the age group of 60-65 years. The number of persons in each group declined gradually as the age increased. Similar trends were seen between males and females when analyzed separately signifying that with the advancing age the number of people alive is reduced.

On analysis between males and females of the same age group, it was figured that females dominated grossly over males in the age group of 60-65 years. Thereafter male dominance was seen in all age groups. The reduction in the number of females was almost to the tune of 50% in the age of 71 years and above. Thus it is evident that more females die after the age of 65 years whereas the males live longer in these age groups (OPCS, 1989)

Datas from England and Wales regarding mortality by age in males and females show similar trends. The number of persons alive reduced as the age advanced.

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The sex differentials in mortality showed that females lived longer than males. This difference was explained by gender differences in health related behaviour, exposure to occupational hazards and possibly due to greater susceptibility of males to stresses socially and economically (Waldron I, 1986) as has been discussed earlier.

But in our study on further analysis of males and females by dividing them into different age groups in increasing order, it was observed that the relative number of females declined significantly after the age of 71 years.

Datas have been found which suggested that sex differentials in mortality are beginning to narrow down. The difference in the life expectancy between males and females in England and Wales in 1970-72 was 3.9 and that in 1988-90 was 3.8 (United Nations, 1988). The changes in the relative propensity of men and women to smoke are an important factor in this (Alderson MR, Ashwood F, 1985). Other causes could be early life influences especially nutritional (Forsdahl A, 1977).

In our study the other possible reasons for significant decline in the number of females after 71 years onwards could be unavailability of good health care facilities for women in this area. Also the women are subjected to equal stresses as males both social and economically and the fact remains that in Indian Society the females are still the under privileged class and are looked down upon by the society. They are not given equal care and attention as the men.

Health status analysis:

1000 elderly persons above the age of 60 years were examined carefully. They were subjected to thorough physical, biochemical and electrocardiographic examinations. Any abnormality detected in either of the type of examinations in any elderly person was regarded as unhealthy.
It was observed that most of the elderly persons examined (99.4%) were unhealthy with no significant difference between rural and urban areas (rural 99.7%, urban 99.2%).

It has been observed that there is a progressive deterioration of the physiologic systems with age which is caused by many damaging processes and organisms that the individuals encounter during life. Apparently, repair systems during post maturation life are not able to fully eliminate the damage. The result is a progressive functional inadequacy of the physiologic systems due to the accumulating damage (Masoro EJ, 1998). Also, in the words of Seneca; "Old age is an incurable disease" (Park K, 1997).

The common diseases found among the ambulatory elderly persons studied were hypertension, cataract, osteoarthritis, COPD, IHD, diabetes mellitus, BPH and depression. The very old people were found to suffer from stroke, dementia, heart failure, facility and physical dependence.

These common ailments in the elderly have been reported to account for 85% of the burden of ill health in them (Dey AB, 2001).

Thus it can be concluded that most of the elderly persons suffer from one or the other ailments and are unhealthy.

Health status analysis:

In our study of 1000 elderly persons, there were 489 males and 511 females. Each of them was examined carefully as per the proforma and was also subjected to electrocardiographic and certain biochemical investigations.

It was seen from the study that 99.4% of the elderly persons were unhealthy. There was no significant difference in the health status of the males and females when analyzed separately.
As is evident, aging is characterized by a gradual loss of function in many organ systems, unrelated to pathological condition (Braunwald Eugene, 2001; Cheitlin Melvin D, Zypes Douglas P, 2001).

In a similar study of 1000 elderly persons, it was seen that women had more of long term illness such as disorders of musculoskeletal system (388 women; 264 men). Among males, heart and circulatory disorders were more common (262 females, 342 males). But the overall prevalence of long standing illness or disability among males and females was found to be almost same (OPCS, 1995) (95.8% males, 97.8% females).

Thus it is observed that the prevalence of health problems is very high in the elderly persons irrespective of their sex or residential status.

Electrocardiographic analysis (Normal/Abnormal):

In this study of 1000 elderly persons, a twelve lead and one long lead II electrocardiogram of all the persons studied was recorded by HP Philips Page writer 100. These electrocardiograms were interpreted and analyzed as normal or abnormal. The abnormalities were suggested by the various patterns like major Q or QS pattern, ST changes, abnormal axis deviation, conduction defects, rhythm defects and hypertrophy patterns. Any of these changes when present were regarded as abnormal electrocardiogram.

On analysis of these 1000 ECGs it was found that a little more than half of the elderly persons studied had abnormal ECG. There were 50.4% abnormal ECGs and 49.6% were normal. When the ECGs of males and females were analyzed separately no significant difference in the prevalence of abnormal ECGs was found.

This high prevalence of abnormal electrocardiograms in the elderly persons is a direct indicator of burden of cardiovascular disorders in the persons with advanced age (Lakatta Edward G 1993). This ECG abnormality could be due to heart disease as well other case, like electrolyte imbalance, cerebrovascular disorders specially intra cranial bleed and lung diseases of chronic variety (Gold Berger Ary L. 2001).

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In Framingham heart study (2001) also, it was seen that the prevalence of heart disease in the age group of 75 to 85 years was 44% in men and 28% in women. Whereas in the age group of 85-94 yrs, it increased to 48% in men and 43% in women (Cheitlin Melvin D, Zypes Douglas P 2001).

Thus the prevalence of heart disease increases consistently with increasing age.

Analysis of types of abnormalities in electrocardiogram:

The electrocardiograms of the 1000 elderly persons were carefully analyzed and interpreted. The analysis was done under the main headings of rate, rhythm, P wave, QRS axis, PR interval, QRS duration, ST segment and T wave. The prevalence of abnormalities under each of these broad headings was calculated.

It was observed that maximum abnormalities were found in rate. 14.4% of the elderly persons had abnormality in their rate. The second in order was the abnormality in the T wave which was seen in 12.3% of elderly persons. Lowest number of abnormality was seen in ST segment (2.5%) and PR interval (3.0%). Rate was defined, as the interval in seconds between two successive R waves divided by 60. The normal rate was considered to be between 60-100/min. Abnormalities in rate with advancing age has been reported by many authors. It could be either bradycardia or tachycardia. It was seen that with advancing age the number of pacemaker cells in SA node grossly decreases. Only 10% cells are found to remain after the age of 75 years (Davies MJ, Pomerance Ariela, 1972). Calcification is also seen to occur in aortic and mitral annuli, interventricular septum, AV node AV bundle, bifurcation and proximal left and right bundle branches. This results in further conduction abnormalities (Lakatta Edward G 1993). There is also a marked reduction in the dynamic range of heart rate. This could be due to latent myocardial disease, age related partial autonomic paraesis or degenerative sinus node disease (Camm AJ et al 1980). Also a decrease in the beta adrenergic stimulation of both the heart and vasculature occurs with aging and in hyper tension and is associated with myocardial changes of decreased heart rate at rest and during stress (Lakatta Edward G 1993; Aronow WS 1998).

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For analysis of T wave changes, the normal T wave was first defined. It is the final major wave depicted on the ECG during a cardiac cycle. It represents ventricular recovery. Its amplitude doesn’t normally exceed 5mm in any limb lead, or 10mm in any precordial lead (Wagner Galen S, 1998). The common changes that were observed in T wave were either inversion, flattening or tall T waves. It represents strain, ischaemia, and infarction, reciprocal changes of some other changes or electrolyte abnormalities. (Goldman MJ, GoldSchlager Nora 1989; Schamroth L, 1990).

