Validation of the Mehran Risk Scoring Tool to Predict Risk for Contrast Induced Nephropathy in Thai Patients Undergoing Cardiac Catheterization or Percutaneous Coronary Intervention

การศึกษาแบบประเมินคะแนนความเสี่ยงของ Mehran ต่อการเกิดภาวะไตทำงานบกพร่องเนื่องจากสารทึบรังสีในผู้ป่วยคนไทยที่เข้ารับการตรวจรักษาหลอดเลือดหัวใจผ่านสายสวน

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ABSTRACT

In this study, the main objective was to study of the Mehran risk scoring tool for predict risk of contrast induced nephropathy in Thai patients undergoing cardiac catheterization or percutaneous coronary intervention. The data collection based on 200 Thai patients who admitted at Phramongkutklao Hospital by using the questionnaire, Mehran risk scoring tool and retrieved from the medical records. The incidence of contrast induced nephropathy are 6.5%. The ROC curve analysis showed that the Mehran risk scoring tool was effective for predict the risk of contrast induced nephropathy in Thai patients cardiac catheterization or percutaneous coronary intervention with concordance statistic (C-statistic) of 0.86

บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์หลักเพื่อศึกษาการทำนายได้ของแบบประเมินคะแนนความเสี่ยงของ Mehran ในผู้ป่วยคนไทยก่อนเข้ารับการตรวจรักษาหลอดเลือดหัวใจผ่านสายสวน ข้อมูลได้จากผู้ป่วยคนไทยที่เข้ารับการรักษาในโรงพยาบาลพระมงกุฎเกล้าจำนวน 200 คน โดยวิธีสัมภาษณ์ ข้อมูลจากแบบบันทึกทางการแพทย์ และจากการใช้แบบประเมินคะแนนความเสี่ยงของ Mehran พบว่า มีอุบัติการณ์ของภาวะไตทำงานบกพร่องเนื่องจากสารทึบรังสีเป็น 6.5% จากการวิเคราะห์แบบอาร์โอซี พบว่าแบบประเมินคะแนนความเสี่ยงของ Mehran สามารถใช้เพื่อทำนายการเกิดภาวะไตทำงานบกพร่องเนื่องจากสารทึบรังสีในผู้ป่วยคนไทยก่อนเข้ารับการตรวจรักษาหลอดเลือดหัวใจผ่านสายสวนได้เป็นอย่างดี โดยมีค่าความสามารถในการทดสอบเท่ากับ 0.86

Key Words: Mehran risk scoring tool, Contrast induced nephropathy, Cardiac catheterization or percutaneous coronary intervention

คำสำคัญ: แบบประเมินคะแนนความเสี่ยงของ Mehran ภาวะไตทำงานบกพร่องเนื่องจากสารทึบรังสี การตรวจรักษาหลอดเลือดหัวใจผ่านสายสวน

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Introduction

Cardiovascular disease (CVD) remains to be importantly caused of death in Thai people and other in the world although the diagnostic and therapeutic methods are modern by using contrast to create an x – ray attenuation differential in tissues in order that increase the visualization of disease processes (Katzberg and Haller, 2006), however, it had led to a rise in the incidence of acute kidney injury caused by an exposure to contrast media consequently, known as contrast induced nephropathy (CIN) (Katzberg and Haller, 2006; Mehran et al., 2004; Mehran and Nikolsky, 2006).

CIN is defined as an increase of $\geq$ 0.5 mg/dl or $\geq$ 25% from baseline serum creatinine within 48 hours of contrast media exposure (Mehran et al., 2004; Rihal et al., 2002; Gleeson and Bulugahapitiya, 2004). It is a common complication post cardiac catheterization or percutaneous coronary intervention (CAG or PCI) which is associated with increased mortality, longer hospital stay and long term renal impairment (Rihal et al., 2002; McCullough et al., 1997; From et al., 2008; McCullough, 2008; Roy et al., 2008). Even though, the incidence of CIN is low (0.6 –2.3%) in the general population ,however, it is significantly higher in selected patient subsets (up to 20% or more) especially in patients with cardiovascular pathology undergoing CAG or PCI (Mehran and Nikolsky, 2006; Chaemchoi, 2010). Once CIN is established, only supportive care is currently provided until renal function resolves, infrequently, hemodialysis may be required, either transiently or even permanently (Mehran et al., 2004). Thus, the prevention is presently the main method to tackle this complication (Mehran et al., 2004).

The several assessment models have shown to predict CIN (Mehran et al., 2004; Bartholomew et al., 2004; Skelding et al., 2007; Nyman et al., 2008; Ghani and Tohamy, 2009; Maioli et al., 2010), they may prove useful as a template to allow radiologists and clinicians alike to increase awareness and identification of CIN (Gleeson and Bulugahapitiya, 2004), however, the Mehran risk scoring tool was be chosen to prove useful in this study because it not only be available in graphic form, making the tool easy for clinicians to use, the large number of patients used in developing and validating the tool but also be the most comprehensive tool that have well-tested (Raingruber et al., 2011).

