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The Electrocardiographic Findings in Patients at Taipei Medical College Hospital — With Special Discussion on Fascicular Block —

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782 Patients received a total of 915 electrocardiographic examinations at Taipei Medical College Hospital. Classification of the ECG findings according to the "Minnesota Code" revealed significant higher incidences of class 1 and class 2 Q waves, tall R waves in left, ST junction and segment depression, T wave inversion, complete RBBB, and atrial fibrillation in patients over age 40 than in patients under age 40. Inverted T waves of 1mm to 5mm was the most frequently found abnomality (11.89%), followed by sinus tachycardia (8.05%), and R waves taller than 26mm in V5 or V6 (5.88%).

Among 30 patients with left axis deviation, 25 met the criteria of left anterior hemiblock (3.19%). There was only one case of combined RBBB and left anterior hemiblock (0.12%).

Among 19 patients with right axis deviation, 5 met the criteria of left posterior hemiblock (0.64%). 2 of them showed combined RBBB and left posterior hemiblock. Pathological arrhythmias were found in the remaining three.

The incidence of complete LBBB was 0.51%, all of them were over age 60. The incidence of complete RBBB was 1.51%, 10 of the 11 patients with this finding were over age 40.

Key words:
left bundle branch block (LBBB), right bundle branch block (RBBB), left anterior hemiblock (LAH), left posterior hemiblock (LPH).

The electrocardiographic (ECG) examination has long been regarded as basic and indispensable diagnostic tool in medicine. The ECG investigations among selected populations, especially on the epidemiological basis, have provided valuable information concerning the prevalence and distribution of certain types of heart diseases [1-3]. However, analysis of ECG in hospital patients is still the most direct method to evaluate the relationship between specific ECG patterns and various disease entities.

QRS axis deviation had been noticed in the early years of clinical electrocardiography, when only three bipolar extremity leads were recorded. In 1956, Grant renewed clinical interest in axis deviation [4]. With the advancement of vectorcardiography and electrophysiological study, knowledge on the etiology and significance of axis deviation expanded rapidly. In 1970, Rosenbaum defined the criteria for left anterior hemiblock (LAH)

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and left posterior hemiblock (LPH) [5]. Since then, the concept of mono-, bi- and tri-fascicular blocks, along with their clinical implication, are topics of extensive discussion in literature [6-10].

The purpose of this paper is to review the ECG finding by using data obtained from Taipei Medical College Hospital. Because of its clearness and popular acceptance, "Minnesota Code" [11] is adapted for classification of ECG findings. Comparison of incidences between patients under and over age 40 is emphasized for people over age 40 are considered to have increased risk of atherosclerotic and hypertensive heart diseases. Increased incidence with age is often a clue to the association between that ECG pattern and ischemic or hypertensive heart diseases. Of course, the clarification of whether such association is coincident or correlated need further investigation [12].

Materials and Methods

During the 21 months period between August, 1976 and April, 1978, 782 patients received a total of 915 ECG examinations at Taipei Medical College Hospital which is a developing general hospital with maximal bed capacity of 250. She is located in the east side of Taipei City and serving as a regional medical center in an area of 150,000 people during the period of study. The age and sex distributions of these patients were shown in Table I.

All ECG were taken with Fukuda FJC-7110 machines and analyzed first by C.Y.H. then checked by C.Z.L. The 1968 revision of Minnesota code [11], which was originally proposed by Blackburn and associate in 1960 [13], was followed for classification of ECG findings. Patients were divided into two groups, group A were those at or under age 40 while group B were those over age 40. The difference in incidences between two groups was compaired by chi-square test. P values less than 0.05 were considered statistically significant.

Table I: Sex and Age Distributions of Patients

Sex \ Age	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - OVER	Gr. A (*)	Gr. B (*)	Total
Male	27	38	67	42	55	87	80	38	10	1	174	271	445
Female	11	32	54	38	44	70	48	33	6	1	135	202	337
Both	38	70	121	80	99	157	128	71	16	2	309	473	782

(*) Group A are patients at or under age 40; Group B are over age 40.