These changes were second most common abnormality prevalent in the study group (12.3%). It can be due to an increase in the ventricular septal wall by 20%, free wall thickness by 18% and that of left ventricular mass by 15% (Gardin JM et al 1979). This results in either decreased perfusion as compared to demand. It can also be due to prolonged ventricular electrical activity.

The changes in the QRS axis, which is the third most common abnormality detected (8.0%) is also an important determinant of ventricular hypertrophy and certain types of blocks. Thus a change in the QRS axis signifies either ventricular hypertrophy or ischaemic myocardial damage (Kannel WB, Belanger AJ 1991).

The lowest incidences of abnormalities were detected in PR interval (3.0%) and ST segment (2.5%). For the purpose of analysis PR interval was defined as the interval between the onset of the P wave and the onset of the QRS complex. The range of normal PR interval was taken to be 0.12sec - 0.20sec (Schamroth L, 1990). Abnormalities in PR interval have been reported in between 5 to 10% of elderly persons and is usually asymptomatic and an incidental finding (Rodstein M, Brown M, Wolloch L, 1968). Almost similar findings have been found in our study also.

ST segment abnormalities were found to be least prevalent in the study group. It was seen in 2.5% of the elderly population. ST segment, for analysis was taken as that portion of the tracing from end of the QRS complex to the onset of the T wave. It is usually isoelectric, but may vary from 0.5 to 2 mm in

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precordial leads (Schamroth L, 1990). The changes in the ST segment either consist of elevation or depression. The measurement of amount of elevation or depression was done from a point on the baseline point 0.08 sec after the J point, by calculating the vertical distance from that point to the ST segment. (Wagner Galen S, 1998). It has been studied that the ST segment changes increase in percentage from 2 to 15% in a span between 5th and 9th decade (Fieg JL, Gerstenblith Gary et al, 1990).

Thus it was seen that the most common abnormality in the ECG of elderly persons is in their rates and the next most common abnormality is in T wave changes. Least number of abnormalities was seen in PR interval and ST segment.

Heart rate analysis of ECG:

The first step in the analysis of the ECGs of 1000 elderly persons was the analysis of the rate. Abnormalities in the rate were the most common abnormality detected, as has been discussed earlier.

Rate was determined as the interval in seconds between two successive R waves divided by 60, given the ventricular rhythm was regular. If the ventricular rhythm was irregular, the number of R waves in a given period of time (6 seconds) was counted and the result was converted into number of R waves per minute. The normal rate was considered to be between 60-100/min (Gold Schlager Nora, Goldman Mervin J, 1989). Rate less than 60/min was regarded as bradycardia. Rate greater than 100/min was regarded as tachycardia.

In this study it was found that 9.4% of the elderly persons had tachycardia and 5.0% of them had bradycardia. On analysis of males and females separately it was seen that tachycardia was more common in males (10.3%) than females (8.7%). On the contrary bradycardia was more common in females (5.2%) than males (4.7%). Thus it is seen that sinus rhythm prevails in majority (85.6%) of the elderly persons and deviation from the normal is seen in only 14.4% of them.

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As discussed earlier, with advancing age the number of pacemaker cells in SA node grossly decreases. Only 10% cells remain after the age of 75 years (Davies MJ, Pomerance Ariela 1972, Aronow Wilber S 1998).

But the decline in the sinus node discharge with advancing years is hardly significant (Landocone M et al 1955, Kostis John B, Moreyra Abd E, Ainendo Manull T 1982). Fleg JL et al (1982) in his study reported sinus rhythm in 100% (Fleg JL et al 1982). Similarly Camm AJ et al reported sinus rhythm in 93% (Camm AJ et al 1980).

In our study, among the patients with abnormal heart rates, tachycardia was found to be commoner than bradycardia. Tachycardia was almost 2 times more than bradycardia. In the study by Camm AJ et al, also s.tachycardia (14%) was more prevalent than S.bradycardia (10%) (Camm AJ et al 1980).

On analysis of bradycardia in males and females separately, it was found that slightly more females had bradycardia than males. On the other hand, on analyzing tachycardia in male and females separately, it was observed that more males had tachycardia than females. However on statistical analysis, the difference in both the categories was found to be insignificant.

Analysis of bradycardia:

In this study of 1000 elderly persons, total 50 of them were found to have bradycardia. Of these 54% were females and 46% were males. The criteria for bradycardia as discussed earlier was rate <60/min.

This group was then further analyzed according to the degree of bradycardia. Percentage of males and females in each such group was calculated. It was seen that 82% of these persons had rate between 50·59/min. with almost similar distribution between males and females (42% females, 40% males). The rest 18% of persons had rate between 40·49/min. with 6% males and 9% females in it. Thus it appeared that majority of bradycardiac persons had mild degree of bradycardia.

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Similar has also been reported, that individuals older than 80 years without cardiovascular disease don’t have bradycardia <43 beats/min or pauses of more than 2 seconds (Cheitlin Melvin D, Zypes Douglas P 2001). Rates less than that may be a manifestation of sick sinus syndrome (Cheitlin Melvin D, Zypes Douglas P, 2001).

The causes of bradycardia other than sinus node dysfunction can be eye surgery, coronary arteriography, meningitis, intracranial tumors, increased intracranial pressure, severe hypoxia, hypothermia, fibro degenerative changes, convalescence from infections and mental depression (Olgin Jeffrey E, Zypes Douglas P, 2001).

Thus it appears from our study that the bradycardia seen in the elderly persons is usually physiological.

A further analysis of the bradycardia needs to be done to evaluate its cause. This will help to determine whether the bradycardia in these persons is physiological or pathological.

Analysis of S. bradycardia and other associated ECG changes:

Among the 50 elderly persons with bradycardia, further analysis was done to find out the prevalence of other associated ECG abnormalities, besides S.bradycardia, in them. It was found that 46% of these persons had isolated S.bradycardia and the remaining 54% had other associated ECG abnormalities. On analysis of males and females separately it was observed that more males had isolated S.bradycardia (32%) than females (14%). Whereas in the group of bradycardia associated with other ECG changes, number of females was much more (40%) than males (14%). Other associated ECG changes included 13 persons of S. bradycardia with chamber hypertrophy, 10 persons of S bradycardia with conduction defect, 3 persons of S bradycardia with ischemic changes and 1 person had S bradycardia with myocardial infarction.

Thus it appears that the prevalence of isolated S.bradycardia and bradycardia associated with other ECG changes is almost equal. But more males have

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isolated S. bradycardia and bradycardia associated with other ECG changes is more in females. S. bradycardia, as discussed earlier, is usually physiological in the elderly persons (Chetlin Melvin D, Zipes Douglas P 2001, Aronow Wilber S 1998).

On the other hand bradycardia associated with other ECG changes has to be pathological.

Thus it can be observed that bradycardia in males was mostly physiological (32%) and that in females was mostly pathological (40%).

Analysis of symptoms in elderly persons with bradycardia:

Bradycardia most commonly present as dizziness or syncope, but may also present as shortness of breath or angina on exertion (Martin Anthony 1998). So an analysis was done to find out the prevalence of chest pain, dizziness and syncope.

It was found that dizziness was the most common symptom in persons with bradycardia (70%). Closely following was chest pain which was seen in 68% of persons with bradycardia. 22% of them had symptom of syncope when compared with persons of normal heart rate it was seen that the symptoms of chest pain, dizziness and syncope were much more prevalent in persons with bradycardia than in normal persons. They were 1 1/2 times higher in persons with bradycardia when compared to persons with normal heart rate.