The aim of the present study was to answer whether or not the Mehran risk scoring tool could use in Thai patients for predict CIN development.

Materials and methods

After permission was obtained to use the Mehran risk scoring tool, prospective data were collected from 200 Thai patients admitted for undergoing cardiac catheterization or PCI at Phramongkutklao Hospital between August 8, 2012 and September 30, 2012. Patients who had been treated for shock, urgent or emergency CAG or PCI for acute myocardial infarction addition to no record of serum creatinine in 48-72 hours after the procedure were excluded from the study.

The Mehran risk scoring tool (Mehran et al., 2004) based on 8 clinical variables. These variables included

1) Patient–related characteristics (i.e., age > 75 years, diabetes mellitus, chronic congestive heart failure or admission with acute pulmonary edema, hypotention, anemia and chronic kidney disease)

2) Procedure–related characteristics (i.e., the use of elective IABP or increasing volumes of contrast media)

However, the Mehran risk scoring tool was used before CAG or PCI, therefore, there were 6 variables in this study. (Table 1)

The present study used the questionnaire and the Mehran risk scoring tool for be the data collection form of individual patients and some of information was retrieved from the medical records of the patients.

Table 1 Calculation of Mehran risk score

Risk factor	Mehran risk score	Assessment		Risk score	Note
		Yes	No		
1) Hypotension : BP ≤ 90/50 mmHg requiring inotropic support with medications	5				
2) CHF rated class III/IV on the NYHA classification or admission with acute pulmonary edema	5				
3) Patient's age >75 years	4				
4) Anemia (hematocrit <39% for men and <36% for women)	3				
5) Documented history of Diabetes mellitus	3				
6) Preprocedural serum level of creatinine >1.5 mg/dl **Or** An estimated glomerular filtration rate <60 ml/min per 1.73 m^2	4 2 for 40–60 4 for 20–40 6 for <20				
Total risk score					

The baseline of serum creatinine and hematocrit levels determined most recently before CAG or PCI and then comparing serum creatinine levels between the value before and in 48–72 hours after CAG or PCI for investigate the incidence of CIN. All of data into the analysis process.

Table 2 Classification of Mehran risk score

Risk groups	Risk score
Low	≤ 5
Moderate	6 to 10
High	11 to 15
Very high	≥ 16

Results and discussion

From 200 Thai participants, a total of 66.5% were men and 33.5% were women. The average age was 67.0 ± 13.79 years that male patients were younger than another (64.4 ± 13.0 years versus 72.19 ±13.95 years). Among of them, 25% had a history of congestive heart failure, 41% had a history of diabetes mellitus, 57% had an anemia, 12.5% had hypotension circumstance and 5% had been treated with an IABP.

The incidence of CIN occurred 13 patients (6.5%) from a total of 200 patients, 13 (100%) had an anemia, 9 (69.2%) had a history of diabetes mellitus and 3 (23.1%) had hypotension circumstance but one of them required using IABP. However, the requiring of hemodialysis, there were 4 (30.8%) patients in the CIN development group and 9 (4.8%) patients in the other group. Although, time of definition of CIN was within 48 hours but time of collection data was continuous before a patient underwent CAG or PCI until discharge or dead or be referred to another hospital so the reason of patient without CIN development had 9 (4.8%) people requiring hemodialysis maybe due to they had other problem health i.e. congestive heart failure that required hemodialysis for decrease volume overload or some patients were kidney failure in the last of admission that over 48 hours after CAG or PCI and resolve by

hemodialysis in the finally. Univariate variables associated with CIN are shown in Table 3. A total of 7 variables such as age, diabetes mellitus, anemia, congestive heart failure, baseline of hematocrit, baseline serum creatinine and baseline eGFR were significantly associated with the developed CIN, the most of these were similar to the result of several studies (Bartholomew et al., 2004; Ghani and Tohamy, 2009; Maioli et al., 2010) especially the results of Mehran et al (Mehran et al., 2004) such as diabetes mellitus, anemia, congestive heart failure, baseline serum creatinine and baseline eGFR .

