

# Prevalence of Abdominal Aortic Calcification in Maintenance Hemodialysis Patients

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**Abstract:** Based on Indonesian Renal Registry Data in 2016, the cause of death of most hemodialysis patients was cardiovascular disease about 41%. One of the prognostic markers of the death caused by cardiovascular disease is vascular calcification. The prevalence of vascular calcification in hemodialysis patients varies, depending on the detection method and the location of calcification. Data on vascular calcification in Indonesia is limited. Primary endpoint of this study was prevalence of abdominal aortic calcification. This was an observational study of 76 consecutive adult patients on maintenance hemodialysis for  $\geq 36$  months in Rasyida Hospital on April 2018. Abdominal aortic calcification was determined by plain lateral lumbar X-ray. Most of patients were male (61.8%) and had hypertension (75%). Patients' median (min-max) age was 57 (25-78) years and median (min-max) dialysis duration was 67 (36-231) months. Fifty-two patients (68.4%) had abdominal aortic calcification. Severe abdominal aortic calcification were in 40 patients (52.6%). Most of patients had vascular calcification in both of layers; intima and media (44.7%). Vascular calcification are highly prevalent in the hemodialysis patient. Further studies were needed evaluating the association between characteristic of demographic, clinical and laboratorium with vascular calcification.

## 1 INTRODUCTION

The mortality rate of hemodialysis patients is very high. Muzasti found that 5 years mortality rate of chronic hemodialysis patients in Indonesia was 62.2% (Muzasti, 2018). Sibarani et al in 2016 found that 1 year mortality rate in of chronic hemodialysis patients was 36,6% (Sibarani, 2018). The risk of death in the group of 25-34 years old is higher (up to 1000 times) than in the general population as well as in patients aged 45 years (up to 100 times) (Kuzniar, 2008). One of the major causes of mortality in many countries is cardiovascular disease (CVD). According to Indonesian Renal Registry in 2016, the cause of mortality of most hemodialysis patients in Indonesia was cardiovascular disease about 41% (IRR, 2017).

One of the prognostic markers of mortality from cardiovascular disease in hemodialysis patients is vascular calcification. Research over the past decade shows that vascular calcification in chronic kidney disease is no longer just a passive degenerative

phenomenon but a complex and active pathological process due to metabolic and mineral bone disorders (Giachelli, 2009). Appropriate management of mineral and bone metabolism disorders, according to the US National Kidney Foundation includes assessment of vascular calcification (KDIGO, 2016). The prevalence of vascular calcification in a regular HD patient ranges from 23-87.5% depending on the detection method and the location of calcification (Gorritz, 2015).

There are several imaging methods in detecting vascular calcification. Unfortunately, none have been used as a gold standard in assessing this vascular calcification (Jayalath, 2005). However, the US National Kidney Foundation still recommends examination of lateral abdominal plain images to detect the presence or absence of vascular calcification in patients with stage 3 to 5 chronic kidney disease (KDIGO, 2016).

Few studies have evaluated vascular calcification in hemodialysis patients in developing countries such

as Indonesia. This study was undertaken to determine prevalence of vascular calcification in maintenance hemodialysis patients using lateral lumbar X-ray.

## 2 METHODS

The present study was an observational cross-sectional study on maintenance hemodialysis patients at Rasyida Hospital Medan in April 2018. Each medical record was reviewed to verify the diagnosis and to obtain all relevant demographic and clinical data.

### 2.1 Patients

#### 2.1.1 Study Population

All patients who undergo haemodialysis in Rasyida Renal Hospital Medan were population in this study.

#### 2.1.2 Sample

All patients undergoing haemodialysis in Rasyida Hospital Medan in April 2018 and met the recruitment criteria were samples in this study.

#### 2.1.3 Recruitment Criteria

- 1) Inclusion Criteria
  - a. Regular hemodialysis for  $\geq 36$  months
  - b. Age  $\geq 18$  years
  - c. Willing in doing lateral lumbar X-ray
- 2) Exclusion Criteria
  - a. Patients with lack of medical record

### 2.2 Methods of Collecting Data

The presence and degree of vascular calcifications was assessed by abdominal aortic calcification scores from lateral lumbar X-rays. Assessment using abdominal aortic segments; anterior and posterior walls that lie in front of the lumbar vertebra one to four (L1-L4):

0 = no calcific deposits in front of vertebra

1 = small scattered calcific deposits  $\leq 1/3$  of segment

2 = calcification of  $1/3$  to  $2/3$  of the segment's aortic wall

3 =  $2/3$  or more of the wall calcified.

