

# Correlation between NT PRO BNP and Impedance Cardiography in Patients of AMI

Bhabani Prasad Chattopadhyay<sup>1</sup>

## ABSTRACT

**Introduction:** NT pro BNP is a relatively costly investigation. It is used for the diagnosis and prognostication of heart failure. However it is not widely available particularly in rural areas of India. On the contrary Impedance cardiography (ICG) is a relatively cheap, simple and promising newly re-emerging tool that can also be used in the assessment of heart failure. Study aimed to evaluate the correlation between NT Pro BNP and Impedance cardiography in patients of AMI.

**Material and Methods:** Estimation of NT-Pro BNP, Echo-doppler and Impedance Cardiography parameters were done in addition to the recording data of other relevant clinical parameters, blood investigations and invasive procedures (as indicated with the intention to treat) in 200 patients of Acute Myocardial Infarction in the department of Cardiology of Medical College and Hospital, Kolkata.

**Results:** Statistical analysis revealed that there is a negative correlation between NT Pro BNP and impedance cardiography derived LVEF ( $r = -0.734620617$ ) which implies that higher the value of NT Pro BNP lower will be the value of ICG derived Left Ventricular Ejection Fraction. The negative correlation between NT Pro BNP and impedance cardiography derived (SV) Stroke Volume ( $r = -0.784620617$ ) also implies inverse relationship between NT Pro BNP and SV. On the other hand there is a positive correlation between NT Pro BNP and Death at 1 year ( $r = +0.58956$ ) which implies that the chance of mortality is high with higher value of NT Pro BNP. Similarly there are positive correlations between NT-Pro BNP and number of re-hospitalisations ( $r = +0.472006656$ ) and ischaemic time ( $r = +0.84645541$ ) which implies that higher the value of NT Pro BNP higher will be the number of rehospitalisations and the ischaemic time in them was longer. There is positive correlation between Impedance Cardiography derived Left Ventricular Ejection Fraction, Stroke Volume with echo-doppler derived LVEF and SV ( $r = +0.615$  and  $p$  value was  $<0.001$ ). ICG-derived LVEF and SV like the echo-surrogates are negatively correlated with the NT Pro BNP and  $p$  value  $<0.001$  in case of both the parameters.

**Conclusion:** There is significant correlation between EF determined by either Echodoppler study or Impedance cardiography and NT Pro BNP. ICG bears the potential of becoming an important cost-effective tool for managing AMI patients in rural health care set up.

**Keywords:** NT PRO BNP, Impedance Cardiography, AMI

## INTRODUCTION

Acute Myocardial Infarction (AMI) is quite common and despite lack of adequate infrastructure it is a compulsion for doctors in India to treat patients of AMI even in the under-equipped rural hospitals due to logistic problem of

shifting patient to higher centers primarily because of lack of transportation and communication facilities on round the clock basis. In rural setup usually ECG and Troponin (T or I) biomarker kits are available. Heart failure in the setting of acute myocardial infarction is still quite common. In majority of patients -this heart failure is systolic (90%) and approximately 10% is diastolic with preserved systolic function. NT pro BNP is used for prognostication of AMI and for the diagnosis and prognostication of both types of heart failure. But the estimation of NT Pro BNP is costly and it is not widely available particularly in rural areas of India. Echo-doppler study is a well established modality of investigation in the setting of AMI with and without HF. But again wide availability of this costly echodoppler equipment and availability of expert cardiologist for performing the Echo-doppler assessment is a big obstacle in rural India.

Impedance cardiography (ICG) on the other hand is very similar to ECG tool and is a relatively cheap, simple and promising re-emerging tool that can be used in the assessment of haemodynamics in presence or absence of the heart failure. We have studied the correlation between echodoppler study and impedance Cardiography<sup>1,2,3</sup> and observed that there is good positive correlation between them.