The mechanism for this common symptom is hypoperfusion of the brain. (Martin Anthony 1998).

It has been seen that there are many causes of chest pain, dizziness and syncope. Cardiovascular disease may be responsible for 21-34% of syncopal episodes in elderly persons. There mainly include MI, aortic stenosis, sick sinus syndrome, heart block (Lipsitz LA 1993). This is consistent with the findings in our study.
However it was noticed that although symptomatology was much more common in persons of bradycardia, a significant number of normal persons too had these symptoms. It indicates that factors other than bradycardia are operating to produce these symptoms (Lipsitz LA, 1993).

In report it was found that carotid sinus syndrome accounted for 45% of the persons with these symptoms. The next in order was orthostatic hypotension with 32%. 11% had it because of vasodepressor syndrome. Cardiac arrhythmias contributed 21% (Mc Intosh SJ et al, 1993).

Thus it can be concluded that the symptoms of syncope, dizziness and chest pain are very common in elderly persons who gets exaggerated in those having additional. But a substantial number of persons with normal rate also have these symptoms. This indicates that with advancing age, factors other than bradycardia also operate which produce these symptoms as is evident from the above mentioned study.

Analysis of tachycardia:

In this study of 1000 elderly persons, total 94 of them were found to have tachycardia. Of these 53.2% were males and 46.8% were females. The criteria for tachycardia as discussed earlier was rate >100/min.

This group was then further analyzed according to the degree of tachycardia. Percentage of males and females in each such group was calculated. It was seen that 71.2% of these persons had rate between 100-109/min with a slight preponderance in males as compared to females (39.3% males, 31.9% females) 16% had heart rate between 110-119/min with similar distribution between males (7.5%) and females (8.5%). The remaining 12.8% had heart rate >120/min with an equal distribution of 6.4% each in males and females. Thus it appeared that majority of persons with increased heart rate had only mild degree of tachycardia.

The causes of tachycardia can be physiological or pathological like fever, hypotension, anaemia, anxiety, exertion, hypovolemia, myocardia ischaemia, cardiac failure or shock (Olgin, Zypes Douglas P, 2001).
Thus it appears from our study that tachycardia seen in the elderly persons can be both physiological and pathological. A further analysis of tachycardia needs to be done to evaluate its cause. This will help to determine whether the tachycardia in these persons was physiological or pathological.

Analysis of S. tachycardia and other associated ECG changes:

Among the 94 elderly persons with tachycardia, further analysis was done to find out the prevalence of other associated ECG abnormalities, besides S.tachycardia in them. It was found that 45.7% of these persons had isolated S.tachycardia and the remaining 54.3% had other associated ECG abnormalities. On analysis of males and females separately it was observed that more males had tachycardia associated with other changes (33%) than females (21.3%). Whereas in the group of S.tachycardia, number of females was more (25.5%) than males (20.2%). The other associated ECG changes included 26 persons of S. tachycardia with chamber hypertrophy, 20 persons of S. tachycardia with conduction defect, 4 persons of S tachycardia with ischemic changes and 3 persons of S tachycardia with myocardial infarction.

Thus it appears that prevalence of isolated S.tachycardia and tachycardia associated with other changes in ECG is almost equal. But more females have isolated S.tachycardia and tachycardia associated with other ECG changes is more in males.

S.tachycardia, as discussed earlier can be both physiological and pathological (Olgin Jeffrey E, Zypes Douglas P, 2001). On the other hand tachycardia associated with other ECG changes has to be pathological. Also, these changes were found to be more prevalent in males than females. This suggests that, though altered automaticity of SA node occurs equally in both sexes with advancing age, other changes also occur in the cardiac structure and physiology. These changes are relatively more common in males resulting in other changes in ECG besides rate disturbance (Aronow Wilbert S, 1998).

The other changes include changes in chamber size, ischaemia, conduction abnormalities and rhythm disturbances. These changes can be attributed to
increase in ventricular mass, calcification fibrosis of conduction system and stiffening of arteries with the advancing age (Lakatta Edward G, 1993; Resnick Neil M, 2001; Aronow Wilbert S., 1998).

Analysis of symptoms in elderly persons with tachycardia:

Tachycardia most commonly presents as shortness of breath, angina, palpitation, dizziness and syncope (Martin Anthony, 1998). So an analysis was done to find out the prevalence of chest pain, dizziness and syncope in persons with tachycardia. The findings were compared to the prevalence of these symptoms in persons without tachycardia.

It was found that dizziness is the most common symptom in persons with tachycardia (44.6%), followed by chest pain which was seen in 36.1% of persons with tachycardia. 9.5% of them had symptom of syncope. When compared with persons of normal rate, it was seen that the symptoms of chest pain, dizziness and syncope were almost equally prevalent in both the groups.

The mechanism for this common symptomatology, as discussed earlier, is hypoperfusion of the brain (Martin Anthony, 1998). Persistent tachycardia is an indicator of cardiac failure (Olgin JE, Zype DG, 2001). Also, accumulation of degenerative and multiple disease processes with advancing age interact in one or the other way and impair cerebral oxygenation. This results in dizziness and when the cerebral oxygen level falls below a critical level, syncope results (Lipsitz LA, 1993).

This probably is also responsible for the almost equal prevalence of the symptoms of chest pain, dizziness and syncope in persons with tachycardia and those with normal heart rate.

Rhythm Analysis of ECG:

In this study of 1000 elderly persons, analysis of rhythm in the electrocardiogram was done as rhythm abnormalities form a very important group of abnormality in the elderly persons. For the purpose of analysis, if
successive RR intervals were equal, the rhythm was considered as regular, otherwise it was considered as irregular (Schamroth L, 1990).

It was found from our study that 5.1% of the elderly persons studied had rhythm abnormalities. On analysis of prevalence of arrhythmias in males and females separately, they were found to have almost equal prevalence of rhythm disturbances (4.8% males, 5.5% females).

Rhythm abnormalities have been found to be very frequent in hospitalized elderly patients that certain arrhythmias are regarded as normal findings in them (Camm AJ et al, 1980). However ambulatory electrocardiography has been found to demonstrate about 5 times as many arrhythmias as a resting ECG (Martin Anthony, 1998).


The findings in our study are much lower than reported in the above mentioned studies. The reason for this could be that one time standard 12 lead electrocardiographic findings are less sensitive as compared to 24 hrs ambulatory electrocardiographic monitoring in detection of arrhythmias in the elderly persons (Martin Anthony, 1998). Most arrhythmias in the elderly asymptomatic persons are transient and need a continuous monitoring to be detected (Martin Anthony, 1998).

The other possible reason could be that the elderly persons on this region are healthier or lack the risk factors for cardiovascular abnormalities.

Analysis of types of arrhythmias:

As has been discussed earlier that with advancing age there is an increase in elastic and collagenous tissue in all parts of the conduction system and fat
accumulates around SA node with a great decrease in the number of pacemaker cells in the SA node leading to disturbances in heart rate and rhythm (Aronow Wilbert S, 1998; Chelitlin Melvin D, Zypes Douglas P, 2000, Dey AB 2001, Devies MJ, Pomerance Ariala, 1972). To find out the prevalence of different types of arrhythmias in the elderly persons we did an analysis of the electrocardiograms of 1000 elderly persons. The criteria for the diagnosis of these arrhythmias were set at the beginning of the study (described earlier in review of literature Review page no. 35 - 45).