Table II: Incidence of ECG Findings at TMCH

ECG Findings * / Patients / Incidence		Total		Group A***		Group B***		Difference between 2 groups · P #
		N **	%	N **	%	N **	%	
Abnormal Q waves (I)	I-1	8	1.02	0	0	8	1.69	< 0.05
	I-2	14	1.79	0	0	14	2.95	< 0.01
	I-1 & I-2	22	2.81	0	0	32	4.65	< 0.001
	I-3	16	2.04	4	1.29	12	2.53	NS
Axis deviation (II)	II-1	30	3.83	3	0.97	27	5.70	< 0.001
	II-2	4	0.51	1	0.32	3	0.63	NS
	II-3	15	1.91	10	3.23	5	1.05	< 0.05
High R waves (III)	III-1	46	5.88	6	1.94	40	8.45	< 0.001
	III-3	18	2.30	7	2.26	11	2.32	NS
	III-1 & 3	64	8.18	13	4.20	51	10.78	< 0.01
	III-2	10	1.36	9	2.91	1	0.21	< 0.01##
ST depression (IV)	IV-1	28	3.58	2	0.64	26	5.49	< 0.001
	IV-2	43	5.43	2	0.64	41	8.66	< 0.001
	IV-3	17	2.17	0	0	17	3.59	< 0.001
	IV-4	19	2.43	3	0.97	16	3.38	< 0.05
T wave change (V)	V-1	6	0.76	0	0	6	1.26	< 0.05
	V-2	93	11.89	11	3.55	82	17.33	< 0.001
	V-3	41	5.24	2	0.64	39	8.24	< 0.001
	V-4	2	0.25	0	0	2	0.42	NS
AV conduction (VI)	VI-1	2	0.25	1	0.32	1	0.21	NS
	VI-2	1	0.12	0	0	1	0.21	NS
	VI-3	8	1.02	3	0.97	5	1.05	NS
Ventricular conduction (VII)	VII-1	4	0.51	0	0	4	0.84	NS
	VII-2	11	1.51	1	0.32	10	2.11	< 0.05
	VII-3	13	1.66	2	0.64	11	2.32	NS
	VII-5	34	4.34	12	3.88	22	4.65	NS
Arrhythmia (VIII)	VIII-1	22	2.81	7	2.26	15	3.17	NS
	VIII-3	27	3.45	1	0.32	26	5.28	< 0.001
	VIII-4	2	0.25	0	0	2	0.42	NS
	VIII-7	63	8.05	32	10.35	31	6.55	NS
	VIII-8	7	0.89	1	0.32	6	1.26	NS
Miscellaneous (IX)	IX-1	26	3.32	10	3.23	16	3.38	NS
	IX-3	9	1.15	1	0.32	8	1.69	NS
	IX-5	11	1.40	2	0.64	9	1.90	NS

* Criteria of these codes : see text or reference (11).
** N indicates number of patients.
*** Group A are patients at or under age 40, Group B are those over age 40.
\# P < 0.05 are considered to be significant, NS indicated non-significant.
\#\# Higher incidence in Group A than in Group B.

Results

Table 2 provided the incidence of codable ECG findings.

Q Waves (Code I):

Codable Q waves was found in 38 patients. As stressed by Epstein and associates (14), Q waves of class 1 and class 2 (Code I-1 and I-2) have close relationship with ischemic heart disease, so we separated the Q waves of class 1 and class 2 from that of class 3 (Code I-3).

Q waves of class 1 and 2 were noticed in 22 patients (2.81%). All of them were over 40 of age. Q waves of class 3 were found in 16 patients (2.04%). Some of them were at their third or fourth decades of age and the difference between group A and Group B was not significant.

QRS Axis Deviation (Code II):

Frontal QRS axis from −30° through −90° was classified as II-1, from 120° through −150° as II-2 and from 90° through 119° as II-3. Left axis deviation (Code II-1) was more frequently found in group B, while borderline right axis deviation (Code II-3) more in groiup A. The incidence of abnormal right axis deviation (Code II-2) was not significantly different.

