Pre-discharge BNP Predicting 30 Day Readmission Rate

Background

BNP is a hormone secreted by cardiac muscle cells of the ventricles in response to stretching caused by ventricular blood volume. It is currently been utilized in diagnosis of acute exacerbation of heart failure as well as for prognostic value post myocardial infarction. BNP levels change during heart failure exacerbation as well as after therapy (diuresis). Could pre-discharge BNP correlate with risk of 30-day readmission?

Method

We conducted a prospective observational study on patients admitted with acute decompensated heart failure who received standard treatment based on current guideline for management of CHF exacerbation. BNP was obtained at the time of admission as well as on the day of or prior to the day of discharge. Clinisync was used to follow up patient's readmission within 30 days to our facility or any other facility within Ohio.

Results

Of 108 enrolled patients, 94 were included for analysis. 58 (54%) patients were evaluated with a pre-discharge BNP and 50 (46%) did not have pre-discharge BNP. Of the 58 patients who had pre-discharge BNP done, 18 patients were readmitted within 30 days and 40 patients were not readmitted within 30 days. The average admission BNP of the 30-day readmission group was 1375.92 vs 1050.81 for those not readmitted. The average discharge BNP of the readmitted patients was 1005.95 vs 623.28 for those not readmitted. The percentage BNP changes (admission to pre-discharge) in both groups were found to be statistically insignificant (p-value=0.418).

Conclusion

Pre-discharge BNP did not objectively predict 30-day readmission rate in patients with acute decompensated heart failure. Though there was no statistical significance in the percentage change in BNP in 30 day readmitted group vs non admitted group, the mean pre-discharge BNP was found to be higher in patients readmitted within 30 days.

Introduction

At many U.S. hospitals, heart failure accounts for the most common discharge diagnosis and it represents a huge cost for the national health care budgets. The current 30-day readmission rates are greater than 20% which is very high when compared to other disease conditions. According to data from the Center for Health Information and Analysis, hospital readmissions cost Medicare about $26 billion annually, $17 billion is spent on avoidable hospital trips after discharge. As a result, several studies and resources have been devoted to reduce these readmissions. Strategies like greater fluid removal during hospitalization, optimization of medical

therapy on discharge (ACEI and Beta blocker) as well as early follow up within 7 days of discharge have been associated with a reduction in readmissions. However, there is currently no objective clinical criterion or scoring system for predicting early outcome after discharge.

BNP is a hormone secreted by cardiac muscle cells in the ventricles in response to distension caused by increased ventricular blood volume. It is currently been utilized as a supportive diagnosis of acute exacerbation of heart failure as well as for prognostication for post myocardial infarction. BNP levels change during heart failure therapy (diuresis) and as such; assessing pre-discharge level may help to identify patients at high risk for readmission.

However after a review of the literature freely available on pubmed, conflicting results show no consensus on the utility of BNP at discharge. Papers such as Kolchi et al show that BNP and changes in BNP can be related to future outcomes (1). Meanwhile a 2016 study demonstrated only the ability to stratify patients based on the BNP at discharge and not the changes in BNP (6). Conflicting results like these exemplify the need to further study this question in detail and in new and differing populations of patients.

Materials & Methods

Patients

Patients were included if they were 18 years or older, were admitted with acute decompensated heart failure, as documented by the admitting physician, with BNP done on admission and prior to discharge. Patients were excluded if they were on dialysis or had end stage renal disease (eGFRStudy Design and Setting

This study was a prospective observational study that was conducted at St Vincent Charity Medical Center, Cleveland Ohio which served as the primary admission site for the patients. CliniSync Health Information, which accesses patients' health information across Ohio, was utilized to follow up on possible 30-day readmission in other hospitals within Ohio region.

Enrolled patients received guideline directed management for acute decompensated heart failure and were assessed daily for response by the primary team. The choice of diuretic agent, route of administration, dosage and time of discharge were all determined by the managing team. Pre-discharge BNP was done a day prior to discharge or day of discharge.

Trial Oversight

This study was designed by 2 residents, under the supervision of a cardiologist, at St. Vincent Charity Medical Center, Cleveland OH. Data were collected by the 3 residents involved in the study. All the authors had access to the data and contributed to the interpretation of results. The protocol was reviewed and approved by the institutional review board at the St Vincent Charity Medical Center and the study was performed in accordance with principles stipulated by the institutional review board. All the authors in this study vouch for the accuracy and completeness of the data presented in this study.

