



## PREVALENCE AND CLINICAL CORRELATES OF LOW LIMB LEAD VOLTAGE ECGS IN A PREOPERATIVE PATIENT COHORT: AN OBSERVATIONAL STUDY FROM NORTH KASHMIR

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Conflicts of Interest: Nil

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DOI: <https://doi.org/10.32553/ijmsdr.v4i8.635>

### Abstract:

**Objectives:** To categorize and characterize clinical correlates of patients with resting Electrocardiograms (ECGs) depicting low QRS voltages only in the limb leads.

**Introduction:** Low QRS voltages are arbitrarily defined as 5mm or less in height (0.5 mV or less in amplitude) in majority of the QRS complexes, in each of the six limb leads. From a practical stand point, voltages were measured manually from the zenith R wave to the nadir of Q or S wave which ever was greater.

**Methods:** During the study period (Four yrs), 12 lead resting ECGs depicting low QRS voltages only in the limb leads were collected for 424 patients and manual measurements were recorded. Associated clinical conditions were determined from the integration and interpretation of data related to patient history, findings of clinical examinations, recent investigations and focused perusal of past medical records. These 424 patients were part of the study group who were planned for various surgeries in our hospital and were sent for medical clearance.

**Results:** Known causes of low limb lead QRS voltages were present in around 41% of our patients. Another 40 % of the patients depicted causes which were not earlier reported in the literature. Surprisingly around 19 % of the patients did not conform to the earlier categories and were labeled as idiopathic. Clinical prudence mandates caution in considering this bigger group as a surrogate for normal variants.

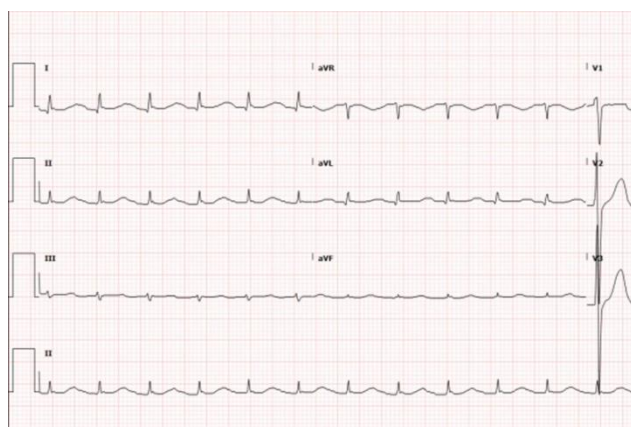
**Conclusions:** In our population ECGs with low QRS voltages specifically in the limb leads are associated with both know causes and many previously unreported conditions.

**Keywords:** Electrocardiograms; low voltages; limb leads; clinical correlates.

### Introduction:

Trigger, for conducting this analytical study was the observation that, a sizeable number of patients turning up at the medical specialist outdoor clinic of district hospital Baramulla; for seeking preoperative medical clearance; before they could be taken up for planned (nonemergency) surgeries at the hospital, came with ECGs depicting low QRS voltages specifically in the limb leads. We were aware that some other patients at the outdoor clinic and few indoor patients also had similar ECG findings.

From a practical standpoint the ECGs depicted low voltages in majority of the QRS complexes in each of the six frontal plane leads or limb leads, quantified arbitrarily as 5 mm or less in height i.e. 0.5 mV or less in amplitude; with the standardization of 10 mm = 1 Mv[1,2].



**Figure 1:** SAMPLE OF A LOW LIMB LEAD VOLTAGE ELECTROCARDIOGRAM

Literature reviews did not provide substantial leads or focused studies specific to this aspect of the ECGs. The direct references were countable [3,4,5]. We were aware

of a clinical dictum that low QRS voltages in the limb leads and/or Praecordial leads, could be part of normal variability of the QRS voltages under the influence of various physiological and demographic factors[6,7,8,9].

However, it was not prudent to take shelter under this class of normal variants [1,6,7] and give clearance for surgery in this era of growing awareness viz a viz the issue of medical negligence.

