CHAPTER VII

Study of -
Clinical Profile and Electrophysiological Changes in acute Myocardial, Ischaemia and Infarction after Nifedipine Therapy.
7.1 Experimental consideration:

If a branch of the dog's coronary artery is tied and an electrode is placed on an area of myocardium supplied by occluded vessels the T wave of the recorded E.C.G. becomes inverted. If the ligature is then removed and the flow of blood is reestablished the inverted T wave becomes normal. Thus T wave inversion indicates ischaemia and is the basis of diagnosis of ischaemia in clinical medicine.

If the ligature is allowed to remain in place, then within a minute or two the ST segment is strikingly elevated and dragging up with it and obliterating the inverted T wave. At this stage, if it is removed, the tracing gradually passes through the inverted T stage and reverts back to normal. ST elevation represents a stage beyond ischaemia but still is reversible and is known as the pattern of injury.

When the pattern of injury is fully developed and the tie is left in place a further striking change occurs. The entire QRS complex becomes inverted to produce a QS complex while the ST segment comes back to the isoelectric line and T wave once more assumes its normal contour. If this is continued, it is found to be irreversible as structural changes have occurred. This pattern is called the pattern of necrosis (Marrioff, M.J.L., 1968).

7.2 Mechanism of the electrographic pattern in myocardial anoxia

The E.C.G. changes resulting from Myocardial anoxia are transitory ST segment deviations and T wave changes.
ST segment changes: It is believed that the currents of injury produce the ST segment deviation. Two theories have been proposed as explanations of this phenomenon.

1. Injury Current of Rest: The injured site will reject ST elevation whereas normal site will record ST depression. This changes are due to electrophysiological phenomenon.

2. Injury current activity: This theory assumes that injured muscle does not become as electrically negative as normal muscle when stimulated. Thus the injured muscle during stimulation will have a lesser negative change and hence has greater positive change than normal muscle during stimulation.

An electrode directly overlying the injured end of the muscle will face this positive change results in an elevation of the ST segment. The electrode overlying the uninjured end will face a negative change during stimulation and therefore will record a ST segment depression.

As a practical rule, an E.C.G. tracing taken directly over injured muscle will record ST segment elevation. If normal muscle less between the electrode and injured muscle, ST segment depression results.

T wave changes: As a result of ST segment depression the T wave may be dragged downwards producing an appearance of T wave inversion. In addition true T wave inversion may occur in those leads which record ST segment depression. This T wave inversion is usually slight to moderate degree. Occasionally one may see very deep T wave inversion simulating that seen in myocardial infarction.
7.3 Calcium Channel Blocker:

Nifedipine in Ischaemic heart disease and Myocardial Infarction:

Total 15 cases are studied of which 11 were male and 4 were female. The age varies from 40 - 70 years and average is 52 years. The patients who has left ventricular failure are included in the study. Out of 15 patients 9 had myocardial infarction affecting different portions of the heart and 6 had ischaemic heart disease. Out of 9 patients, 2 cases showed ischaemic heart disease at admission and subsequently after 24 hours, E.C.G. showed recent myocardial infarction. On admission, patients were given oxygen, diuretics (Frusemide) and Nifedipine sublingually 10 mg. by opening the capsule followed by oral capsules 10 mg. thrice daily. Those who were hypertensive had Nifedipine Retard (20 mg) thrice daily or twice daily. Most of the patients were brought within one hour and only 2 cases were brought after 2 hours.

Time taken for clinical improvement: All the patients improved within 3-4 hours and one patient expired inspite of all treatment.

7.4 Supportive treatment: Apart from oxygen and diuretics, sedation was given in the form of Morphine & Diazepam.

In all cases, serum electrolytes (sodium, potassium and calcium) and urinary calcium, SGPT were done. SGPT levels were very high in cases of Myocardial infarction. In all cases, serum calcium was between 9.5 - 10.5 mgms and only in one case it was 11.5 mg. It was interesting to note that the patient who had serum calcium level 11.5 mg% developed resistant tachycardia and cardiogenic shock and died after 30 minutes of resuscitation.
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case - (1) Inferior wall Ischaemia

I
Before - ST flat
After - ST elevated
T inverted

II
Before - ST flat
I inverted
After - ST flat
T upright

III
Before - ST flat
T inverted
After - ST flat
T upright

V3
After - ST elevated

VS
Before - T inversion

V5
After - T upright

V6
Before - T inversion
After - T upright

AVL
Before - ST depression
After - ST Depression
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case (2) - Inferior wall ischaemia