High R Waves (Code III):

High R waves in the left (Code III-1 and III-3) existed in 64 patients (8.18%). The incidence of R wave in V5 or V6 higher than 26mm (Code III-1) was 5.88% and that of SV1 + RV5 ⩾ 35mm (Code III-3) was 2.3%.

Right R waves in the right occurred in 10 patients (1.36%). Most of them were infants or children. In most instances, this finding did not indicate abnormality for those under age 16.

ST Junction and Segment Depression (Code IV):

ST segment depression of 1 mm or more (Code IV-1) was noticed in 28 patients (3.58%). Only 2 patients with this finding were under age 40. ST segment depression of 0.5 mm to 0.9 mm (Code IV-2) was foung in 43 parients (5.49%). This chang was also predominantly found in patients over age 40.

17 patients (2.17%) demonstrated ST segment downward slopping at least 0.5 mm but no concomitant junction depression as much as 0.5 mm (Code IV-3). They were all over age 40.

Junctional depression of 1 mm or more with ST segment upward slopping occurred in 16 patients (Code IV-4). Half of them had tachycardia.

T Wave Changes (Code V):

There were 6 patients (0.76%) with deeply inverted T waves of more than 5 mm (Code V-1). 93 patients (11.89%) had inverted T waves of 1 mm to 5 mm (Code V-2). This is the most frequently observed ECG change in this study. T wave negative or biphasic with negative phase less than 1 mm (Code V-3) was found in 41 patients (5.24%). T/R amplitude ratio less than 1/20 (Code V-4) was found in 2 patients (0.25%).

AV Conduction Defects (Code VI):

The incidences for complete, second degree and first degree AV blocks were 0.25%, 0.12% and 1.02%, respectively.

A 13 years old boy with rheumatic fever showed sequential changes of complete, second degree and first degree AV block within 2 days.

A demand type pacemaker was implanted transvenously in a 66 years old man with complete AV block. He received a permanant pacemaker implantation later at our hospital.

No cases of accelerated conduction were found.

The incidences of AV conduction defects were not significantly different between the two groups of patients.

Ventricular Conduction Defect (Code VII):

Complets LBBB (Code VII-1) was

noticed in 4 patients (0.51%), all of them were over age 60. Complete RBBB (Code VII-2) was found in 11 patients (1.66%), only one of them was under age 40. Incomplete RBBB (Code VII-3) was noticed in 13 patients (1.66%). RR' in V1 or V2, not meeting the criteria of VII-2 or VII-3, was classified as VII-5 in the 1968 revision of Minnesota code. This finding was noticed in 24 patients (4.34%). Only complete RBBB showed significant difference in incidence between groups.

Arrhythmia (Code VIII):

Only arrhythmia recorded on complete 12 lead ECG were analyzed. Those usually seen on bedside monitor, like agonal rhythm, ventricular tachycardia, ventricular fibrillation and cardiac standstill were not included.

Frequent premature beats, either atrial, junctional or ventricular in nature (Code VIII-1) were found in 22 patients (2.81%).

If all premature beats were analyzed, either occasional or frequent in occurence, the incidence of premature beats ranked in descending orders were VPC (4.21%, 33 patients), NPC (1.02%, 8 patients) and APC (0.89%, 7 patients).

Atrial flutter-fibrillation (Code VIII-3) occurred in 27 patients (3.45%). Only one patients was in her fourth decade of age, all the rest were over age 40.

Episodes of supaventricular tachycardia (Code VIII-4) were recorded in two patients (0.25%), sinus tachycardia (Code VIII-7) in 63 patients (8.05%) and sinus bradycardia (Code VIII-8) in 7 patients (0.87).

Among the other types of arrhythmia, we had one case of sinoatrial block, one case of ventricular parasystole, two cases of multifocal atrial tachycardia (MAT), three cases of wandering pacemaker between SA node and AV junction. The age of patients with MAT were 67 and 79, both were male and suffered from advanced pulmonary disease.

