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**Original Research Article**

# Acute pulmonary oedema in chronic dialysis patients, causes, clinical course and outcome admitted into emergency department

**Jimnaz P. A.[1]*, Ajmal Abdul Kharim[2]**

[1]Department of General Medicine, [2]Department of Emergency Medicine, MES, Medical College and Hospital, Kerala, India

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***Correspondence:**
Dr. Jimnaz P. A.,
E-mail: jimnazpa@gmail.com



## ABSTRACT

**Background:** Chronic dialysis (CD) patient are at increased risk of multiple organ dysfunction. Recent study, estimated that 2% of CD patients require intensive care unit (ICU) admission every year. Acute Pulmonary Oedema is major cause for ICU admissions, objective of the study is to determine the cause, clinical course and outcome of APO in CD patients admitted in Intensive Care Units under Emergency Department.
**Methods:** Prospective and observational study conducted for 1 year in our institute, a tertiary care centre, was done on chronic dialysis(CD) who presented with Acute pulmonary oedema(APO) for determine cause for APO, severity of outcome by APACHE II and sofa score. Data was entered in Microsoft Excel spread sheet and analyzed using SPSS software. Descriptive analysis and chi square test was done.
**Results:** Study included 100 CD patients. Main etiologic factor of CKD was T2DM 56%. Etiology of APO in this study showed as 34% are due to excessive interdialytic weight gain. Only 4 patients were assessed by SOFA score and high sofa score no patients had expired. Study showed survived patients got mean APACHE II score of 24±3.4 and expired patients got mean APACHE II score of 32.9±2.5, with a significant P value <0.001.
**Conclusions:** Main etiology of APO in CD patients were excessive interdialytic weight gain 34 %. APACHE II score as outcome predictors. APACHE II score of more than 30 have poor outcome.

**Keywords:** Acute physiology and chronic health evaluation, Acute pulmonary oedema, Chronic dialysis, Interdialytic weight gain

## INTRODUCTION

Chronic dialysis(CD) patient are at increased risk of multiple organ dysfunction resulting from pre-existing medical conditions and secondary complication of renal replacement therapy. Recent study, estimated that 2% of CD patients require intensive care unit (ICU) admission every year.[1] he presence of established end stage organ failure and numerous comorbidites can impact on decisions regarding escalation of care and ICU admission. Managing fluid status of dialysis patient remains a challenge, because dialysis patient are usually oliguric or anuric their tendency to accumulate fluid must be managed through a combination of limiting salt and fluid intake and ultrafiltration during dialysis session. Achieving a balance between avoiding hypovolemia during dialysis and developing fluid over load between dialysis session is complicated by patient adherence, challenges in assessing fluid status, limitation on length of dialysis session. This fluid status CD patients got adverse outcome by exacerbation of congestive heart failure and increased risk of death. We did Prospective

and observational study to determine the cause of acute pulmonary oedema (APO) in CD patients admitted in ICU and to evaluate the clinical course and outcome. We found out main etiology of Acute pulmonary edema in chronic dialysis patients were excessive interdialytic weight gain, APACHE II score as outcome predictors.

## METHODS

A prospective observational study conducted for 1year from Jan 2015-December 2015 on all patients on chronic dialysis who present with features of Acute pulmonary Oedema to emergency department in our institute, a tertiary care centre. Chronic dialysis, CKD Patients on more than 3 months of hemodialysis. Acute pulmonary oedema, patients resenting to emergency department with complaints onset of severe cough respiratory distress with clinical and radiological signs of pulmonary congestion will get admitted to ICU. Diagnosis of acute pulmonary oedema is made by clinical and radiological signs of pulmonary congestion. Echo cardio-graphic done after admission. Thus, a total of hundred patients with APO in CD patients were included in the study. Regular protocol for the Acute Pulmonary Oedema followed in MES Medical College shall be followed. No active intervention is planned for this study. Distinguishing cardiogenic from noncardiogenic pulmonary oedema is important in management, (Table 1).