Before

After

II
ST segment flat

II
ST segment flat

III
ST - flat

III
ST - flat

V6
ST - flat

V6
ST - flat

AVF
ST - elevated

AVF
St - Flat
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case (3) : Left ventricular hypertrophy and lateral wall ischaemia

Before

V1
ST - flat
T - inverted

After

V1
ST - elevated
T - upright

V5
T - upright

V5
T - inverted

V6
ST - elevated

V6
ST - flat
### 7.5 E.C.G. Changes:

<table>
<thead>
<tr>
<th>Before Nifedipine</th>
<th>After Nifedipine</th>
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<tbody>
<tr>
<td><strong>Case (1): Inferior wall Ischaemia</strong></td>
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<tr>
<td>Lead I - T wave inversion</td>
<td>T wave upright but amplitude less</td>
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<tr>
<td>Lead II - T wave inversion</td>
<td>T wave upright ST segment slightly depressed</td>
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<tr>
<td>Lead III-</td>
<td>T wave inversion</td>
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<td>ST - flat</td>
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<tr>
<td>V₅</td>
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<td>V₆</td>
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<td>ST - flat</td>
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<td><strong>Case (2): Inferior wall Ischaemia</strong></td>
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<tr>
<td>Lead II - ST segment flat</td>
<td>ST segment flat</td>
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<tr>
<td>Lead III - ST - flat</td>
<td>ST - flat</td>
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<tr>
<td>aVF - ST - flat</td>
<td>ST - slightly elevated</td>
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<td>V₆ - ST - flat</td>
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<td><strong>Case (3): Left Ventricular hypertrophy and lateral wall Ischaemia</strong></td>
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<td>Lead I - ST - flat</td>
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<td>V₁</td>
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<td>V₅ - T wave inversion</td>
<td>T wave upright</td>
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<td>V₆</td>
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</tbody>
</table>
Electrophysiological changes in myocardial Ischaemia before and after Nifedipine

Case (4) - Global Ischaemia

Before

I
ST - flat

II
ST - elevated

III
ST - flat

AVF
ST - Flat
T - inversion

AVL
ST - flat
T - upright
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case (4) - Global Ischaemia

After

I

ST - flat

II

ST - flat

III

ST - depressed

V6

ST - elevated

AVF

ST - flat

AVL

ST - flat
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case (5) - Inferior wall Ischaemia

Before

L1
ST segment - flat

L2
ST segment - flat

After

L1
ST segment - flat

L2
ST segment - elevated

Before

AVF
ST segment elevated

After

AVF
ST segment flat
Electrophysiological changes in myocardial ischaemia before and after Nifedipine therapy

Case (6) - Inferior wall Ischaemia

Before

L2
ST - flat
After

ST - flat

II
ST - elevated
Before

ST - elevated

V6
ST - depressed
T - inverted
After

AVF
ST - flat

AVF
ST - elevated
<table>
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<tr>
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<tr>
<td><strong>Case (4): Global Ischaemia</strong></td>
<td></td>
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<tr>
<td>Lead I - ST flat</td>
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</tr>
<tr>
<td>Lead II - ST flat</td>
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<tr>
<td>Lead III - ST depressed</td>
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</tr>
<tr>
<td>aVF - ST flat</td>
<td>ST flat</td>
</tr>
<tr>
<td>aVL - ST flat</td>
<td>ST flat</td>
</tr>
<tr>
<td>V6 - ST flat</td>
<td>ST elevated</td>
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<td><strong>Case (5): Inferior wall Ischaemia</strong></td>
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<td>ST elevated</td>
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</table>
Electrophysiological changes in Myocardial Infarction before Nifedipine therapy.

B₁ Left Ventricular Hypertrophy with old inferior wall infarction:

ST segment depression

Pathological Q wave

V₅
R wave - 30 mm
S wave - 2 mm

V₆
ST segment depression
P wave inversion

V₁
S wave - 23 mm
R wave - 3 mm

V₄
ST segment depression

aVL
ST segment depression

AVF
Pathological Q wave
Electrophysiological changes in myocardial infarction after Digitalis therapy.