Role of NT-Pro-BNP and Echodoppler study in AMI with and without HF is now well-established. Role of Impedance cardiography in the assessment of haemodynamics has also been studied in the past.<sup>4,5,6</sup> The aim and objective of the present study was to investigate the correlation between NT-Pro-BNP level and Impedance Cardiography in patients of Acute Myocardial Infarction.

## MATERIAL AND METHODS

This study was carried out over a period of two years in the department of Cardiology of Medical College, Kolkata. 200 Patients fulfilling the diagnostic criteria of acute myocardial infarction (presenting with typical chest pain, ECG evidence of myocardial infarction and biomarker criteria of cardiac muscle necrosis) were included in the study. All relevant

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**How to cite this article:** Bhabani Prasad Chattopadhyay. Correlation between NT PRO BNP and impedance cardiography in patients of AMI. International Journal of Contemporary Medical Research 2020;7(11):K1-K4.

**DOI:** <http://dx.doi.org/10.21276/ijcmr.2020.7.11.11>



clinical parameter recording, blood tests, other investigations and invasive procedures were performed as indicated from cardiological viewpoint.

Estimation of NT-Pro BNP(Roche-cobas e 411 Electrochemiluminescence) was done within 24 hours of hospitalization.

ECG gated Echo-doppler study was done (Fig1a to 1d) and the parameters were recorded with GE™ Vivid 7 Dimension machine.

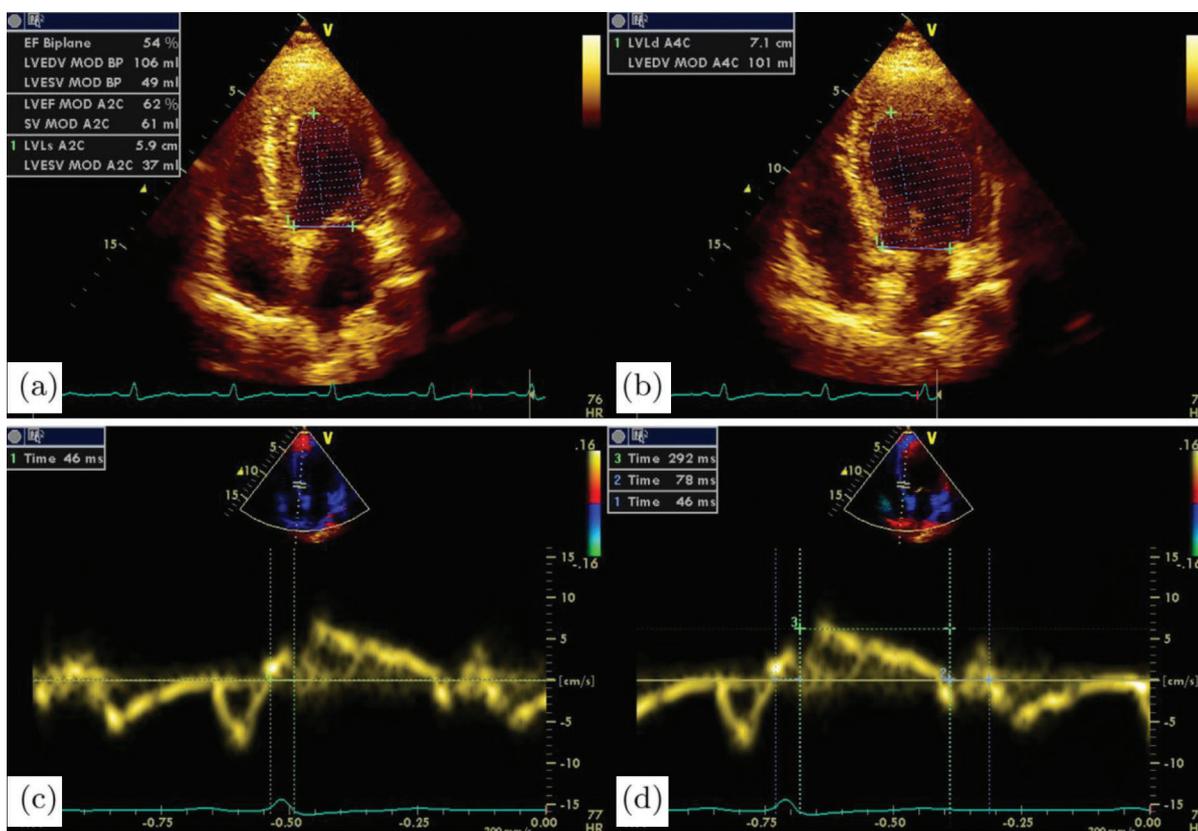
Impedance Cardiography parameters were recorded by the device designed and developed by Sudipta Ghosh et al<sup>2</sup> in IIT, Kharagpur. Impedance cardiography is the recording of the ionic impedance signals comparable to the electrical conduction signals of ECG(Electrocardiogram). ICG is simple as well as cheap like ECG. It has been patented by Ghosh et al, though it is not yet commercially available.