Statistical Analysis

For the categorical variables, sex and race, the results are summarized as frequency and percent. For those variables, to make comparisons between 30-day re-admission groups Fisher's exact test and the chi-square test of contingency table data were used, respectively. Quantitative data are summarized separately for patients in several aggregations: for the entire group and by 30 day re-admission (code 0 /code 1) type. Also, for the latter sub-groups, each sub-group has summary statistics for the variables (BNP and weight) only for patients whose paired data were used.

The summary statistics include the mean, standard deviation, median, 25th percentile, 75th percentile, maximum and minimum, as well as the sample sizes. To compare 30-day re-admission groups for individual variables (except for eGFR), the "Student" t-test for independent groups was utilized*. For the paired data (admission and discharge BNP and weight), the "Student" t-test for paired data was employed. For the eGFR data (because of its truncated "> 60" values), it would not be apt to cite the mean and standard deviation, but rather summarize the central location and dispersion of those data using only the non-parametric statistics the median and inter-quartile range (IQR) presenting them as "median (IQR)" with the form of presentation for the IQR being "(25th percentile – 75th percentile)" [which is the two values separated by a hyphen].

To compare 30-day re-admission groups for eGFR, the non-parametric Mann-Whitney U-test was utilized. Statistical significance was taken as p

When employing the "Student" t-test for independent groups, first Levene's Test for Equality of Variances was utilized and only when the latter had p

Results

A total of 94 patients were included for analysis in this prospective study. See Table 1 for average demographics of the participants. The average age of participants was 69.3 years with a standard deviation of +/- 13. Admission BNP was 1141.7 with a standard deviation of +/- 1166.7. Weight, height, and BMI on admission were 94.34 kg +/- 29.49, 168.94 cm +/- 10.89, and 32.87 kg/m2 +/- 9.07 respectively. Patients were taking an average lasix equivalence dose of 36.56 mg orally +/- 27.127. BNP at discharge was 742 +/- 868 which was equivalent to a change of -31.97% +/- 33.33. Average weight at discharge was 92.18 kg +/- 28.05, which was a change in weight of -2.04% +/- 4.58. Average length of stay was 4.22 days +/- 3.373.

There was no significant difference in proportions of 30-day re-admissions for either sex (p = 0.353 Fisher's exact test) or race (p = 0.872, chi-square test), please see Table 2. Overall males accounted for 55 patients and females 39. Of the 26 readmissions interestingly they were half female and half male, 13 patients each. This correlates to 33% readmission for females and 25% readmission for males in our study.

African American ethnicity represented the majority of study participants in both readmission groups. Caucasians made up the next largest ethnic group, while Asian and Latino each accounted for 2 or 1 patients in this study. African Americans had 28% readmission rate, while Caucasians had 30% readmission rate.

See Table 3 comparing the following variables: Age in years, Admission BNP, Admission Weight, Height in cm, and Admission BMI between the groups based on readmission. All

patients with data are included; the data are aggregated irrespective of 30-day readmission code. The means of these variables by 30-day readmission groups (other than eGFR whose non-parametric summary statistics are given below; N.B., for eGFR the sample means and standard deviations are not valid estimates of those parameters and should not be presented) were tested with student t-test for independent groups.

No p-values on this analysis were statistically significant. For comparisons between the not readmitted versus the readmitted groups the following were calculated: Admission BNP 1050.8 vs 1375.9, Admission Weight 97.39 vs 86.38, Height 169.4 vs 167.8, BMI 33.7 vs 30.7, Lasix use 37.91 vs 33.1, Discharge BNP 623.3 vs 1006, BNP change -30% vs -36.4%, Discharge weight 95.2 vs 84, Weight Change -2.2% vs -1.5%, and Length of Stay 4.22 vs 4.23.

For the paired values (admission and discharge) of BNP and weight the “Student” t-test for paired data was used to compare mean values of 30 day re-admission groups, whereupon it was found that the discharge values were each very highly significantly less than the admission values (p

There was no significant differences in the distribution of eGFR values based on 30 day re-admission group (p = 0.408, Mann-Whitney U-test). The following tables give the non-parametric summary statistics for those data for each 30-day re-admission group, see Table 5.

Discussion

This prospective study documents and validates that high pre-discharge blood BNP levels are a strong predictor of readmission to the hospital within 30 days, however, the change in BNP from admission to discharge was found to be statistically insignificant as it correlates to readmission rates. This study showed that patients with predischarge BNP of 1000 and above are more likely to be readmitted within 30 days. This population of patients could be identified as high risk for 30 day readmission and hence might require more closer follow up as well as optimization of their diuretics to obviate the need for readmission.