B₁: Left ventricular hypertrophy with old inferior wall infarction:

- **V₁**: S wave - 16 mm
- **III**: Disappearance of Q wave
- **V₅**: R wave - 28 mm
- **AVL**: ST segment elevation
- **L₁**: ST flattening
- **V₄**: ST flattening
- **V₆**: ST segment elevation, T upright
- **AVF**: ST segment elevation
Electrophysiological changes in myocardial infarction before Nifedipine therapy (A) & after Nifedipine therapy (B)

B2 - Anterior Wall infarction:

A

Pathological Q wave
T wave inversion

Pathological Q wave
T wave inversion

Pathological Q wave
T wave inversion

Pathological Q wave
T wave inversion

Pathological Q wave
T wave inversion

Pathological Q wave
T wave inversion

B

Normal Q wave
T wave upright

Normal Q wave
T wave upright

Normal Q wave
T wave upright

Normal Q wave
T wave upright

Normal Q wave
T wave upright

Normal Q wave
T wave upright
Electrophysiological changes in myocardial infarction before and after Nifedipine therapy

B3: Anterior wall infarction

Before

After

V2
Pathological Q wave
T wave inversion

V2
Normal Q wave
T wave upright

V3
No Pathological Q wave
T wave inversion become upright

V3
Abnormal Q wave
T wave inverted

V5
Pathological Q wave
T wave inversion

V5
Normal Q wave
T wave inverted
<table>
<thead>
<tr>
<th>Before Nifedipine</th>
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<tr>
<td><strong>B₁</strong>: Left ventricular hypertrophy and old inferior wall infarction</td>
<td></td>
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<tr>
<td>SV₁</td>
<td>23 mm</td>
</tr>
<tr>
<td>RV₅</td>
<td>30 mm</td>
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<tr>
<td>Lead III</td>
<td>Pathological Q wave</td>
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<td>aVF</td>
<td>ST segment depression</td>
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<td>Lead I</td>
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<td>V₆</td>
<td>Pathological Q wave</td>
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<td>B₂: Anterior wall infarction</td>
<td></td>
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<td>T - inversion</td>
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<td>B₃: Anterior wall infarction</td>
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</tr>
<tr>
<td>T wave inversion</td>
<td>T - inverted</td>
</tr>
<tr>
<td>ST - flat</td>
<td>ST segment - depressed</td>
</tr>
</tbody>
</table>
Electrophysiological changes in myocardial infarction before and after Nifedipine therapy.

B4 - Inferior wall infarction

Before

After

V1
ST segment elevated
T wave inverted

V1
ST segment slightly elevated
T wave inverted

L2
ST depression
T inversion

L3
ST depression
T upright

III
ST depression
T inversion

L3
ST flat
T flat

AVF
ST depression
T inversion

AVF
ST slightly elevated
T inverted
Electrophysiological changes in myocardial infarction before and after Nifedipine therapy

B5: Subendocardial infarction

Before

V1
ST depression
T inversion

ST depression
T upright

V5
ST depression
T upright

V5
T wave inversion

After

V1
ST elevated
T wave upright

V5
ST depression
T upright

V5
ST depression
T wave inversion
<table>
<thead>
<tr>
<th>Before Nifedipine</th>
<th>After Nifedipine</th>
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**B₄** : Inferior wall infarction

- Lead II - ST - depression - ST - depression
  - T - inversion - T - upright

- Lead III - ST - depression - ST - flat
  - T - inversion - T - flat

- aVF - ST - depression - ST - flat
  - T - inversion - T - flat

- V₁ - ST - segment - elevated - ST - slightly elevated
  - T - inversion - T - inverted

**B₅** : Subendocardial infarction

- V₄ - T wave inversion - ST - depressed
  - T - upright

- V₅ - T wave inversion - ST - slightly depressed
  - T - upright

**B₆** : Subendocardial infarction

- V₁ - ST - depressed - ST - elevated
  - T - inverted - T - inverted

- V₂ - T - inverted - T - inverted

- V₃ - ST - depressed - ST - flat
  - T - inverted - T - flat

- V₄ - ST - flat - ST - upright
  - T - inverted - T - upright

- V₅ - ST - Normal - ST - sagging
  - T - inverted - T - upright
Electrophysiological changes in myocardial infarction before and after Nifedipine therapy

B7: Anterior Wall infarction

Before

I
ST segment flat
T wave upright

II
ST - flat
T - upright

V4
ST - Flat, Pathological
T - Inversion

After

I
ST segment flat
T inverted

II
ST - depression
T - inversion

V4
ST - elevated
T - inversion
Q Normal

After-
V6
ST segment elevated
T upright

Before-
V6
ST depression
T inversion
Electrophysiological changes in myocardial infarction before and after Nifedipine therapy.

