

Role of β -type natriuretic peptide as predictor of early post-operative outcomes in Chinese patients undergoing anesthesia

Chun Chen and Lei Lin

Department of Anesthesiology, Yichang Central People's Hospital, Yichang, Hubei 443000, China.

Article Info

Received: 27 August 2017

Accepted: 10 September 2017

Available Online: 30 October 2017

DOI: 10.3329/bjp.v12i4.33712

Cite this article:

Chen C, Lin L. Role of β -type natriuretic peptide as predictor of early post-operative outcomes in Chinese patients undergoing anesthesia. Bangladesh J Pharmacol. 2017; 12: 393-96.

Abstract

The purpose of the present study was to assess whether pre-operative and post-operative B-type natriuretic peptide (BNP) levels could be used as the predictor of post-operative complications in Chinese patients undergoing elective surgery under general anesthesia. A total of 80 adult patients were analyzed. Blood sample to measure BNP was collected from each patient before and after surgery to assess the relationship of pre-operative BNP with all possible clinical outcomes. Elevated BNP levels were associated with prolonged hospital stay and mortality. Our study results suggested that the high levels of BNP predict the prolong hospital stay, increased mortality, and increased usage of balloon pump. Also results suggested that the BNP is one of the key predictors of early post-operative outcomes in Chinese patients undergoing elective surgery under general anesthesia.

Introduction

Prediction of early post-operative outcomes is one of the important concerns in current medical practice. For the optimal care and success of medical treatment, prediction of outcome of diseases condition after treatment or surgery with some accuracy plays a vital role in achieving success of medical intervention. Early prediction in outcome helps to improve healing potentials, and give chance to take decision about the future treatments and care intensity and to avoid ineffective diagnostic procedure. Moreover, the understanding of forthcoming consequences of patients' illness is the mainstay of the regaining process (Grassi et al., 2011; Aspromonte et al., 2008; Cohen-Solal et al., 2009; Morrrow et al., 2005; Ang et al., 2009).

In the emergency setting, clinical decision based on the patient's condition has high impact on mortality and death among patients of critical illness. There are several methods used in critical care unit to predict the early outcome of patient condition, the simplified acute physiology score method is the most reliable tools to

predict the outcome. The key limitation of this method includes: Time-consuming method, chances of bias conclusion if there are multiple variables and giving worst values during first 24 hours when the most critical decisions to be made. Thus, there is a need of very simple and effective tool which provides rapid and accurate results (Ang et al., 2009; Cavallazzi et al., 2008; Sanchez et al., 2010; Lancellotti et al., 2010; Shah et al., 2007; Ikonomidis et al., 2010).

Recently, B natriuretic peptide (BNP) is known to provide a good prediction of outcome in cardiovascular disorders which includes failure of heart, acute coronary diseases, deep vein thrombosis or pulmonary emboli of lungs. Apart from the cardiac pathologies, it also indicated in other condition which needs critical care or immediate attention (Ang et al., 2009; Cavallazzi et al., 2008; Sanchez et al., 2010; Lancellotti et al., 2010; Shah et al., 2007; Ikonomidis et al., 2010; Noveanu et al., 2009; Mair et al., 1999). It has been observed that BNP levels were high among the patients with life threatening conditions. Few studies demonstrated that the levels of BNF predicted the post-operative complication in terms



of mortality and morbidity after cardiac surgery (Mair et al., 1999; Struthers, 1994; Morrison et al., 2002; Harrison et al., 2002). In contrast to this, there are few studies which reported variation in response of BNP, possibly due to the age factor or severity factor of cardiac diseases. Since causes of few clinical conditions are complex and uncertain although many efforts were taken to discover the possible reasons.

The role of BNP was not yet evaluated in Chinese patients undergoing elective surgery under general anesthesia. The purpose of the present study was to assess whether pre- and post-operative BNP levels could be used as predictor of post-operative complications in Chinese patients undergoing elective surgery under general anesthesia.

Materials and Methods

This pilot, single center, prospective observational study was conducted on 80 adult patients. The patients were of either gender with age between 20 to 65 years who met the Grade I or II criteria of American Society of Anesthesiology (ASA), and underwent elective surgery under general anesthesia. Inclusion criteria were the patients' need urgent surgical intervention, meeting with ASA Grade II or more criteria. Those were not willing to join this observational study were excluded during screening phase of our study.