Clinical milieu dictated that, we categorize our patient's depicting low limb lead QRS voltages on their ECGs for proportions associated with known common causes of such ECGs like Chronic Obstructive Pulmonary Disease, Severe Hypothyroidism, Severe pericardial effusions, Cardiomyopathies – Ischemic or Infiltrative and Obesity [10]. We needed to figure out the percentage of patients wherein, no definite cause was discernable i.e. 'Idiopathic group' and also try to reach at a likely 'Normal Variant' subgroup. There was always a chance that some of our patients from the study group may have some different set of associations not reported elsewhere.

These background dynamics were factored in and this study was planned and subsequently executed.

#### Material and Methods

Total number of 424 Patient constituted our study group cohort. Patient's were examined and relevant clinical data was prospectively recorded in a proforma over a 4 yrs. period (Jan 2014 – Jan 2018). This longitudinal data was analyzed at the end of the trial period for this patient cohort (planned for surgery and medical clearance seeking patient having low limb lead QRS voltages on their ECGs).

On their first visit majority of patients had done the baseline investigations at our hospital like, Blood grouping, complete bloodcount (CBC), Fasting Blood Sugar (FBS), Urea, Creatinine, Bilirubin, SGOT, SGPT, Alkaline Phosphatase (ALP), Electrolytes, Triple Serology, USG Abd-Pelvis, X-Ray Chest and ECG. These investigations were seen and recorded.

In case investigations were not available they were advised for and subsequently when available they were recorded. These investigations were of mandatory nature for all patients seeking medical clearance [11]. Therefore, these did not put any additional cost burden on the patients who were part of our study. Prior consent of the patients with low QRS voltage ECGs was taken for using their medical data during the course of study without disclosing their identity. We took authorization from Medical Superintendent of our hospital for this work.

ECGs, which were the main denominators, were repeated once again, to display reproducibility and recorded. The following criteria were applied while manually measuring

the QRS voltages mainly in the limb leads (I, II, III aVR, aVL and aVF). QRS complexes were manually measured from the peak of R wave to the nadir of Q or S wave whichever was greater [2,12].

Some additional investigations needed on clinical merits were done at our hospital like HbA1c%, TSH, Coagulogram, Random Cortisol, 2D Echo Doppler, Upper G.I. Endoscopy and CT Scan chest/abdomen, so as to help arriving at decisions about pre-operative clearance with confidence in a smaller sub set of patients.

A minute segment of cohort patients needing superspecialist consultation/ clearance were sent to our referral Centre i.e. SMHS hospital Srinagar. Some higher investigations (not available at our hospital) like TMT, CAG, PFT, Bronchoscopy if advised by the Superspecialists were done at the same referral hospital. Subsequently on back referral, recommendations of the superspecialists and reports were recorded.

Clinical details pertaining to known comorbid conditions like hypertension, COAD, CAD, Primary hypothyroidism, Diabetes and heart failure were quantified and extrapolated from medical records of the patients. Records were in the form of prescriptions, hospital discharges, procedure notes and investigations. History and examination details were also entered in the proforma. The treatment being taken by the patients i.e. medicines were verified and recorded especially antiplatelets, antihypertensive, anticoagulants, antidiabetics, antiischemics, alpha blockers, inhalational medicines, Nonsteroidal antiinflammatory drugs, steroids, antiepileptics etc.

Based on the integration of data relevant to examinations, investigations and comorbidities; medical clearance was given for the planned surgeries; from time to time, occasionally with a few treatment riders. This process continued from Jan 2014-Jan 2018 for our study cohort and all other patients seeking clearance for surgeries.

Post operatively, one mandatory follow up visit with the medical specialist was conducted. Any complications during surgery or in the immediate postoperative period were also noted. One ECG was repeated on this visit, to look for any variance in the QRS voltages in the limb leads during the intervening period and exclude any reversibility element i.e. increase in amplitude[8].