Enrolled patients received guideline directed management for acute decompensated heart failure and were assessed daily for response by the primary team. The choice of diuretic agent, route of administration, dosage and time of discharge were all determined by the managing team. All patients were judged to be stable at discharge, although approximately 26% were readmitted within 30 days.

Clinisync, a web based electronic Ohio Health information Partnership was used to follow up patient readmissions within 30 days to our facility or any other facility within Ohio. Of the 26 patients that were readmitted to the hospital within 30 days: 16 were readmitted for CHF exacerbation, 2 for chest pain, 2 for HAP, 1 NSTEMI, 1 lightheadedness and dehydration, 1 right distal femur fracture, 1 sepsis, 1 supratherapeutic INR, and 1 unknown. Since our study was statistically insignificant with regard to our primary endpoint, it is difficult to pinpoint why the above CHF patients were readmitted, especially since all variables that were compared also were determined to be statistically insignificant. For the patients that were not readmitted for CHF, but were admitted within 30 days for other reasons, we also can’t say that CHF was not a factor in the patient readmissions.

The Hospital Readmissions Reduction Program (HRRP) is a Medicare value-based purchasing program that reduces payments to hospitals with excess readmissions. The program supports the national goal of improving healthcare for Americans by linking payment to the quality of hospital care.8

The Affordable Care Act requires the Secretary of the Department of Health and Human Services (HHS) to establish HRRP and reduce payments to Inpatient Prospective Payment System (IPPS) hospitals for excess readmissions beginning October 1, 2012 (i.e., Federal Fiscal Year [FY] 2013). Additionally, the 21st Century Cures Act requires CMS to assess penalties based on a hospital's performance relative to other hospitals with a similar proportion of patients who are dually eligible for Medicare and full-benefit Medicaid beginning in FY 2019.

CMS uses excess readmission ratios (ERR) to measure performance for each of the six conditions/procedures in the program:

- Acute Myocardial Infarction (AMI)
- Chronic Obstructive Pulmonary Disease (COPD)
- Heart Failure (HF)
- Pneumonia
- Coronary Artery Bypass Graft (CABG) Surgery
- Elective Primary Total Hip Arthroplasty and/or Total Knee Arthroplasty (THA/TKA)

As mentioned previously, According to data from the Center for Health Information and Analysis, hospital readmissions cost Medicare about $26 billion annually, $17 billion is spent on avoidable hospital trips after discharge. Furthermore, a retrospective, observational study done in Thousand Oaks, CA based on data from the national 5% sample of Medicare beneficiaries showed that data gathered from 63,678 inpatients with a mean age of 81.8 years were included in the analysis. All costs were inflated to $2,015 based on the medical care component of the Consumer Price Index. The mean per-patient cost of an HF-related hospitalization was $14,631. The mean per-patient cost of a cardiovascular (CV)-related or all-cause hospitalization was $16,000 and $15,924, respectively. The cumulative rate of all-cause hospitalization was 218.8 admissions per 100 person-years, and the median length of stay for HF-related, CV-related, and all-cause hospitalizations was 5 days. Also, 22.3% of patients were readmitted within 30 days, 33.3% were readmitted within 60 days, and 40.2% were readmitted within 90 days. Essentially the costs associated with hospitalization for Medicare beneficiaries with HF are substantial and are compounded by a high rate of readmission.

Our results appear to be unfavorable with regard to statistical significance and relation to our primary endpoint. However it should not be overlooked that high pre-discharge BNP levels are a strong predictor of 30 day readmission to the hospital as seen in this study. Therefore, appropriate diuresis and other clinical management should be targeted to achieve a goal BNP that is less than arrival, which in turn would BJshould trigger clinicians to draw 2 BNPs, one on arrival and one on discharge. This practice will have a two fold effect: 1) we will attempt to achieve the best clinical outcome for our patients and 2) we will have potentially avoided a future payment reduction from CMS.

Limitations of the study can mainly be attributed to sample size and patient follow up.

Conclusion

Pre-discharge BNP did not objectively predict 30-day readmission rate in patients with acute decompensated heart failure. Though there was no statistical significance in the percentage change in BNP in 30-day readmitted group vs non readmitted group, the average pre-discharge BNP was found to be higher in patients readmitted within 30 days.

Acknowledgements

This study was conducted with the financial support of the Internal Medicine Graduate Medical Education Department of St. Vincent Charity Medical Center in Cleveland, OH. The authors would like to thank Dr. Rowland, Statistician, for his contribution to the statistical analysis section.

The authors report no conflicts of interest associated with the writing of this manuscript.