Study coordinator explained the study protocol to each patient who agreed to participate in this study. Written inform consent was taken from each patient or their relative to participate in this trial. During screening phase, all the identified patients who were admitted in our hospital for scheduled surgery were undergone laboratory investigation to confirm their suitability as per our study protocol. Each patient was instructed to complete the medical and family history which was required as per this study protocol before the start of surgery. Data related to the surgical intervention during surgery were captured in case report form of each patient.

Blood samples (5 mL) were obtained from the patients both before and after operation. Blood was collected into a tube containing potassium ethylenediamine tetraacetic acid (EDTA). Samples were analyzed for the BNP levels using a fluorescence immunoassay kit (Biosite Diagnostics, USA). The precision and sensitivity of this kit have been previously described (Wieczorek et al., 2002). Blood samples were drawn for BNP analysis after patients rested for 30 min. The venous samples were placed into chilled EDTA tubes and placed on ice. After centrifugation, the plasma samples were stored at -80°C until assay. All data were collected subsequently. The outcome of interest measured after surgery were: Post-operative adverse events including

any cardiac events (each suspected symptom was monitored), cardiac arrhythmia; dependence of ventilator after 48 hours of surgery; time of intensive care support or stay in ICU; total days of hospitalization or hospital stay (longer or shorter); readmission; mortality or morbidity in 30 days or 1 year after surgery; requirement of medicines for any suspected events after surgery.

Since this study was a pilot observational study, no formal sample size calculation was performed. However, we planned to include at least 70 Chinese patients in this study. Descriptive statistics was used for demographic and baseline characteristics. Correlations between BNP levels and outcome of interest in patients undergoing elective surgery under general anesthesia were done using Pearson's correlation. Statistical analysis was performed using version 6.2 of GraphPad Prism.

Results

We identified a total of the 100 medical records of patients during March 2015 to March 2016 who were recommended for elective surgery including cardiac surgery at the time of their consultation. Of these, a total of 80 patients agreed to participate in this study, and willing to provide data as required by the study. The majority of the enrolled patients were males (n=64) with mean (SD) age of 44 (3.2) year who were admitted during March 2015 to March 2016 were studied (Table I).

The majority of patients underwent cardiac surgery with pre-operative ejection fraction was 53.2%. Of the total eligible patients, 10% of patients had myocardial infarction during the last six month before surgical intervention. The most common concomitant disease

Table I

Clinical characteristic of patients undergoing elective surgery under general anesthesia	
Variable	n = 80
Age, year, Mean	44
Male/female, n	64/16
BMI (kg/m ²), Mean	25.4
Pre-operative ejection fraction (%)	53.2
Myocardial infarction in last six month, n	8
Type 2 diabetes mellitus, n	76
Renal insufficiency, n	8
Under went angiography followed by angioplasty, n	30
Cerebrovascular diseases, n	10
Bypass surgery, n	65
Valve replacement, n	10
Septal defect, n	8

Table II	
Clinical outcome among the patients with high BNP levels	
Variable	n = 80
Bypass procedure time, min, Mean (SD)	130 (23)
Hospital stay after surgery, day, Mean (SD)	8.2 (5)
Patients with arrhythmia, n	12
Patients with elevation of cardiac enzyme, n	14
ICU stays more than 5 days, n	66
Ventilator stay more than 2 days, n	73
Reintubation, n	19
Readmission, n	10
Mortality within 30 days, n	4
Mortality within 1 year, n	9
Hospital stay more than 10 days, n	17

was type 2 diabetes mellitus which was observed almost in 95% patients, and all these patients were depended on insulin. A total of 10% of patients had renal insufficiency. A total of 38% of patients had angiography followed by angioplasty with the placement of drug eluting stents. Of the total, 13% of patients had cerebrovascular diseases. The majority of patients underwent bypass surgery (81%), followed by surgery related to valve replacement (13%) and septal defect (10%). The patients who underwent bypass surgery, for them the total mean time of completing procedure was 130 min. A small number of patients had change in heart rate profile and few had mild elevation of cardiac enzyme which could be most probably due to incidence of angina pectoris or myocardial infarction.