Based on this scoring system, the minimum value of abdominal aorta combined calcification scores is 0 to a maximum of 24. It is no calcification if the score is 0, mild calcification if the score is 1-4, severe calcification if the score is above 4 (Honkanen, 2008).

The difference between intima and media calcifications can also be determined by this examination, that is, if there are radio-opaque images such as patches and pieces with irregular and patchy distributions, called intima calcifications, whereas radio-opaque images such as straight lines such as rail-road track is referred as media calcification (Hashimoto, 2008).

Demographic and clinical data recorded in frequency of hemodialysis, duration of hemodialysis, the etiology of renal failure, body weight and height to determine body mass index, age, gender. This study was conducted after obtaining approval from the Commission of Ethics FK USU-RSUP HAM on the implementation of health research. All participants granted written informed consent.

### 2.3 Statistical Analysis

All data were analyzed with statistical software SPSS 22.0 using univariate analysis. Data from categorical variables are expressed in frequency (n) and percentage (%), whereas data from numeric variables are expressed in central size (mean, median or proportion) and size of variation variation (standard deviation or range).

## 3 RESULTS

We studied 76 hemodialysis patients (47 males, 29 females). Patients' median (min-max) age was 57 (25-78) years with a mean (standard deviation [SD]) of age was 54.39 (11.32) years and median (min-max) dialysis vintage was 67 (36-231) months with a mean (SD) dialysis vintage of 73.24 (35.11) months. Renal failure etiologies were diabetic nephropathy in 14 (18.4%) of patients and hypertension in 57 (75%) of patients. A total of 12 (15.8%) patients had history of cardiovascular disease and 24 (31.6%) % patients were tobacco-smokers.

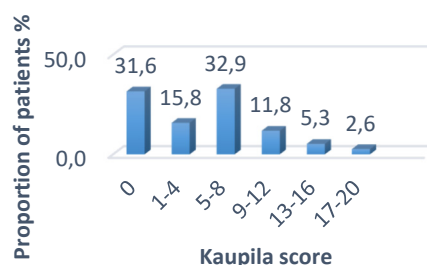


Figure 1: Distribution of 76 patients based on AAC.

Based on the lateral lumbar X-ray, the prevalence of abdominal aortic calcification are 68.4% with the mean (SD) abdominal aorta calcification scores are 5.07 (4.79) and median (min-max) abdominal aorta calcification scores are 5 (0-19). Distribution of patient that based on abdominal aortic calcification scores is seen in Figure.1

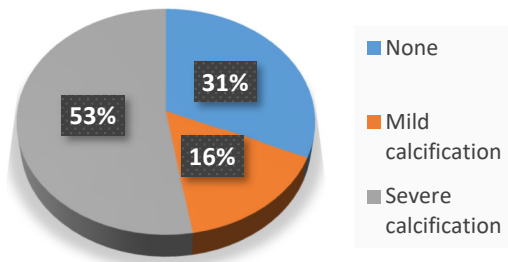


Figure 2: Severity of vascular calcification according to AAC scores

Based on abdominal aorta calcification scores, there were 24 patients (31.6%) did not has calcification. Twelve patients (15.8%) had mild calcification and 40 (52.6%) had severe calcification. Figure 2 shows the degree of calcification based on the abdominal aortic calcification scores.

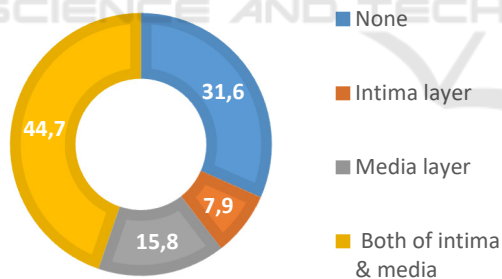


Figure 3: Location of AAC

In addition to determine the calcification severity, lateral lumbar X-rays may also determine the location of calcification. Figure 3 shows that vascular calcification was common in both layers; intima and media were 34 patients (44,7%), followed by media

layer on 12 patients (15,8%) and tunica intima on 6 patients (31,6%).