It was found on analysis that ventricular premature beats was the most common type of arrhythmia in the elderly persons in both males and female (1.4% in males, 1.8% in females). The next most common (0.5% males, 0.4% females) was the atrial premature beats. Others included junctional tachycardia (2 cases) and atrial fibrillation (1 case). Paroxysmal atrial tachycardia, junctional premature beats, ventricular bigeminy and ventricular trigeminy were also seen in 1 person each.

It has been reported that with advancing age calcification occurs in aortic and mitral annuli, central fibrous body summit of the interventricular septum, AV node, AV bundle, bifurcation and proximal left and right bundle branches are affected leading to increased frequency of supraventricular and ventricular premature beats (Lakatta Edward G, 1993). These abnormalities are found to be so frequent that certain arrhythmias are often regarded as normal findings in them (Camm AJ et al, 1980). Jerome L Fleg, 1990, in his study reported supraventricular arrhythmias in 11.22% of his subjects (Fleg Jerome L et al, 1990). In another study atrial premature beats were reported in 37% of the elderly persons studied (Manyari DE et al, 1990). In a separate study by Camm AJ et al, 1980 supraventricular arrhythmias were reported in 15% of the elderly subjects. In the same study on 24 hrs ambulatory monitoring of the same elderly persons supraventricular arrhythmias increased to 27% and atrial premature beats were noted in 21% of them (Camm AJ et al, 1980).

Similarly ventricular ectopic activity is also very high in elderly persons. Studies have shown that ventricular premature beats may occur in upto 80% of apparently healthy old people (Camm AJ et al, 1980, Fleg JL et al, 1990).
Fleg JL et al, 1990 reported isolated VPCs in 7.14% of his subjects in a standard 12 lead electrocardiogram. In the same persons on 24 hrs ambulatory ECG monitoring the prevalence was shown to increase to 80% (Fleg Jerome L et al, 1990). In another study 54% of the elderly persons were seen to have VPCs (Manyari DE et al, 1990). A similar study by Camm AJ et al, 1980 showed major ventricular arrhythmias in 15% of the elderly persons in single 12 lead electrocardiograms. On 24 hrs ambulatory monitoring the prevalence increased to 69% (Camm AJ et al, 1980).

Other forms of arrhythmias which are less common may also been seen the elderly persons. Among the supraventricular arrhythmias, atrial fibrillation is seen to increase with age in prevalence. It is seen in 3-4% of persons between 60 to 65 years of age. The incidence doubles for each decade after the age of 60, reaching 8.8% of the population older than 80 years (Manolio TA, Furberg CD, Rautaharju PM et al 1994; Ryder KM, Benjamin EJ, 1999). The prevalence of AF in men and women without cardiovascular disease in the cardiovascular health study was 1.6%, rising to 4.6% in persons with subclinical and to 9.1% in those with overt cardiovascular disease (Furberg CD, Psaty BM, Manolio TA et al, 1994). Jerome L Fleg et al, 1990 in his study reported AF in 11% of his subjects (Fleg JL et al, 1990). Manyari DE et al, 1990 reported it in 3% of his subjects (Manyari DE et al, 1990) and Camm AJ et al, 1980 reported it in 10% of his subjects (Camm AJ et al, 1980). In Framingham heart study 1982 which included 5191 persons between 30 and 62 years of age, when followed up for over 27 years showed the development of chronic atrial fibrillation which increased in frequency sharply with age. 98 of them were found to develop AF (1.9%) (Kannel WB, Abbott CD et al, 1982).

Paroxysmal atrial tachycardia is an uncommon type of arrhythmia and is usually manifested in ill old people. Fleg Jerome L et al, 1990 reported it in 13% of his subjects (Fleg JL et al, 1990), Manyari et al, Camm AJ et al, reported it in 3% and 1% of their subjects respectively (Manyari DE et al, 1990; Camm AJ et al, 1980). Similarly junctional tachycardia and junctional premature beats were observed in 2% and 4% of the elderly persons (Camm AJ et al, 1980). In the study by Jerome L Fleg junctional tachycardia was reported in 1% of the
elderly persons (Fieg JL et al, 1990). Among the ventricular arrhythmias, ventricular bigeminy was reported by Camm AJ et al in 5% of the elderly persons (Camm AJ et al, 1980).

Thus we see that the findings in our study are in consistency with the above mentioned reports. The observation of some of the rare types of arrhythmias like paroxysmal atrial tachycardia, ventricular bigeminy and trigeminy carries special importance. Therefore, it can be seen that, in elderly person's ventricular premature beats is the most common form of arrhythmia followed by atrial premature beats. But other rare forms of arrhythmia too exist in these persons though in a smaller percentage (3.5%-4.5%).

Analysis of symptoms in elderly persons with abnormalities in rhythm:

Abnormalities in rhythm present as breathlessness, dizziness, syncope or chest pain (Martin Anthony, 1998). On analysis of symptoms in person with abnormal rhythm it was seen that 45.1% of elderly persons with irregular rhythm had breathlessness and dizziness. The next most common symptom was chest pain (41.2%). Syncope was least common with 7.9%. However among persons with normal rhythm also, these symptoms prevailed in almost equal frequency with breathlessness being seen in highest number of them (50.5%) and syncope in the lowest number (9.1%).

It has been reported that besides cardiovascular system abnormality, there were various other causes of symptoms of chest pain, dizziness and syncope in elderly persons (Lipsitz LA, 1993). This is consistent with the findings in our study.

It was reported that carotid sinus syndrome accounted for 45% of the persons with these symptoms. The next in order was orthostatic hypotension with 32%, cardiac arrhythmias constituted 21% (McIntosh SJ et al, 1993).

This explains the almost equal incidence of these symptoms in persons with a normal rhythm and in those with an abnormal rhythm.
Analysis of P wave of ECG:

For the analysis of P wave in the ECGs of 1000 elderly persons studied, the normal P wave was defined as the deflection produced by atrial depolarization and was the first positive wave before QRS complex. Its normal duration was considered to be <0.25 mV in all leads (Schamroth L, 1990). P pulmonale was reported when the P waves were tall (over 2.5mm) and peaked in leads II, III, aVF (Goldschlager Nora, Goldman MJ, 1989). P mitrale was reported when P waves were broad and notched in several frontal plane leads and in V4-V6. They were biphasic in lead V1, with a terminal position that was negative (atleast 1mm) and broad (atleast 0.04sec) and represented LAH (Goldschlager Nora, Goldman MJ, 1989).

It was observed from our study that 4.6% of the elderly persons studied had abnormal P wave. P pulmonale was the most common of these all (3%) and P mitrale was seen in just 0.4% of them. Absent, inverted and variable P waves constituted the rest 1.2%. On analysis of males and females separately, males were found to have a little higher prevalence of both P pulmonale and P mitrale.

The most common cause of P pulmonale is right ventricular hypertrophy (Goldberger Ary L, Mirvis David M, 2001). The common cause of isolated P pulmonale is chronic obstructive pulmonary disease (Schamroth L, 1990). In these persons a P pulmonale reflects a more vertical heart position within the chest caused by pulmonary hyperinflation and low level of diaphragm rather than true cardiac damage (Schamroth L, 1990; Goldberger Ary L, Mirvis David M, 2001).