Among the patients with high BNP levels, most of the patients stay in ICU for more than 5 days with ventilator access of more than 2 days (Table II). The majority of the patients had at least 1 or more cardiac events after surgical intervention among the patients with high BNP levels. Re-intubation was performed for few of them. Readmission due to cardiac related complication was observed in 13% of patients. Few patients have used balloon pump after surgery. The incidence of mortality within 30 days after surgery was in 5% of patients, whereas the mortality incidence after 1 year of surgery was noted in 11% of patients, which is more than double than the 30 days period. A total of 17 patients (21%) were stayed in hospital for more than 10 days.

Table III shows the relationship between pre-operative BNP levels with all clinical outcomes such as ejection fraction, days stay in hospital after surgery, age, number of coronary blood vessels joined, bypass surgery time. The high levels of BNP levels were associated with the prolong hospital stay, increased mortality, and increased usage of balloon pump.

Table III		
Correlations between pre-operative BNP levels and outcome of interest in patients		
Variables	Correlations coefficient	p value
Age	0.08	>0.05
Ejection fraction	0.29	<0.05
Hospital stay after surgery	0.32	<0.05
Number of blood vessels corrected	0.02	>0.05
Mortality within 30 days	0.09	>0.05
Mortality within 1 year	0.12	>0.05
Bypass procedure time	0.10	>0.05
Readmission	0.09	>0.05
Usage of balloon pump	0.33	<0.05
p value was calculated by Pearson's correlation test		

Discussion

In our study, we found the relationship between pre-operative BNP with all clinical outcomes such as ejection fraction, days stay in hospital after surgery, age, number of coronary blood vessels joined, number of pre-operative coronary blood vessels, bypass surgery time. Among all these variables, we found there was higher correlation of ejection fraction and number of days stayed in hospital with BNP levels. Also there was positive correlation between usage of balloon pump and BNP levels. The relationship between all of them was found positive weak relationship, but the difference was statistically significant. The patients who utilize the balloon pump, and stayed in hospital for more than 10 days had high levels of BNP as compared to the patients who stayed shorter in hospital and have not used the balloon pump. This indicates that the high levels of BNP associated with longer hospitalization stay and increased usage of balloon pump. We also observed that the incidence of mortality was significantly higher in patients whose pre-operative BNP was higher as compared to the patients whose pre-operative BNP was lesser. This indicates that the higher BNP levels predict higher mortality than in patients with lower pre-operative BNP levels. For other outcomes of measure, there was no statically significant difference between outcomes and pre-operative BNP levels.

Our study is the first pilot study suggests the role of pre-operative BNP levels as predictor of early post-operative outcomes in Chinese patients undergoing anesthesia. The study was designed as pilot study and conducted at single study center in China (limitation of study). Therefore, the present findings cannot be generalized to the overall Chinese population. Based on the study results, we suggest for conducting large multi-centric randomized clinical study in future to generalize our findings.

Conclusion

The high levels of BNP predict prolong hospital stay, increased mortality, and increased usage of balloon pump in Chinese patients undergoing elective surgery under anesthesia. This study results support the hypothesis that BNP is one of the key predictors of early post-operative outcomes in Chinese patients undergoing elective surgery under general anesthesia.

Ethical Issue

This study and study protocol was reviewed and approved by institutional ethics committee of Yichang Central People's Hospital, Yichang, China. All the ethical principles which are laid down in Helsinki Declaration of 1964, as revised in 2013 were followed.

Acknowledgement

All authors would like to thank the subjects for their participation in this study.