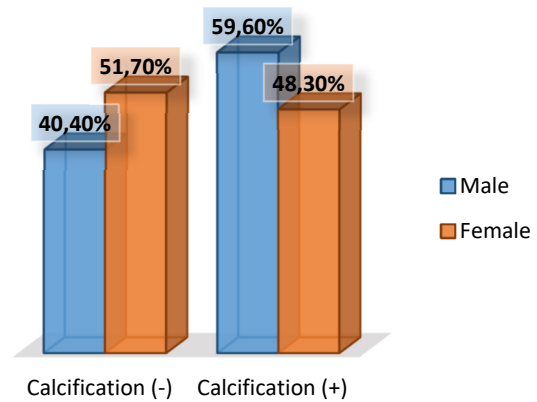


Figure 4: Proportion of vascular calcification according to gender

Figure 4 shows that patients who had calcification were more men (59.60%) than women (48.30%). While in patients who did not have calcification, women (51.70%) were more than men (40.40%).

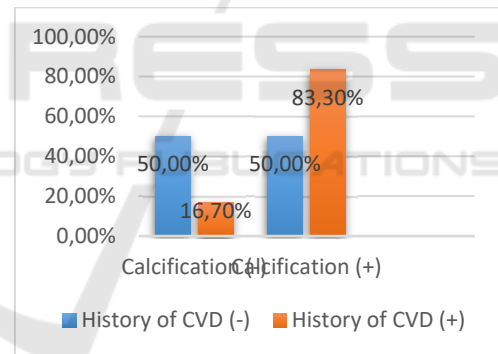


Figure 5: Proportion of vascular calcification according to history of cardiovascular disease

Figure 5 shows that patients with history of CVD (83.30%) were more than patients without a history of CVD (50.00%) in the calcified patient group. While in the non-calcified patient group, patients with no history of CVD were more (50.00%) than patients with a history of CVD (16.70%).

More smokers (70.80%) than non-smokers (48.10%) in the calcified patient group. Whereas in the non-calcified patient group, the non-smokers (51.90%) were higher than the smokers (29.20%).

## 4 DISCUSSION

To date, no imaging method has been used as a gold standard in assessing vascular calcification (KDIGO, 2016). However, the US National Kidney Foundation still recommends examination of lateral lumbal X-rays to detect vascular calcification in patients with stage 3 to 5 chronic kidney disease (KDIGO, 2016).

In this study, the prevalence of vascular calcification was 68.4%. Publications in recent years have shown that the prevalence of vascular calcification in regular hemodialysis patients ranges from 23-87.5% depending on the detection method and the location of calcification. Using Electron-Bearn Computed-Tomography (EBCT), there was vascular calcification in 87.5% of young hemodialysis patients (20-30 years) (Gorriz, 2015). A study by Shantha et al stated that the abdominal aortic calcification score has a fairly good diagnostic value in detecting vascular and valve calcification when compared with ultrasound and echocardiography in regular hemodialysis patients. The technique also showed a high correlation with the score used on EBCT, which were 87.5% in sensitivity, 75% in specificity, positive predictive value was 82,% and negative predictive value was 80.9% for abdominal aortic calcification score > 9.375%. However, when compared with Multi Slice Computed-Tomography (MSCT), the examination using lateral lumbal X-rays is highly subjective and less sensitive (Li ES, 2010). When compared to the results of this study with previous research, it was seen that the prevalence of vascular calcification is almost the same. Research conducted in France obtained vascular calcification as much as 68%, while in Australia found a greater prevalence of 90%. Separate studies conducted in Japan and Brazil have a prevalence of 50-60% vascular calcification (Guillermo, 2017).

Vascular calcification in chronic kidney disease can occur in both artery layers, ie, intima and media. Both types can be observed through the abdominal aorta, although calcification in media layer is more common (Jayalath, 2005). In this study it was found that vascular calcification was most common in both artery layers; intima and media.

Kraus et al found that moderate / severe calcification at the abdominal aortic was more prevalent in men than in women (Krauss, 2015). The study also showed the same result that more males experienced vascular calcification than females.

This study shows that history of cardiovascular diseases was associated with abdominal aortic calcification scores. This is similar to that of Guillermo et al and Kraus et al (Guillermo,

2017;Krauss, 2015). Even in the study of Calcification Outcome in Renal Disease (CORD) it was stated that a history of cardiovascular diseases was associated with higher AAC scores and predicted calcification on multivariate analysis (Krauss, 2015)

## 5 CONCLUSION

Vascular calcification are highly prevalent in the hemodialysis patients. Further studies were needed evaluating the association between characteristic of demographic, clinical and laboratorium with vascular calcification.

**Conflict of Interests:** None to declare.

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