Similarly, P mitrale is most commonly caused by left ventricular hypertrophy (Wagner Galen S, 1998). The other causes of P mitrale can be systemic hypertension, acute pulmonary oedema (Goldman MJ, Goldschlager Nora, 1989). It mainly occurs due to conduction delay within the enlarged atrial wall or due to increased left atrial pressure (Schamroth L, 1990). It can be due to the fact that with advancing age atrial contraction contributes to a great

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extent to ventricular filling due to altered diastolic properties of the ventricle (Spirito Paolo, Marron barry J, 1988; Lakatta Edward G, 1993).

The presence of variable, inverted P wave and absence of P wave suggests sinus node dysfunction and that the atrial impulse arises from places other than SA node. As discussed earlier, this is consistent with the fact that with advancing age the SA node function gradually declines as the number of cells are progressively destroyed (Aronow Wilber S, 1998; Chetlin Melvin D, Zypes Douglas P, 2000; Davies MJ, Pomerance Ariela, 1972).

In our study we have not evaluated the cause of each of the P wave abnormalities detected. However it was a general observation that 4.6% of the population studied had abnormal P wave of which P pulmonale was the most common of all (3.0%). No such similar study on elderly persons has been found to support the datas in our study.

Analysis of PR interval:

In our study of 1000 elderly persons in electrocardiogram, PR interval of all of them was calculated. For the purpose of analysis PR interval was considered as the interval between the onset of P wave and the onset of QRS complex. The normal range was considered to be between 0.12 sec and 0.20sec (Schamroth L, 1990). An interval less than 0.12sec was considered as short PR interval and those greater than 0.20sec were considered as prolonged PR interval.

On analysis of all the electrocardiograms it appeared that 3% of all the elderly persons studied had abnormal PR interval. 2% of them had prolonged PR interval and only 0.6% had short PR interval. The remaining 0.4% had variable PR interval. On analysis of males and females separately it was seen that more males had PR interval abnormalities than females but the difference was insignificant. Thus it was seen that prolonged PR interval was most common of all the PR interval abnormalities.

This is also suggested by the fact that with advancing age there is an increase in the elastic and collagenous tissue in all parts of the conduction system and

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fat accumulates in the SA node (Aronow Wilber S, 1998; Cheitlin Melvin D, Zypes Douglas P, 2000; Davies MJ, Pomerance Ariela, 1972). It was also suggested by Lakatta Edward G that calcification occurs in aortic and mitral annuli, central fibrous body, summit of interventricular septum, AV node, AV bundle and bifurcation and proximal left and right bundle branches. All these lead to conduction abnormalities of which increased PR interval is an important feature (Lakatta Edward G, 1993).

Jerome L Fleg et al in his study reported prolonged PR interval in 6.12% of his subjects (Fleg Jerome L et al, 1990). Manyari DE et al reported it in 7% of his subjects (Manyari DE et al, 1990).

Thus it was a general observation that in our study 3% of the elderly persons had PR interval abnormality of which 2% had prolonged PR interval. It is seen that the value in our study is lower than those in the above mentioned studies. The reason for this could be that the elderly persons in our area are healthier and lack the risk factors for degenerative changes in the heart with advancing age.

Analysis of QRS axis of ECG:

The mean or dominant direction of all cardiac vectors is the mean vector and expressed electrocardiographically as the mean QRS axis. The direction of the mean QRS axis on the frontal plane is known as the mean manifest frontal plane QRS axis and is determined from the frontal plane leads I, II, III, aVR, aVL and aVF (Schamroth L, 1990). The frontal plane axis is normally directed between -30° to 110° (Goldschlager Nora, Goldman MJ, 1989).

The above mentioned facts were kept in mind while calculating the QRS axis of the 1000 elderly persons studied. It was found that 8.0% of the elderly persons had abnormal QRS axis. Of these left axes deviation was seen in 5.7% of them, 2.2% of them had right axis and just 0.1% had QRS axis in NW zone. There was no significant difference between the prevalence of abnormal QRS axis in males and females when analyzed separately (8.6% males, 7.5% females). Also, it was seen that left axis deviation was about 2 times more common than right axis.
deviation.

It has been reported that QRS axis shifts left wards with age, becoming $-30^\circ$ (or more in 20% by the age of 90. It is due to increased LV mass or interstitial fibrosis of the anterior fascicular radiation (Aronow Wilbert S, 1991). Also there is an increase in the ventricular septal wall by 20% and left ventricular free wall thickness by 18% with advancing age (Gardin JM et al, 1979).

Thus the findings in our study correlate with the above mentioned reports. In our study, however, QRS axis abnormality was seen in 8% of the elderly subjects which is lower than the value mentioned in the above report. This could be due to the fact that the value mentioned in the above study was for very elderly persons who were around 90 years of age. But in our study maximum numbers of individuals were between 60-70 years.

So, it can be concluded that QRS axis deviation is common with advancing age resulting due to increased LV mass and interstitial fibrosis of the anterior fascicular radiation.

Analysis of duration of QRS complex of ECG:

In our study of 1000 elderly persons duration of QRS complex was analyzed as normal or prolonged. The upper limit of normal was considered as 0.1sec in frontal leads and 0.11 sec in precordial leads. QRS duration was measured from the onset of Q wave (or R wave in no Q wave was visible) to the termination of S wave (or r' or s' wave if no S wave was visible) (Schamroth L, 1990).

On analysis it was found that 4.6% of the elderly persons studied had prolonged QRS duration. No significant difference in the prevalence between males and females was observed.

It has been reported that prolongation of QRS duration correlates strongly with age and may be a marker of slowly progressive degenerative disease affecting the myocardium (Cheitlin Melvin D, Zypes Douglas P, 2001).

In the Framingham Heart Study (Kreger BE et al, 1989) 2% of subjects older than 70 years were found to have non specific intraventricular conduction

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defects, associated with presence of organic heart disease. In another study of 855 elderly persons older than 50 years observed for 30 years, showed 1% of those aged 50 years and 17% at age 80 years developed bundle branch block. Manyari DE et al, reported widening of QRS in 5% of his subjects with RBBB in 3 subjects and LBBB in 1 subject. In another study of elderly persons over 65 years with aortic stenosis, widening of QRS was reported in 4.9% of them (Roberts William C et al, 1970). Fleg JL et al, (1990) reported AV block and intraventricular conduction defects in 20% of his subjects (Fleg JL et al, 1990) whereas Camm AJ reported it in none of his subjects (Camm AJ et al, 1980).

No relation between bundle branch block and ischaemic heart disease or mortality was found (Erikson P et al, 1998).

Thus, it was a general observation from our study that 4.6% of the elderly persons in our area had prolonged QRS duration. The findings in our study correlate with the reports by Manyari DE et al, 1990 and Roberts William C et al, 1970. However in our study we have not correlated the prolongation of QRS duration and presence of organic heart disease and neither have we done a follow up of these persons to note any change in electrocardiogram with time, as our study was a point study. So no correlation could be drawn with the studies by Kreger BE et al, 1989 and Eriksson P et al, 1998.

ST segment changes analysis:

ST segment changes from an important part of interpretation of ECG in elderly persons as it is an important determinant of myocardial ischaemia (Fleg Jerome L et al, 1990).