Miscellaneoue items (Code IX):

26 patients (3.32%) showed low QRS amplitude (Code IX-1). P wave amplitude of 2.5 mm or more (Code IX-3) occurred in 3 patients (1.15%). T wave amplitude greater than 12 mm (Code IX-5) was found in 11 patients (1.40%). Dextroversion was found in a 34 years old woman.

Discussion

The incidence of left axis deviation (Code II-1) in the present study (3.83%) was not significantly different from Ostrander's study [12] in Tecumseh (5.3%) and Tseng's study [2] in Taipei (3.89%).

Among 30 patients with left axis deviation, 21 were men and 9 were women. The sex difference in incidence was not significant, compatible Tseng's data given in Taipei [2], although Ostrander found a significant high incidence in men than in women [12].

Rosenbaum believed that leftward shift of axis beyond −45° was a reliable sign of left anterior hemiblock (LAH) [5]. This strict criteria eliminate almost all false positive diagnoses, but experimental and clinical observations suggest that LAH may be overlooked if the diagnosis is considered only in the presence of extreme left axis deviation [17, 18].

Analysis of 30 patients whose QRS axis lie between −30° and −90°, 3 showed inferior wall myocardial infarction and 2 showed complete left bundle branch block. Excluding these 5 patients, we had 25 cases meeting the crireria of LAH [5]. 9 of these 25 patients had either high R waves in the left meeting the criteria of left ventricular hypertophy (Code III) or ST-T change meeting the requirements of Code IV and V, another one patients had complete right bundle branch block and the remaining 15 showed no ECG abnormalities other than

left axis deviation. It is now generally accepted that left axis deviation in patients with left ventricular hypertrophy, chronic coronary artery disease or cardiomyopathy are induced by block of the anterior division of the left bundle branch; so LAH is diagnosed in the presence of these conditions if the criteria for LAH were fulfilled. In Tecumseh, 41% of patients with left axis devistion were free of other ECG finding that suggested heart disease, and therefore Ostrander concluded that isolated left axis deviation appeared to be a common finding without unfavorable prognostic implications [12].

The incidence of LAH was 3.19% in the present study, that reported by Rosenbaum was 4.58% [5]. The incidence of combined RBBB and LAH was 0.12%, lower than that reported by Lasser et al [19]. and Walt et al [20]. They offered an incidence of approximate 1% in a series of consecutive hospital ECG records. The data are too limited to reach a conclusion in regard to our rarity of combined RBBB and LAH.

We had 4 patients with QRS axis lie to the right of 120° (Code II-2). 3 of them had evidence of cor pulmonale. The etiology of cor pulmonale was kyphoscoliosis in 2 patients and advanced pulmonary tuberculosis in the other. We also had 15 patients demonstrated QRS axis from 90° through 119° (Code II-3). This finding was not codable in the classification system originally proposed by Blackburn [13]. Right axis deviation of this extent is frequently acceptable in children.

If 6 patients with right ventricular hypertrophy, 5 patients under age of 16, 2 asthenic patients with QRS axis lie to the left of 105°, and 1 patients with lateral wall myocardial infarction are excluded from the 19 patients classified as having right axis deviation, a total of 5 patients (0.64%) will meet the criteria of LPH [16]. 2 old men, (one at age 63, the other at age 69), showed combined RBBB and LPH. The incidence of this type of bifascicular block was 0.25%, not significantly different from that of combined RBBB and LAH. However, Scanlon et al. suggested that RBBB and LAH was 6 time more common than RBBB and LPH [21]. Among 3 parients (0.38%) who demonstrated LPH without RBBB, 2 had frequent premature beats and one had atrial fibrillation.