B9: Anterior wall infarction

Before - Pathological Q wave

After - Pathological Q wave

Before - ST flat
T inversion

After - ST elevated
T upright

Before - Pathological Q wave
T inversion
Electrophysiologic changes in myocardial infarction before and after Nifedipine therapy

B₀ : Inferior wall infarction

A V L Before - ST depression

A V L After - ST flat
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<tr>
<th>Before Nifedipine</th>
<th>After Nifedipine</th>
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**B₇ : Anterior wall infarction**

- **Lead I** - ST - flat - ST - flat
  - T - inverted - T - upright

- **Lead II** - ST - depressed - ST - flat
  - T - inverted - T - upright

- **V₄** - ST - flat - ST - flat
  - T - inverted - T - upright

- **V₅** - ST - depression - ST - flat
  - T - inversion - T - inverted

**B₈ : Inferior wall infarction**

- **Lead I** | ST - flattening | ST - flattening
  - T - inversion | T - flat

- **aVL** | T - inversion | T - flat

- **V₄** | ST - depression | ST - elevation

- **V₅** | T - inversion | T - upright

- **V₆** - ST - depression - ST - flat
  - T - inversion - T - upright

**B₉ : Anterior wall infarction**

- **V₂** - Pathological Q wave - Pathological Q wave
  - T wave - upright - T wave - flat

- **V₃** - Pathological Q wave - Pathological Q wave
  - ST - elevation - ST - depression
  - T - inversion - T - upright

- **V₄** - Pathological Q wave - Pathological Q wave
  - ST - depression
  - T - inversion - T - upright
7.6 Discussion:

Fifteen cases of coronary heart disease were studied to see the effects of Nifedipine. Out of fifteen cases, six were ischaemic heart disease and nine were myocardial infarction. The cases were diagnosed on the basis of the clinical profile. E.C.G. changes and rise of enzymes according to criteria of WHO - 1976. The clinical profile is more pathognomonic because sometimes the enzymes are not raised in prolonged ischaemic pain and in coronary artery disease. (Gottlieb et al, 1988). Similarly high isoenzymes (CK MB) levels were documented after heavy exercise (Strauss et al 1982). Thus the present criteria of inclusion of the cases were more rational.

In the present study, the effect of Nifedipine was excellent in regards to symptomatic relief and subsequent follow up. All the patients recovered completely except one who died after 2½ hours inspite of all treatment. It is interesting to note that the patient had high calcium level (11.5 mg%). No data is available relating the outcome of the patient with the calcium level. However, such type of patients need detailed evaluation including autopsy studies. Our results are quite comparable with the observation of other authors. Moskowitz et al 1979, Muller, M.S. and Chahine, R.A., 1981 have described that Nifedipine is a good drug in stable angina. Flugenholtz et al 1981, Muller, J.E. et al, 1984, Gurstanblith, et al 1982 have described that Nifedipine is a drug for unstable angina, Jean et al, 1991 have also recommended Nifedipine as a drug for coronary insufficiency diseases.
Gettleib et al (1988) has suggested that Nifedipine is a drug of choice in Myocardial infarction. Nifedipine acts by reduction of after load which is mediated by peripheral vasodilatation, increase in coronary flow via coronary vasodilatation and antispasmodic effects and there is a possibility of direct protective effects on the myocardium.

In the present study, there is definite improvement of E.C.G. after Nifedipine therapy. This may be due to increase in coronary blood flow in the ischaemic area. In animals, it has been well documented by different authors (Milen et al 1984, Nayler et al 1980) that the infarct size is less but it is quite controversial in human beings. The authors (Muller et al 1984, Sirnes, et al 1984) have documented that the infarct size remains same.

It is very interesting to note that during 6 months regular follow up no one has recurrence of attack though all the patients were on Nifedipine. Thus this study should be concluded that Nifedipine is a unique drug in the treatment of myocardial, ischaemia and infarction and it also a good drug as a prophylactic for prevention of recurrence of attacks.