In our study for the analysis of ST segment changes first the criteria for an abnormal ST segment was decided. An up sloping ST segment was considered abnormal when the degree of depression at 0.08sec from the J point was 1.5mm or more below the baseline, whereas for a horizontal or down sloping ST segment a depression of 1.0mm at 0.08sec from J point was considered abnormal (Krishna Swami Shanker, 2003).
It was found on analysis that 2.5% of the individuals studied had ST segment changes. On analysis of males and females separately, it was seen that more males had ST segment changes than females. Males had ST segment changes almost 2 times more than females (3.2% males, 1.7% females).

Fleg Jerome L et al, 1990 in his study reported increase in percentage of ST segment changes from 2 to 15% in a span between 5th and 9th decade (Fleg JL et al, 1990).

In another study the incidence of myocardial infarction too showed an upward trend with age with a value of 1.9% in persons forty years and younger to 31.9% in patients older than 80 years (Lakatta Edward G, Schulman Steven P, Gersten Blith Gary, 2001). The incidence is seen to increase due to increase in the severity and diffuse distribution of coronary obstruction. It is probably due to prolonged exposure to atherosclerotic risk factors (Cheitlin Melvin D, Zypes Douglas P, 2001).

The difference in the prevalence of ST segment changes in males and females detected in our study is consistent with the reports in the previous studies. It was reported that men develop CAD at a younger age than women (37% in men aged 65 to 74 yrs, 22% in women of same age group) (Cheitlin Melvin D, Zypes Douglas P, 2001). In another study the prevalence of CAD in persons aged between 75 to 84 years 44% men and 20% women were found to be diseased (Kannel WB, Vokonas PS, 1992). It has also been reported that CAD mortality is about 2 times as high in men as in women (U.S. Department of Health and Human Services, 1996).

ST segment changes, however, occur in conditions other that myocardial ischaemia and infarction. ST segment elevation has been reported in acute myocardial infarction (Wasir HS, 2003; Schamroth L, 1990; Goldschlager Nora, Cannon Christopher P, 2001) Prinzmetal angina (Braunwald Eugene, Selwyn Andrew P, 2001), Pericarditis (Bpodick David H, 2001; Schamroth L, 1990; Wagner GS, 1998) as normal variant (Wasir HS, 2003; Schamroth L, 1990; Goldschlager Nora Goldman MJ, 1989; Wagner GS 1998).
myocarditis (Melvin David M, Goldberger Ary L, 2001).


In our study we have not evaluated the cause of ST segment deviation. However it is a general observation that 2.5% of population studied had ST segment changes. This finding however is lower than the findings in the above mentioned studies. This can be due to absence of sufficient risk factors for CAD. The other factor can be that the people residing in this area are healthier.

T wave changes analysis:

T wave is the final major wave depicted on the electrocardiogram during a cardiac cycle. It represents ventricular recovery. The amplitude of T wave normally doesn't exceed 5mm in any limb lead, or 10mm in any precordial lead (Schamroth L, 1990). The abnormalities in T wave include inverted, flat or tall T waves.

In our study of electrocardiograms of 1000 elderly persons, T waves in each of them was analyzed and it was found that 12.3% of the subjects studied had T wave abnormalities. Of these, the majority (11.7%) had inverted T wave. 0.5% had tall and 0.1% had flat T wave. On analysis of prevalence of T wave changes in males and females separately it was observed that there was no significant difference between them.

T wave inversion is most commonly seen in myocardial ischaemia or infarction (Schamroth L, 1990; Wagner GS 1998). The other causes can be left or right ventricular overload with strain pattern (Goldschlager Nora, Goldman MJ

Similarly tall T waves are seen in posterior wall infarction (Schamroth L 1990; Wagner Galen S, 1998), electrolyte imbalance like hyperkalemia (Goldschlager Nora, Goldman MJ, 1989) and sometimes in cerebrovascular accidents particularly with subarachnoid haemorrhage (Goldberger Ary L, Mirvis David M 2001).

Previous reports by various authors also suggests the prevalence of ischaemia in elderly persons to range between 2-15% (Fleg Jerome L et al, 1990) have an upward trend with value of 1.9% in persons 40 years and younger to 31.9% persons older than 80 years (Lakatta Edward G et al, 2001).

In our study we have not evaluated the cause of T wave changes, however it was a general observations that T wave changes were seen in 12.3% of the elderly persons in the study group of which T inversion constituted, 11.7%. These findings are in consistency with the above mentioned studies.

Analysis of chamber hypertrophy:

As we all know that the heart has 4 chambers and hypertrophy of any of these chambers carries a significance of its own. There are fixed criteria for the diagnosis of chamber hypertrophy from an electrocardiogram. For the purpose of our study, we also fixed the criteria to be used during analysis of chamber hypertrophy. In our study left atrial hypertrophy was designated when the P wave were broad and notched in several frontal plane leads and in V4-V6. They

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were biphasic in lead V1 with a terminal portion that was negative (at least 1mm) and broad (at least 0.04 sec) (Goldschlager Nora, Goldman MJ, 1989). Similarly right atrial hypertrophy was diagnosed when P waves were tall (over 2.5mm) and peaked in leads II, III, aVF (Schamroth L, 1990). Left ventricular hypertrophy was designated by using voltage criteria. It included, presence of SV1, and RV5 (RV6) >35mm or RV5 or RV6>26mm, associated with either RAVL>11mm or R I and SIII >26mm. The last two criteria were only suggestive of presence of LVH and their presence without the first two criteria had no significance (Goldschlager Nora, Goldman 1989). Similarly right ventricular hypertrophy was present when the mean frontal plane QRS axis was >90 degree with prominent anterior forces (RV1 >5mm or R:S ratio >1 in lead V1) (Wagner GS, 1998). Lastly biventricular hypertrophy was diagnosed when the voltage criteria for left ventricular hypertrophy with ST depression and T wave inversion in leads V5-V6 was present along with a frontal plane QRS axis >90 degree or greater (Schamroth L, 1990).

On analysis, it was seen that 20.9% of the elderly persons in our study group had one or more chamber hypertrophy. Almost similar distribution was seen between males and females.

It is also evident from the previous report which shows that the heart increases in mass by an average of 1gm/year in men and 1.5gm/year in women in subjects aged 30-90 years (Lakatta Edward G, 1993). It was also observed that in both sexes interventricular septal wall thickness increase more than the left ventricular free wall (Lakatta Edward G, 1993). In another study it was seen that 20% of the subjects had an increase in ventricular septal wall and 18% had an increase in left ventricular free wall thickness (Gardin Julius M et al, 1979).

Thus, the results in our study are supported by the above mentioned reports. But a further analysis is needed to find out the prevalence of each type of chamber hypertrophy and the probable causes for each of them. However, it was a general observation that 20.9% of the elderly persons studied had one on the other chamber hypertrophy.

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Analysis of atrial hypertrophy:

In our study of 1000 elderly persons, chamber hypertrophy was analyzed as discussed earlier. An analysis of atrial hypertrophy was done separately. For analysis of atrial hypertrophy, the P waves of the electrocardiograms were examined carefully as has been discussed earlier in detail.

It was found on analysis that 2.8% of the elderly persons had right atrial hypertrophy, 0.4% had left atrial hypertrophy and just 0.1% had biatrial hypertrophy. Thus right atrial hypertrophy was found to be much more common than left atrial hypertrophy (7 times). Also, the over all prevalence of atrial hypertrophy was found to be more in males as compared to females.