References

- Ang DS, Kong CF, Kao MP, Struthers AD. Serial bedside B-type natriuretic peptide strongly predicts prognosis in acute coronary syndrome independent of echocardiographic abnormalities. *Am Heart J.* 2009; 158: 133-40.
- Aspromonte N, Valle R, Peacock WF, Vanderheyden M, Maisel A. Inpatient monitoring and prognostic importance of β -type natriuretic peptide. *Congest Heart Fail.* 2008; 14: 30-34.
- Cavallazzi R, Nair A, Vasu T, Marik PE. Natriuretic peptides in acute pulmonary embolism: A systematic review. *Intensive Care Med.* 2008; 34: 2147-56.
- Cohen-Solal A, Logeart D, Huang B, Cai D, Nieminen MS, Mebazaa A. Lowered β -type natriuretic peptide in response to levosimendan or dobutamine treatment is associated with improved survival in patients with severe acutely decompensated heart failure. *J Am Coll Cardiol.* 2009; 53: 2343-48.
- Grassi P, Calderan C, Vassallo MC, Caggegi D, Stenner E, Biasioli B, Berlot G. β -type natriuretic peptide as a predictor of outcome in a general intensive care unit. *HSR Proc Intensive Care Cardiovasc Anesth.* 2011; 3: 59-66.
- Harrison A, Morrison LK, Krishnaswamy P, Kazanegra R, Clopton P, Dao Q, Hlavin P, Maisel AS. β -type natriuretic peptide predicts future cardiac events in patients presenting to the Emergency Department with dyspnea. *Ann Emerg Med.* 2002; 39: 131-38.
- Ikonomidis I, Nikolau M, Dimopoulou I, Paraskevaidis I, Lekakis J, Mavrou I, Tzanela M, Kopterides P, Tsangaris I, Armaganidis A, Kremastinos DT. Association of left ventricular diastolic dysfunction with elevated NT-pro-BNP in general intensive care unit patients with preserved ejection fraction: A complementary role of tissue doppler imaging parameters and NT-pro-BNP levels for adverse outcome. *Shock* 2010; 33: 141-48.
- Lancellotti P, Moonen M, Magne J, O'Connor K, Cosyns B, Attenu E, Donal E, Pierard L. Prognostic effect of long-axis left ventricular dysfunction and β -type natriuretic peptide levels in asymptomatic aortic stenosis. *Am J Cardiol.* 2010; 105: 383-88.
- Mair J, Friedl W, Thomas S, Puschendorf B. Natriuretic peptides in assessment of left-ventricular dysfunction. *Scand J Clin Lab Invest Suppl.* 1999; 230: pp 132-42.
- Morrison LK, Harrison A, Krishnaswamy P, Kazanegra R, Clopton P, Maisel AS. Utility of a rapid β -natriuretic peptide (BNP) assay in differentiating CHF from lung disease in patients presenting with dyspnea. *J Am Coll Cardiol.* 2002; 39: pp 202-09.
- Morrow DA, de Lemos JA, Blazing MA, Sabatine MS, Murphy SA, Jarolim P, White HD, Fox KA, Califf RM, Braunwald E. Prognostic value of serial β -type natriuretic peptide testing during follow-up of patients with unstable coronary artery disease. *JAMA.* 2005; 294: 2866-71.
- Noveanu M, Hartwiger S, Mueller C. What anesthesiologists should know about β -type natriuretic peptide. *Minerva Anesthesiol.* 2009; 75: 698-702.
- Sanchez O, Trinquart L, Caille V, Couturaud F, Pacouret G, Meneveau N, Verschuren F, Roy PM, Parent F, Righini M, Perrier A, Lorut C, Tardy B, Benoit MO, Chatellier G, Meyer G. Prognostic factors for pulmonary embolism: The prep study, a prospective multicenter cohort study. *Am J Respir Crit Care Med.* 2010; 181: 168-73.
- Shah KB, Nolan MM, Rao K, Wang DJ, Christenson RH, Shanholtz CB, Mehra MR, Gottlieb SS. The characteristics and prognostic importance of NT-ProBNP concentrations in critically ill patients. *Am J Med.* 2007; 120: 1071-77.
- Struthers AD. Ten years of natriuretic peptide research: A new dawn for their diagnostic and therapeutic use? *BMJ.* 1994; 308: 1615-19.
- Wieczorek SJ, Wu AH, Christenson R, Krishnaswamy P, Gottlieb S, Rosano T, Hager D, Gardetto N, Chiu A, Bailly KR, Maisel A. A rapid β -type natriuretic peptide assay accurately diagnoses left ventricular dysfunction and heart failure: A multicenter evaluation. *Am Heart J.* 2002; 144: 834-39.

Author Info

Lei Lin (Principal contact)

e-mail: lewmanyevemao@yahoo.com; Tel & Fax: +86 717 648 3536