A small proportion of patients who were acutely sick, morbidly obese, grossly oedematous, CKD patients were referred to the tertiary care centre for management and further decision about surgical procedures. These patients by default constituted an 'exclusion group' in this study .Patients with QRS voltages 10 mm or less in height

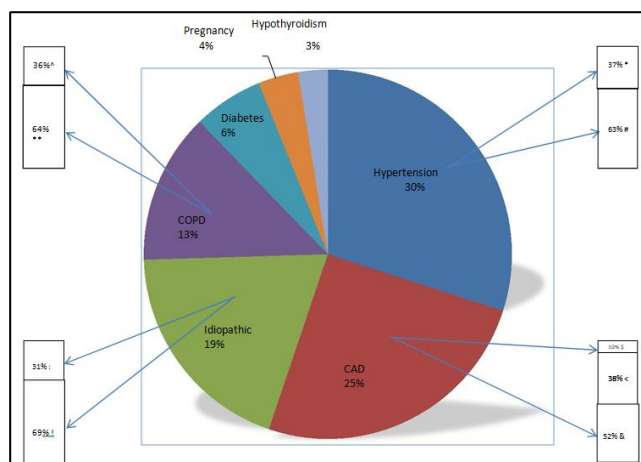
i.e.1.0mV or less in amplitude in the praecordial leads ( $v_1 - v_6$ ) were also *excluded* from this study.

### Results and Discussion

Sociodemographic and clinically relevant medical data of patients was tabulated and subjected to statistical analysis. The Pie diagram so obtained is self-explanatory and depicts the proportions of clinical categories constituting our patient cohort. The 'legend' below the pie chart supplements the results.

**Table 1:**

S.No	Particulars	No	Percentage
1	Hypertension	127	30
2	CAD	107	25.2
3	Idiopathic	82	19.3
4	COPD	56	13.2
5	Diabetes	26	6.13
6	Pregnancy	15	3.54
7	Hypothyroidism	11	2.59
Total.		424	100.00



**Figure 2:** PIE DIAGRAM DEPICTING CONTRIBUTING PROPORTIONS OF VARIOUS PATIENT GROUPS WITH THEIR CLINICAL CORRELATES THAT DISPLAYED LOW LIMB LEAD QRS VOLTAGES ON RESTING ECGs.

### LEGEND

\* Younger age hypertensive (18-50) Years, controlled on treatment : no T.O.D

#Elderly hypertensive (> 50Years) needing optimisation of treatment, no T.O.D

§ Patients with previous MI, with or without stenting, on Antiischaemic treatment : symptomatic dilated CMP

< Hypertensive Cardiovascular Disease, needing optimisation of treatment, T.O.D ++, N-EF

& Elderly with angina on effort, on Antiischaemic treatment: N-EF

^ COPD patients on inhalers, no dependency on LTOT,

\*\* COPD patients with recurrent Hospital admissions, dependent

on LTOT

; Asymptomatic elderly age greater than 50 Years,

! Asymptomatic younger age 18-50 Years

Data from which, our results were computed confirmed that around 40 % of patients (n=170) were from clinical categories which were probably never reported earlier to be associated with ECGs depicting low limb lead QRS voltages; these categories were: Diabetes 6%, Pregnancy 4% and uncomplicated hypertension 30%.

An 'Idiopathic' group 19% (n=80) was also associated with low QRS voltage ECGs. Clinical prudence however restrains us from suggesting that normal variant in our population may be of such a proportion.

Study results also reveal that around 41% patients (n=174) were associated with already known clinical conditions depicting low limb lead QRS voltage ECGs; these conditions were: COPD 13%, Primary Hypothyroidism 3% and CAD 25 % (majority a dilated form of Cardiomyopathy). Our results however did not reveal any patient with 2 D Echo Doppler suggestive of a major Pericardial effusion [13,14] or infiltrative Cardiomyopathy[6,7].

