CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
http://doi.org/10.5281/zenodo.3266197

Available online at: http://www.iajps.com Research Article

ARTERIAL STIFFNESS SUBSEQUENT CORONARY ARTERY BYPASS GRAFT, FACTOR OF PREDICTION FOR ACUTE KIDNEY INJURY

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Article Received: April 2019 **Accepted:** May 2019 **Published:** June 2019

Abstract

Outline: *Acute kidney injury (CSA-AKI) after cardiac surgery, is considered to be serious postoperative complication that has a great impact on patient mortality. The instrument that has been used to forecast development of kidney disease through pulse wave velocity which holds imperative position in cardiovascular and chronic kidney disease. Our hypothesis considers that PWV (pulse wave velocity) can also predict the presence of acute injury of kidney (AKI) in patients, recently experienced coronary artery bypass graft (CABG), excluding valve repair.*

Method: *The study was of an observational and exploratory nature where PWV was measured. The standard clinical parameters and biochemical controls were also used in the study.*

Results: We included 137 patients in our study of which 85 percent male subjects and the mean age being 66.3 years. The incidents of CSA and AKI were 29 percent. The increase in one unit of PWV could be the reason of 1.5 times more chances of AKI that is p = 0.006 (ratio 1.5 and interval surety: 1.13 to 2.10). Increase of one unit in glomerular filtration rate was found to decrease 85 percent in AKI development. It is also found that men who demonstrated reduction of 15 percent development of AKI as compared to females every year. Increase in age also lowers 87 percent chance of developing AKI.

Conclusions: *The study reveal that PWV independently predicts CSA and AKI events before the non-valve repair CABG and this technique is simple which can be used to assess risk of AKI-CSA after elective cardiac surgery.*

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Please cite this article in press Shawana Saeed et al., ***Arterial Stiffness Subsequent Coronary Artery Bypass Graft, Factor Of Prediction For Acute Kidney Injury.,*** *Indo Am. J. P. Sci, 2019; 06(07).*

INTRODUCTION:

AKI (acute kidney injury) can affect twenty percent of the patients who have been hospitalised[1]. It also contributes to major health implications which can as a result affect socioeconomic implications[2,3]. An incident of AKI is able to increase the chance of chronic kidney disease (CKD) and mortality shown by studies[4]. Coronary artery bypass graft (does not include valve repair) is shown in published data increases the incidence of AKI by 12 percent[5,6]. In this research we performed an analysis of patients who were undergoing elective CABG from January 2017 to December 2018. An incidence of AKI was found in 19.6 percent patients through serum AKI criteria. In absence of specific therapy of AKI that can completely support the management of patients and the absence of specific biomarkers it can be considered that a minute event of AKI implicates a less prognosis that could bear greater risk development of CKD in patients. The focus of our study is the prevention and early detection of risk. In various studies of patient outcomes and death reports it is identified that 30 percent of AKI patients were deficiently cured and could be prevented. Prevention of AKI could also save millions per annum, in economic terms[3]. Low eGFR, diabetes and old age are factory that are associated with risk of AKI[7]. PWV is a technique that can assess arterial stiffness that is also non-invasive[8]. Renal perfusion and vascular health are the factors of reliance in Kidney function. Studies emphasise this relationship of renal function decline and increased risk of death through cardiovascular events[9]. Increased Arterial stiffness in renal transplant recipients is shown by some studies an independent factor[10, 11]. We undertook this study to assess whether AS may possibly be branded as an independent factor of risk in post CABG coronary artery bypass graft which results in AKI through measuring Pulse Wave Velocity.

METHODS:

Participants

Participants of the study have been admitted to Mayo Hospital Lahore and there they were approached to undertake this study. Only patients more than the age of 18 with no associated valve surgery. A written consent of the patients was taken before their inclusion into the study. Only the patients who due to have CABG were included in the study and all the others that had CKD stage 4 or 5 were excluded from the study.