The most common cause of right atria hypertrophy is right ventricular hypertrophy (Goldberger Ary L, Mirvis David M 2001). The common cause of isolated right atrial hypertrophy is chronic obstructive pulmonary disease (Schamroth L, 1990).

Similarly, the most common cause of left atrial hypertrophy is left ventricular hypertrophy (Wagner Galen S, 1998). The other causes of left atrial hypertrophy can be systemic hypertension and acute pulmonary oedema (Goldman MJ, Goldschlager Nora 1989). The hypertrophy occurs mainly due to increase in left atrial pressure (Schamroth L, 1990).

As has been discussed earlier, atrial contraction contributes to a great extent to ventricular filling with advancing age due to altered diastolic properties of the ventricles (Spirito Paolo, Marron Barry J, 1988; Lakatta Edward G 1993).

In our study the higher prevalence of right atrial hypertrophy as compared to left could be due to the relatively higher prevalence of chronic pulmonary diseases in this region. The factors like hypertension and other risk factors associated with it may be less prevalent in these regions which are responsible for causing left atrial hypertrophy. However it was an overall observation that 3.3% of our study group elderly persons had atrial hypertrophy of which right atrial hypertrophy was more common that left. Also, males had a relatively
higher prevalence of atrial hypertrophy than females, may be because smoking is more common in males in this region as compared to females which is an important contributor to development of chronic pulmonary and cardiovascular ailments (Stout Robert W, 1998).

Analysis of ventricular hypertrophy:

Ventricular hypertrophy is an important finding in elderly persons. In our study we analyzed the prevalence of ventricular hypertrophy as detected from these electrocardiograms of 1000 elderly persons. The criteria in electrocardiogram for establishing right, left or biventricular hypertrophy has been discussed in detail earlier under analysis of chamber hypertrophy.

In our study we observed that 17.6% of the elderly persons had ventricular hypertrophy. Of these left ventricular hypertrophy was found to be almost 10 times more common than right (15.6% LVH, 1.6% RVH). Also it was seen that females had a slightly higher prevalence of ventricular hypertrophy than males (16.1% males, 18.8% females).


Various studies have been done to show the increase in the ventricular size with advancing age. It has been shown that in subjects aged 30-90 years, the heart increases in mass by an average of 1gm/year in men and 1.5gm/year in women.

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In another study, 20% increase in ventricular septal wall, 18% increase in left ventricular free wall thickness and 15% increase in left ventricular mass was shown with advancing age (Gardin Jullius M et al, 1979). An increase in the heart mass with aging was shown to be, mostly due to increase in the average myocyte size (Aronow Wilbert S, 1998). Myocardial lipofuscin and amyloid protein too was found to be deposited in the heart in about half of the aged over 70 years (Hwang YT et al, 1993). According Framingham heart study (1991), prevalence of ECG-LVH was shown to be 10.1 in men and 4.1 in women in 55 to 64 years age group. It was shown to be 7.1 in men and 9.6% in women in 65 to 74 years age group (Kannel WB, Belanger AJ, 1991). In a study of elderly persons with aortic stenosis 52.4% of the subjects were found to has LVH (11 persons out of 21 persons studied) (Roberts William C et al, 1970). Also hypertension, its duration and severity was found to be directly related to LVH (Scott Andrew K, 1998).

Thus we see the findings in our study are very well supported by the above mentioned reports.

Analysis of non specific ST segment / T wave changes:

As we all know advancing age is associated with diffuse atherosclerosis and damage to the left ventricle (Cheitlin Melvin D, Zypes Douglas P, 2001). These changes are manifested in the electrocardiograms in the form of either specific pattern of infarction or as non specific ST segment / T wave changes. In our study of 1000 elderly persons we analyzed the electrocardiograms of all persons to find out the prevalence of these changes. Here we will discuss the non specific ST segment / T wave changes, which were recognized in the electrocardiogram by ST segment depression of 1mm or more in one or more ECG leads or by ST segment elevation (Golschlager Nora, Goldman MJ, 1989).

On analysis of these changes it was observed that 6.0% of the elderly persons studied had non specific ST segment / T wave changes. Females were found to have a slightly higher prevalence of these changes than males. It has been reported that as the population grows older there is an increase in the prevalence of ST segment / T wave changes. A male propensity has been

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observed, with men developing CAD at a younger age than women. The prevalence of CAD in Framingham cohort aged 75-84 years was 44% in men and 28% in women. In 85-94 years age group it was 48% in men and 43% in women (Cheltlin Melvin D, Zypes Douglas P 2001). In Baltimore longitudinal study the prevalence of exercise induced silent ischaemia was found to increase from 2% in 5th decade to 15% in 9th decade (Gerstenblith Gary 1998). In India, the prevalence was found to be 65.4 and 47.8 per 1000 males and females respectively in urban area and 22.8 and 17.3 per 1000 males and females respectively in rural areas (Park K, 1997).

But the results in our study seem to differ from the results in the above mentioned studies. In our study 6% of the elderly persons were found to have a non specific ECG change which is lower than the findings of the above mentioned studies. Also, in our study females were seen to have a slightly higher prevalence of these changes than males which are reverse of the findings in the previous reports.


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T wave inversion is most commonly seen in myocardial ischaemia or infarction (Schamroth L, 1990; Wagner GS 1998). The other causes can be left or right ventricular overload with strain pattern (Goldschlager Nora, Goldman MJ 1989, Schamroth L, 1990), apical hypertrophic cardiomyopathy (Goldberger AL 1999; Wyne Joshua, Braunwald Eugene 2001), secondary T wave changes as in bundle branch blocks, Wolff Parkinson white pattern (Schamroth L, 1990) ventricular ectopics or paced beats (Morvis David M, Goldberger Ary L 2000, Goldschlager Nora, Goldman MJ 1990), cerebrovascular accident especially intracranial bleed and related neurogenic patterns like radical neck dissection and Stokes Adam's syndrome (Schamroth L, 1990; Wagner Galen S 1998; Goldschlager Nora, Goldman MJ 1989, Mirvin David M Goldberger Ary L, 2001), idiopathic global T wave inversion (Walder LA, Spodick DH, 1991) and as normal variant (Goldberger Ary L, 1999).

This findings of a lower prevalence of non specific non specific ST segment / T wave changes can be attributed to the fact that in this analysis we have taken into account only the non specific changes and not specific infarction. Of other factors could be due to an overall low prevalence of risk factors for CAD in this region. A separate analysis of the prevalence of the infarcts thus needs to be done. Also the higher prevalence of these changes in females could be due to more presence of risk factors like hyperlipidemia, diabetes, obesity, sedentary habits and stress in them (Gerstenblith Gary, 1998; Park K, 1997; Selwyn Andrew P, Cheitlin Melvin D, Zypes Douglas P, 1998) as compared to males in this region.

Analysis of old and fresh myocardial infarction in ECG:

In the elderly persons, myocardial infarction results in an increase in mortality compared with younger persons. 80% of all deaths due to myocardial infarction occur in those 65 years of age and older (Wegner NK 1992). Thus, looking at the importance of myocardial infarction in the elderly persons, a detailed analysis of prevalence of this change was done in our study group on the basis of the electrocardiographic changes seen. An old myocardial infarction was diagnosed when T wave inversion and Q wave or QS complex was present, in

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which Q wave was at least 0.04 sec in duration and 25% of the R wave height in a given lead (except III, aVL and V1) (Goldschläger Nora, Goldman MJ, 1989). A recent myocardial infarction was diagnosed by ST segment elevation and tall upright T waves (Schamroth L, 1990).