Data from our study on the cohort of 424 patients, which was recorded, tabulated and followed over a four year period has shown that in patients with low limb lead QRS voltage ECGs, 'Hypertension' is the largest group of associated diseases 30% [n=(127)65 males,62 females]; i.e. nearly equal proportions. Age categorization revealed, a younger subgroup aged 18-50 years 37% (n=47), with hypertension controlled on medications, and, an elderly subgroup aged >50 yrs 63% (n=80), many of them needing optimization of medication doses for better control. Patients in this group were free from Anginal symptoms or any history suggesting TIA or Cardiovascular accidents. Their ECGs in addition did not reveal chamber enlargement, Atrial Fibrillation or overt Ischemic changes. X-Ray chest revealed grossly normal sized Cardiac Silhouettes. These uncomplicated Hypertensives were taken up for surgery at our hospital.

The next most frequent group of patients in our cohort was Coronary artery disease (CAD) 25% [n=(107)66 males,41 females]; males exceeding females. There were three subgroups within the CAD group. The first subgroup comprised of 10% (n=11) patients with history of previous Myocardial Infarction with or without Stenting, who were on antischaemic treatment. They had symptoms of class II – III Angina and Dyspnea. Their ECGs in addition to low voltages revealed prolonged PR intervals in some and widening of QRS complexes (IVCD/LBBB) in majority. Chest X-Ray revealed enlarged Cardiac Silhouette. Echo studies revealed RWMA and dilated ventricles. The visual ejection fraction was reduced, being in the range of 30-50% in around 80% of the patients. All of these features favored

the development of a dilated form of Cardiomyopathy likely Ischemic [15,16,17]. These patients were referred to our referral hospital i.e. Government SMHS hospital, Srinagar for cardiology consultation. They were subsequently taken up for surgery at the higher center only.

A second subgroup from the CAD group comprised of Hypertensive heart disease patients, 38% (n=41) they had historical evidence of Angina on effort class II, along with evidence of target organ damage on ECGs in the form of Left Atrial abnormality and/or voltage LVH depiction or Atrial fibrillation along with low QRS voltages in the limb leads [18,19,20,21]. The chest X-Rays revealed cardiac enlargement and Echo suggested concentric LVH, grade II–III Diastolic dysfunction but no RWMA. Mild CHF was clinically evident in six patients and Atrial Fibrillation was noted in eight patients. These patients needed optimization of treatment, with 4-6 weeks of deferment in the planned surgery; a mandatory cardiologists review and subsequent clearance for surgery at our hospital.

The third subgroup comprised of elderly patients (aged > 50 yrs), with stable Angina (SIHD), on antiischemic treatment 52% (n=55). The low QRS voltage ECGs in addition had ST-T changes; X-Ray chest revealed borderline cardiac enlargement [19,21]. However, their 2D Echo Doppler studies revealed grade I-II Diastolic dysfunction in majority, normal EF, but did not reveal evidence of any gross regional wall motion abnormality (RWMA).

The data characterization of the study also revealed low voltage ECGs in 13% [(n=56) 36 males, 20 females] COPD patients. Two subgroups were evident among the COPD patients with low voltage QRS ECGs [22,23]. One subgroup was taking domiciliary treatment (inhalational medications) without any dependency on long term oxygen therapy (LTOT) 36% (n=20). Second subgroup revealed clinical features of Cor Pulmonale [24] and history of recurrent hospital admissions along with LTOT dependency 64 % (n=36). Age, surprisingly was not a discriminant between these subgroups. Majority of the patients from the second subgroup were referred to the higher center for pulmonary and cardiology consultation and clearance decisions for the scheduled surgery at the tertiary care hospital.

The surprise element in our study was a sizeable group, comprising of patients who were asymptomatic and clinically stable. Their lab data and medical records were noncontributory for characterizations into any of the earlier groups. However the common factor was low limb lead QRS voltage ECGs. We labeled them as 'Idiopathic group' 19% [(n=82) 37 males, 47 females] i.e. females outnumbering males. The subgroup analysis revealed 31% (n=25) elderly patients age >50 years and 69% (n=57)

patients in the age group of 18 -50 years. Clinical prudence dictates caution in considering such a bigger group as a surrogate for 'normal variants' in our population. Since higher investigations like Coronary Angiography, Nuclear cardiac imagings were beyond our working mandate; a properly designed study may help us to reach out at a sizeable normal variant group in our population.

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