Table 3 Univariate association of demographics and procedural characteristics with CIN after CAG or PCI

Variable	CIN (n = 13)	No CIN (n = 187)	p-value
Age (years)	75.46 ± 8.0	66.42 ±13.92	0.002*
Age>75 years	7 (53.8%)	56 (29.9%)	0.118
Body weight(kg)	60.77 ± 10.79	63.72 ± 11.81	0.383
Body mass index(kg/m^2)	24.95 ± 4.35	23.98 ± 3.75	0.372
Diabetes mellitus (DM)			
Anemia			
Congestive heart failure	9 (69.2 %)	73 (39.0 %)	0.042*
Baseline hematocrit (%)	13 (100.0 %)	101 (54.0 %)	0.001*
Baseline serum	9 (69.2 %)	41 (21.9 %)	0.001*
creatinine(mg/dl)	32.15 ± 3.80	36.90 ± 5.79	0.004*
Baseline eGFR	2.48 ± 1.29	1.30 ± 0.68	0.000*
(ml/min/1.73m^2)	33.49 ± 25.06	66.33 ± 28.05	0.000*
Use of nephrotoxic drugs	3 (23.1%)	47 (25.1%)	1.000
history	51.46 ± 41.90	52 ± 37.93	0.961
Time of procedure (minutes)	3 (23.1%)	22 (11.8%)	0.211
Hypotension	65.23 ± 45.21	95.66 ± 64.62	0.097
Contrast media amount (ml)	7 (53.8%)	76 (40.6%)	0.392
History of CAG or PCI	2(15.4 %)	27 (14.4 %)	1.000
Use of N-Acetylcysteine	1(7.7%)	9 (4.8 %)	0.498
(NAC)			
IABP use			

* Significance at p-value < 0.05

Table 4 Types of hydration

Hydrations	Total	CIN	No CIN
0.9% NSS	137 (68.5 %)	8 (61.5 %)	129 (69.0%)
5%DNSS	3 (1.5 %)	None	3(1.6%)
5%DN/2	27 (13.5 %)	None	27 (14.4%)
10%DNSS	1 (0.5 %)	None	1 (0.5%)
10%DN/2	1 (0.5 %)	None	1 (0.5%)
Others	31 (15.5 %)	5 (38.5%)	26 (13.9%)
Total	200 (100%)	13 (100%)	187 (100%)

Table 5 Risk score model according to Mehran et al.

Risk score	Frequency of total	Frequency of CIN	Risk of CIN
≤ 5	88	0	0%
6 to 10	58	4	6.90%
11 to 15	33	3	9.10%
≥ 16	21	6	28.60%

The hydration using in patient with CIN development had only 2 types such as 0.9% NSS and the others that be different from the types of hydration in patients without the developed CIN which were variety. It maybe involve with CIN occurring but have no enough research of hydration in the developed CIN patient in the present.

The ROC curve analysis was performed and presented the area under ROC curve (AUC) was identical to C-statistic = 0.861 ($p < 0.001$) which indicated that this index was a significant discriminator to CIN. This result is greater than the C-statistic value of Mehran et al' s study (Mehran et al.,

2004) reported that C-statistic = 0.67. The optimum cutoff point for risk score was 7; whereas, the sensitivity was 92.3% (95% CI = 0.667 to 0.986) and the specificity was 61.3% (95% CI = 0.538 to 0.677). In this study, the risk score could classified for prediction the occurrence of CIN as follow :

1) According to the result of study by Mehran et al (Mehran et al., 2004)

2) According to cutoff value by the percentile at 25.

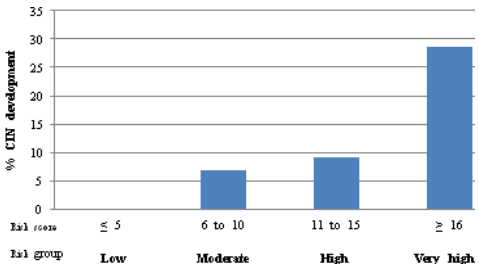

Figure 1 Risk score model according to Mehran et al.

Each of the risk score models were 4 risk groups (low, moderate, high, very high). Moreover, the incidence of CIN increased exponentially relate to an increasing risk score number both of them although the absolute risk score were different based on demographics, procedural characteristic, laboratory and others. However, the risk score model according to Mehran et al. (Mehran et al., 2004) is preferred to recommend for utilization because it has the simple risk scale for use and easily recall. The adequate risk score model for assess the developed CIN in Thai patients before CAG or PCI is believed to increase the opportunity to screen and early supportive care when the CIN development is presently detected.

Table 6 Risk score model according to the cutoff value by percentile at 25

Risk score	Frequency of total	Frequency of CIN	Risk of CIN
≤ 3	78	0	0%
4 to 7	37	1	2.70%
8 to 11	40	3	7.50%
≥ 12	45	9	20.00%

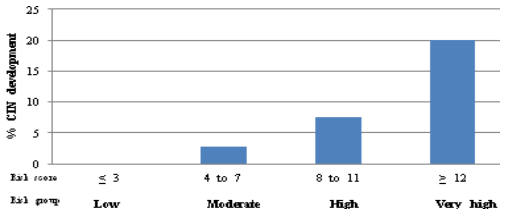

Figure 2 Risk score model according to the cutoff value by percentile at 25

Conclusions

The Mehran risk scoring tool was effective for predict the risk CIN in Thai patients undergoing cardiac catheterization or percutaneous coronary intervention which is recommended to utilization because it has the simple risk scale for use and easily recall.

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