Details of the principle of ICG has been discussed earlier.<sup>1,2</sup>

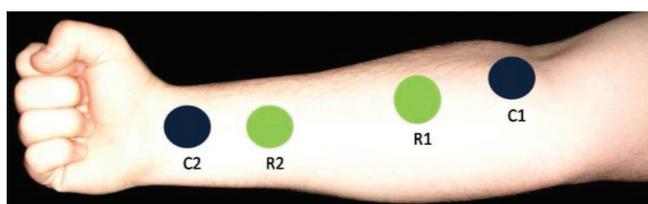
**RESULT**

Correlation between	Value of r
ICG-DERIVED LVEF(all pts) and NT Pro BNP	-0.734620617
ICG-derived Stroke Volume and NT Pro BNP	-0.784620617
NT Pro BNP and ICG derived LVEF in STEMI subgroup	r = -0.8646
ECHO DERIVED LVEF and ICG	+0.615
NT Pro BNP and Death by one yr	+0.58956
NT Pro BNP and Rehospitalisation by one yr	+0.472006656
Ischaemic Time and NT Pro BNP	+0.84645541

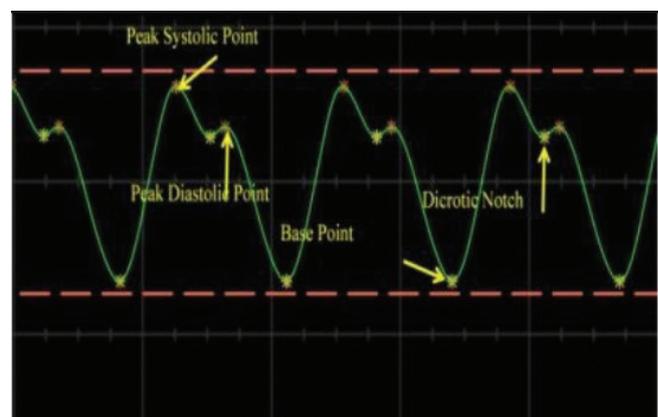
**Table-1:** Correlation between NT-Pro-BNP and ICG Derived Parameters etc



**Figure-1(a-d):** ECG gated Echo-images



**Figure-2:** Electrodeplacement on the fore-arm



**Figure-3:** Impedance Cardiography Signal after filtering

Statistical analysis revealed that there is a negative correlation between NT Pro BNP and impedance cardiography derived LVEF ( $r = -0.734620617$ ) which implies that higher the value of NT Pro BNP lower will be the value of ICG derived Left Ventricular Ejection Fraction. The negative correlation between NT Pro BNP and impedance cardiography derived (SV) Stroke Volume ( $r = -0.784620617$ ) also implies inverse relationship between NT Pro BNP and SV. On the other hand there is a positive correlation between NT Pro BNP and Death at 1 year ( $r = +0.58956$ ) which implies that the chance of mortality is high with higher value of NT Pro BNP. Similarly there are positive correlations between NT-Pro BNP and number of re-hospitalisations ( $r = +0.472006656$ ) and ischaemic time ( $r = +0.84645541$ ) which implies that that higher the value of NT Pro BNP higher will be the number of rehospitalisations and they have longer ischaemic time. There is positive correlation between Impedance Cardiography derived Left Ventricular Ejection Fraction and Stroke Volume with echo-doppler derived LVEF and SV ( $r = +0.615$  and  $p$  value  $<0.001$ ). ICG –derived LVEF and SV like the echo-surrogates are negatively correlated with the NT Pro BNP and  $p$  value was  $<0.001$  for both the parameters (table-1) (figure-4).