Study procedure

Blood and urine samples were collected of all the patients included in the study. Data regarding the demography, subject's medical history which included heart rate, blood pressure and other factors were collected. All the assessments were done in the same visit. Patients were approached during early afternoon visits. Gold standard method of carotid femoral PWV has been used to quantify pulse wave velocity in patients[12]. Measurement protocol of Hickson et al was followed during the process[13]. Any inherent bias at high arterial PWV was removed through mathematical femoral segment removal protocol and the measurement of 20 signals the average of 3 was recorded at each moment of time.
The KDIGO clinical practice guideline for AKI criteria was followed to determine development of AKI[14]. Blood sample, Serum creatinine was analysed in the biochemistry department of Mayo Hospital Lahore. Resting blood pressure and HR with one minute interval between measurements were recorded in triplicate, sphygmomanometer that was automated was used in this process and the average reading of recorded was 3.

Statistical analysis

For formally distributed data parameters are expressed as means ± SD and median and a range of interquartile for data that was non parametric. Independent samples were used to assess the difference between groups. T-test and chi-squared tests were used appropriately according to the data type and Pearson's correlation coefficient was used to assess correlations. To generate regression beta coefficients as well as odds ratio for variables that are baseline, logistic and linear regression analysis were used to determine independent factors of AKI risk.

RESULTS:

The number of participants which were included in this study was 137 in a period of two years. In table 1, their demographic measurements are presented. 85 percent of the participants of the study were male (85% ($n = 116$)), the mean age of 66.3. Majority participants did not have a renal disease and were not unstable before surgery but 29(40) percent of the patients developed AKI as defined by the criteria of KDIGO[14]. Contrast of the variables in patients who suffered AKI and who did not develop AKI after surgery is shown in table 1. $p_{H0} < 0.05$ defines statistical significance and the display of PWV values also the AKI associated with cardiac surgery can be found in figure 1.

Table 1: Descriptive statistics as well as univariate tests to associate to acute kidney injury.

Variables factors	Negative Acute Kidney Injury	Acute Kidney Injury	p
Age	67 (61.0 to 73.7) [b]	71.5 (56.7 to 74.7)[b]	0.405 *
(BP)Blood pressure mm Hg	133.8 (17.3) [a]	136.0 (10.9) [a]	0.578 $
Heart rate	65 (56.0 to 72.0) [b]	66.5 (59.0–76.2) [b]	0.645 *
Pulse wave velocity ms^{-1}	8.3 (7.3 to 9.9) [b]	9.3 (8.4–10.7) [b]	0.049 *
eGFR $ml^{-1}.min^{-1}.1.73\ m^{-2}$	78.5 (68.2 to 90.0) [b]	53 (42–65.2) [b]	< 0.001 *
Diabetes	21.4%	50%	0.007 #
Ejection fraction category	69.2%	65%	0.912 #
Gender	87.2%	70%	0.049 #

Median = [b]
Mean = [a]
ISMT (median test of Independent sample) = *
T-test of independent groups = $
Test of Chi-square = #

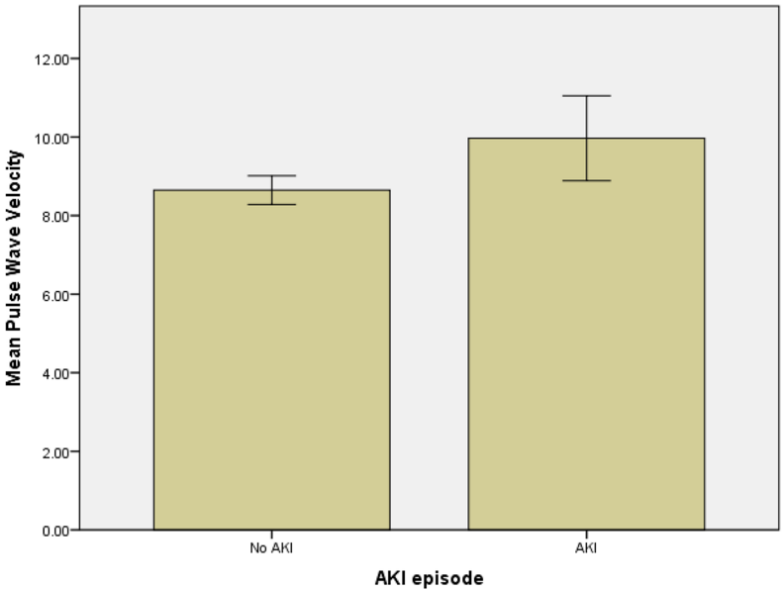

Figure 1.