The incidence of complete LBBB (Code VII-1) in patients over age 40 was 0.84%. That was 0.24% reported by Tseng [2] and 0.36% by Lamb [22]. In Tseng's series, same as in our study, all patients with complete LBBB were over age 60. Although no statistically significant age trend was demonstrated in the present study, Rotman and co-workers concluded from their experience in US Air Force that LBBB was predominantly found in older individuals [23]. We had one case of LBBB and first degree AV block; this is the type of bifascicular block that associated with highest frequency of cardiovascular morbility and mortality [24].

According to Tseng [2] and Johnson [25], the incidence of complete RBBB in patients over age 40 was 1.24% and 2.9%. That was 2.11% in our series. It had been recognized that RBBB without associated organic heart disease carried a benign nature and Rotman et al. reported that 94% of patients with RBBB had no organic heart disease [23]. In our series. the incidence of RBBB was significantly higher in patients over age 40. Whether they carry a benign nature await long-term follow-up.

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台北醫學院附設醫院病人之心電圖所見特別是有關傳導枝阻滯的討論

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自1976年8月至1978年4月的21個月間，有782位病人在台北醫學院附設醫院做了915次心電圖檢查。依照明尼蘇達法（Minnesota Code 判讀心電圖，發現異常變化以1毫米至5毫米間的T波倒置出現率最高（11.89％），竇性速脈次之（8.05％），左心室肥大而V 5或V 6之R波大於26毫米又次之（5.88％），0.5毫米至1毫米間的ST節段低陷居四（5.43％），不及一毫米的T波倒置居五（5.24％）。依出現率高低之秩序，其他變化包括：V1有RR′波型（4.34％），電軸偏左（3.83％），大於1毫米的ST節段低陷（3.58％），心房顫動（3.45％），低振輻之Q R S波（3.32％），頻發性早發收縮（2.81％），向上傾斜之ST節段低陷（2.43％），左心室肥大而在V 1有深S波（2.30％），無交界點低陷而ST節段低陷（2.17％），第三類之Q波（2.04％），邊際性電軸偏右（1.91％），第二類之Q波（1.79％），不完全右束枝傳導阻滯（1.66％），完全右束枝傳導阻滯（1.51％），高P波（1.40％），右側之高R波（1.36％），高T波（1.15％），第一類之Q波（1.02％），及第一度房室傳導阻滯（1.02％）。出現率少於1％之變化包括竇性徐脈（0.89％），大於5毫米的T波倒置（0.76％），確定性電軸偏右（0.51％），完全左束枝傳導阻滯（0.51％），T波與R波之比率小於1比20（0.25％），完全房室傳導阻滯（0.25％），上心室性心博過速（0.25％）及第二度房室傳導阻滯（0.12％）。

將病人分爲40歲上下兩組，比較各種異常心電圖變化之發生率，發現第一類及第二類Q波，電軸偏左，左心室肥大而V 5或V 6有高R波，各種型式的ST節段低陷，除了T波與R波比率小於1比20的T波變化，完全右束枝傳導阻滯及心房顫動，在40歲以上之病人皆有意義地多於40歲以下之病人；反之，邊際性電軸偏右及右側之高R波則40歲以下之病人，多於40歲以上之病人。

本報告中，電軸偏左之發生率（3.58％）與其他報告相近，且無性別之差異。30名電軸偏左中，25名合乎左前枝阻滯之診斷，其發生率爲3.19％；合併右束枝及左前枝阻滯在本報告只有一例，發生率0.12％，與其他學者之1％相比顯然較少。

19位電軸偏右之病人中，確定性電軸偏右（大於120°）有4人，其中3人有肺心症，本報告中有5位合於左後枝傳導阻滯之診斷，其中2人合併右束枝傳導阻滯。未合併右束枝傳導阻滯之3位左後枝傳導阻滯病人，皆有病態性心律不整。

本文完全左束枝傳導阻滯之出現率爲0.84％，全部出現在60歲以上之病人，其中一位合併第一度房室傳導阻滯，此爲雙傳導枝阻滯中最嚴重的一種。

完全右束枝傳導阻滯之出現率爲2.11％，40歲以上者居多。其預後是否良好，尚待追查。

台北醫學院附設醫院內科

民國67年六月一日受理