Subgroup analysis revealed that the negative correlation between NT Pro BNP and ICG –LVEF is stronger in STEMI subgroup of acute Myocardial Infarction ( $r = -0.8646$ ).

**DISCUSSION**

In our past as well as in this present study we had found that there is positive correlation in between the several different parameters obtained from echocardiography and those same parameters derived from impedance cardiography. Both the modalities correlated with NT Pro BNP as well. Some previous studies showed results establishing utility of impedance cardiography in assessment of cardiovascular haemodynamics. The ESCAPE trial<sup>8</sup> showed

correlation between invasive measurements and non-invasive (impedance cardiography/echo-doppler derived) measurements of the haemodynamic parameters.

Ischaemic time is defined as the time interval between onset of chest pain(AMI) and initiation of revascularization(pharmacological thrombolytic reperfusion/ percutaneous coronary intervention or emergency surgical revascularization) and Ischaemic time serves as a predictor of LV Systolic function.<sup>9,10</sup> NT Pro BNP is elevated in LV systolic dysfunction and ICG derived LVEF is found to be less in these patients with elevated NT Pro BNP. We have previously studied the prognostic value of NT-Pro-BNP in prediction of Left Ventricular systolic function and outcome of patients of Acute Coronary Syndrome<sup>11</sup> and found reasonably good predictive role of NT Pro BNP and that had a negative correlation with echocardiography derived LV Systolic function. Impedance Cardiography is also able to predict the afore mentioned EF and Stroke Volume parameters, without any expert supervision. So this methodology can be used for acquisition of such cardiological parameters whenever facility or expertise of estimation of NT Pro BNP or echo-doppler study are not available.

**CONCLUSION**

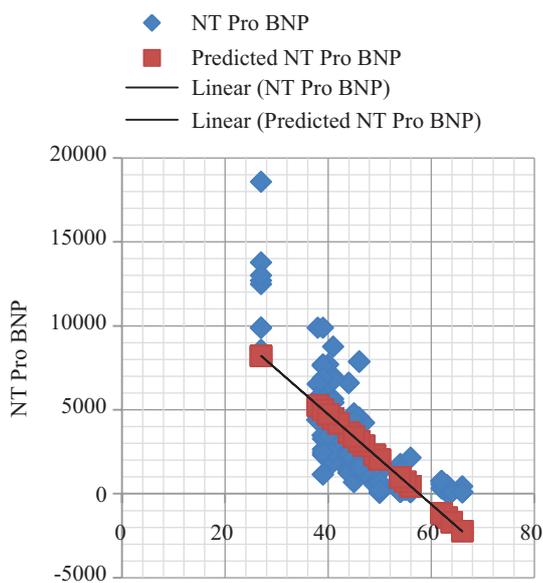
There is significant correlation between EF determined by either Echodoppler study or Impedance cardiography and NT Pro BNP. ICG bears the potential of becoming an important cost-effective tool for managing AMI patients in rural health care set up.

**abbreviation**

NT-Pro-BNP = N-Terminal Pro Brain Natriuretic Peptide, ICG = Impedance Cardiography, AMI = Acute Myocardial Infarction, STEMI = ST Elevation Myocardial Infarction, LVEF = Left Ventricular Ejection Fraction HF = Heart Failure

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**Figure-4:** Correlation between NT Pro BNP and impedance cardiography Derived LV EF

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 28-09-2020; **Accepted:** 19-10-2020; **Published:** 30-11-2020