Lesser values of eGFR ($p < 0.001$) was found in patients who suffered an incident of AKI, diabetes ($p = 0.007$), PWV (p=0.049) instances compared to the patients who had no AKI. AKI instances were found to be higher in women than men.

Type I error inflation can be accepted as a result of multiple testing but the initial indicators of possible predicting factors in the modelling process uses these results. An analysis of exploratory nature was done through logistic regression and backwards step regression model. Hierarchical modelling that was confirmatory in nature was used through forced entry to determine the independent factors which predicted AKI after testing validity of analyses assumptions. The factors that were used in these models determined by the metier of suggestion in univariate tests with developing AKI had been performed in the following order;

1. Gender
2. Heart rate
3. Ejection fraction category
4. eGFR
5. Diabetes

6. Pulse Wave Velocity
7. (BP) Systolic blood pressure
8. Age

For every 10 events one predictor is the limit for regression modelling that is logistic as the number of predictor variables is recommended specially for this case in the instance of AKI [15]. Recently this number has been modified and is increased to 5-9 events for one variable [16]. The recommended predictors should be no more than 4 as there were 20 AKI instances in this study.
That is shown as following;

1. eGFR
2. pulse wave velocity
3. age
4. gender

This complies with reverse stepwise model and the forced entry model is taken as the final model with predicator variables such as these and for the stability four predictors are sufficient for the final model. PWV, gender, age, eGFR and diabetic participants are noteworthy predictors.
This is shown in following Table 2.

Table 2: The Final (Ending) modelling

Factors	B.	S..E.	W	p	Exp (B)	95% C.I. for EXP (B)	
						Lower	Upper
eGFR	−.157	.035	20.211	<.001	.855	.798	.915
Pulse Wave Velocity	.431	.158	7.453	.006	1.538	1.129	2.096
Age	−.140	.052	7.271	.007	.870	.786	.963
Gender	−1.912	.896	4.555	.033	.148	.026	.855
Constant	15.396	4.815	10.226	.001	4,856,062.071		

DISCUSSION:

The study in nature investigates post elective CABG surgery, the relationship of Pulse wave velocity and AKI data related to this study was also found previously that was published and supports and association between AS and kidney function [9]. Younger males with higher levels of kidney function measured via eGFR were found to have lower risk of AKI development after the operation performed and that is consistent with studies done in the past [7]. Female sex and pre-operative renal injury (eGFR less than 60 ml/m and creatinine less than 2.1 mg/dl) are found to be the risk factors for developing AKI-CSA. A significant relation between vulnerability of developing AKI after surgery of CABG and arterial stiffness found in our study. The development of AKI had an increased ratio of 1.5 with one unit PWV increase. Kidher et al[17] finds that a weak connexion amid aortic-post replacement surgery and PWV in subjects with insignificant as well as the normal pre-operative patients of renal impairment. It contradicts because different cardiac surgeries were undertaken in both studies. Increase in AS in the contrivance of damage in CKD is thought to relate with barotrauma caused on glomeruli in a vascular system that is considered to be stiff [9]. The prevention of AKI-CSA are found not to be substantive and are limited. PWV being a non-invasive AS measurement technique offers a reliable way that is quick to predict risk of AKI-CSA n patients in our study. Therapeutic strategies can potentially modify arterial stiffness and can shrink the risk of CSA-AKI.

The study has its limitations and that need be acknowledged specially the small number of patients. This means that the number of variables needed to be restricted in multivariate model.

CONCLUSION:

PWV was assessed erstwhile to CABGs which predicted AKI events post-operative in this exploratory study. Pulse Wave Velocity is a simple technique that is non-intrusive which may be practised to potentially help with reduction in the danger of CSA and AKI instances subsequent to CABG. Most significantly, unlike risk factors as eGFR, to adjust AS pre cardiac surgery and lessen risk of AKI there is probability. More research is significant in the evaluation of potential therapeutic strategies to reduce AS.

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