It was found on analysis that 2.9% of the elderly persons had myocardial infarction. On analysis of males and females separately, males were found to have a slightly higher prevalence of myocardial infarction than females (3.7% males, 2.2% females). It has been reported that persons aged 55 to 64 years were 22 times more likely to die of MI than were persons younger than 55 years, whereas persons aged 65-74, 75-84 and >85 years were at 4.2, 7.8 and 10.2 times greater risk of dying (Goldberg RJ et al 1998). In another study the in hospital mortality from MI in persons younger than 65 years of age was 3%, of those between 65 to 74 years was 9.5%. It was 19.6% at age 75-85 years and 30.3% in those older than 85 years (White HD et al 1996). The prevalence of CAD in the United States now is 1-2% and mortality is 2-4%. In India, its prevalence ranges from 4-9.45% (4% rural areas, 9.45% urban areas) (Sethi KK, 2003).

Thus we see the results obtained from our analysis are in consistency with the above mentioned datas. So with this analysis, we see that in elderly persons, ischaemia is more prevalent in females (as discussed earlier, refer table no. 39) whereas infarcts are more common in males. This shows that elderly females have more diffuse involvement of the coronaries, whereas the males have more of segmental involvement. This was proved from the Framingham study, 1995, also in which angina was the presenting symptom in 47% of women with IHD, whereas myocardial infarction was the most initial symptoms in 46% of males (Murarbito JM 1995).

Analysis of areas of infarction from ECG:

Moving further in the analysis of infarction in the elderly persons, the areas of prevalence of infarcts were analyzed, in the same way as was done for areas of ischaemia. Analysis for males and females was done separately.

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On analysis it was seen that among males, anterior wall and combination of 2 or more walls of infarct was the most common (33.3%). Whereas in females inferior wall infarction predominated all other areas of infarction (82%). It has been reported that atherosclerotic lesions in coronary arteries are distributed in one or more of the 3 major coronary arterial trunks, the highest incidence being in the anterior descending branch of the left coronary (anterior wall infarction), followed in decreasing frequency by right coronary artery (inferior wall infarction) and still less in circumflex branch of left coronary artery (lateral wall infarction) (Mohan Harsh, 1995).

In another study by Mavani DB 2001 showed that 100 males had anterior wall MI as against 71 males who had inferior wall MI. Among females, 15 were found to have anterior wall and 14 had inferior wall MI (Mavani DB 2001).

Thus we see that among males, the left anterior descending artery is more commonly involved than the others, whereas in females, right coronary artery is more commonly involved.

Analysis of prevalence of fresh and old myocardial infarction and their symptoms in elderly persons:

In elderly persons, myocardial infarction results in a variety of symptoms depending on the duration and the extent of myocardial infarction. A detailed analysis of the prevalence of fresh and old MI in elderly persons and the symptoms present in them was done. For the purpose of analysis, a fresh MI was present in ECG when the T waves in the leads representing the area of MI were inverted along with the presence of other signs of MI. An old MI was present when the T waves were upright in the leads showing signs of MI (Goldschlager Nora, Goldman MJ, 1998).

It was found on analysis that fresh MI was slightly more common than old MI in both males and females (1.6% fresh MI, 1.3% old MI). On analysis of symptoms in these persons it was seen that among males chest pain and breathlessness were equally common in fresh and old MI. However in females, breathlessness was more common in fresh MI (43.7%), but in old MI, both these symptoms were

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equally common (30.8% each).

It has been reported that in elderly persons, AMI results in an increase in mortality compared with younger persons. 80% of all deaths due to AMI occur in those 65 years of age and older (Wegner NK, 1992). Age alone can result in changes that increase mortality from AMI due to increasing diastolic dysfunction, altered baroreceptor and beta-adrenergic receptor responsiveness and age related decreases in renal and pulmonary function, all of which make the elderly persons vulnerable to increased complications (Cheitlin Melvin D, Zypes Douglas P, 2001). Complications of MI are also more frequent in the elderly including CHF, atrial arrhythmias, cardiogenic shock and cardiac rupture (Cheitlin Melvin D, Zypes Douglas P, 2001).

The Multicenter Investigation of limitation of infarct size Study group reported that 65-74 years old persons with acute infarction had a higher frequency of CCF (44 Versus 28%), in hospital death (14 Versus 7%) and 1 year mortality for hospital survivors (19 Vs 5%) than less than 65 years (Tofler GH, Muller JE, Stone PH et al, 1988).

This probably may be the reason for the slightly higher prevalence of persons with fresh MI as compared to old MI, as elderly persons with MI may not be surviving for a long time.

It has also been reported that symptoms in elderly persons are more likely to be dyspnoea and those related to decreased cardiac output rather than typical chest pain (Solomon CG, Lee TH, Cook EF et al, 1989).

Similar has been observed in our study in which breathlessness was found to be more common than chest pain in persons with fresh MI.

Thus it was seen that mortality from MI is higher in elderly persons signified by the presence of more number of persons alive with a fresh MI rather than those with an old MI. Also that chest pain is not the most common symptom in these persons on the other hand breathlessness was found to be more common.
Analysis of blocks and conduction defects:

The changes in the sinus and AV node due to aging, along with the decreased sensitivity to adrenergic stimulation, create an increased risk of sick sinus syndrome, as well as AV and bundle branch conduction disease (Cheitlin Melvin D, Zipes Douglas P 2001). This was analyzed in our study by observing the electrocardiograms of 1000 elderly persons. The criteria for diagnosis of the various blocks and intraventricular conduction defects were decided at the beginning of the study and have been described in Review Page No. 35 - 45.

It was found on analysis that left anterior hemi block (LAHB) was the most common abnormality both among males (52.1%) and females (51.3%). Right bundle branch block was the next most common type of abnormality (27.1% males, 25% females). First degree AV block was seen in 11.9% males and 11.8% females. The least common types of abnormalities were second and third degree AV block and left posterior hemi block (LPHB).

It has been reported that with aging, the incidence of AV and bundle branch block is increased, possibly as a result of increasing fibrosis and calcification of the fibrous skeleton of the heart (Aronow WS, 1991). It has also been reported that QRS axis shifts left wards with age, becoming -30 degree in 20% by age of 90 years, possibly due to increased LV mass or interstitial fibrosis of the anterior fascicular radiations. Also right bundle branch block was found in 3% of healthy older people and in 8-10% of those with heart disease (Aronow WS, 1991; Rajala SA, Geiger UK, Haavisto MV et al, 1985). In another report it was observed that types 1 and 2 degree AV block were usually benign and the presence of Mobitz type II and third degree AV block is unusual, even in older persons (Aronow WS, 1991).

In the study by Manyari DE et al, first degree AV block was detected in 7% of the subjects and second degree AV block in 1% of subjects (Manyari DE et al, 1990). Widening of QRS was seen in 5% of subjects with RBBB in 3 subjects and LBBB in 1 subject (Manyari DE et al, 1990). In another study of elderly persons with severe aortic stenosis, LBBB and RBBB were reported in 4.9% each and

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transient heart block was seen in 14.2% subjects (Roberts William C et al, 1970).

Thus we see that the findings in our study are in consistency with the above mentioned reports. So it can be said as a general observation that the most common block in the elderly persons is LAHB and the least common are the $2^{nd}$ and $3^{rd}$ degree AV blocks.

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