**Table 1: Distinguishing cardiogenic from noncardiogenic pulmonary oedema.**

| | Cardiogenic | Non-cardiogenic |
|---|---|---|
| Physical examination | Evidence of increased Intracardiac pressure [S3 gallop, elevated JVP, peripheral edema] Rales and wheeze on auscultation of chest | Normal on early stages |
| Chest radiography | Enlarged cardiac silhouette Vascular redistribution<br>Intersititial thickening<br>Perihilar alveolar infiltrates<br>Pleural effusion<br>Hypoxemia is due to V/Q mismatch a respond to administration of supplemental oxygen | Heart size normal<br>Alveolar infiltration uniformity distributed<br>Pleural effusion is uncommon<br>Hypoxemia in noncardiogenic pulmonary is due to primarily to intrapulmonary shunting, persist despite high concentration of inhaled O2 |
| | Pulmonary capillary wedge pressure (PCWP) 18 mmHg | (PCWP) <18 mmHg |

Those patients who satisfy the inclusion criteria will be explained about the study. An informed consent is taken. These patients are treated according to the standard protocol. Each patient will be followed from the time of presentation to the time of discharge from the Hospital including in hospital mortality. Data are collected on patient characteristics at base line, including demographics, day of admission, primary cause of ESRD, and duration of dialysis and chronic treatment. Causes of pulmonary oedema, biological (Clinical) radiological and echo cardio-graphic parameters, treatments and outcome, APACHE II and SOFA score are assessed in ICU.

The APACHE II scoring systemic hypertension was released in 1985 and included a reduction in the number of variable to 12.

APACHE II score is sum of

- Acute physiology score
- Age
- Chronic health score

APACHE II score (0-71), Total APACHE II Score =A+B+C

- A: APS score
- B: AGE points
- C: chronic health points

Predicted mortality (adjusted) =-3.517 + (score APACHE II) 0.146 + diagnostic category weight (Table 2).

SOFA score involves six organ systems (respiratory, cardiovascular, renal, hepatic, central nervous, coagulation) and the function of each is scored form O (normal function) to 4 (most abnormal) giving a possible score of 0 -24. Mortality rate increase as number of organs with dysfunction increases. Unlike other score, the worst value on each day is recorded. Key difference is in the cardiovascular component instead of the composite variable, the SOFA uses a treatment-related variable (dose of vasopressor agent) (Table 3). Data was entered in Microsoft Excel spread sheet and analyzed using SPSS (Statistical Programme for Social Science, trail version 22 software. Descriptive analysis was done for etiology of APO in CD patients. Severity of APO is assessed by APACHE II score SOFA score. Chi square test was used to look for association between APACHE II score and SOFA score to outcome of APO in CD patients.

**Table 2: The APACHE II severity of disease classification system.**

| Physiologic variable | +4 | +3 | +2 | +l | 0 | +l | +2 | +3 | +4 |
|---|---|---|---|---|---|---|---|---|---|
| Temperature - rectal (°C) | ≥41 | 39-40.9 | | 38.5-38.9 | 36-38.4 | 34-35.9 | 32-33.9 | 30-30.9 | ≤ 29.9 |
| Mean arterial Pressure (mm Hg) | ≥160 | 130-159 | Ll0-129 | | 70 - 109 | | 50-69 | | ≤4 9 |
| Heart rate | ≥180 | 140-179 | 110-139 | | 7 0-109 | | 55-69 | 40-54 | ≤39 |
| Respiratory rate (nonventilated or Ventilated) | ≥50 | 35-49 | | 25-34 | 12-24 | 10-ll | 6-9 | | ≤5 |
| Oxygenation (mmHg) | A ≥500 | 350-499 | 200-349 | | <200 | | | | |
| $Fio_2$>0,5ll use a-$ado_2$ $Fio_2$<0,5use$pao_2$ pal>. | B | | | | >70 | 61-70 | | 55-60 | <55 |
| Arterial pH | ≥7.7 | 7.6-7.69 | | 7.5-7.59 | 7.33-7.49 | | 7.25-7.32 | 7.15-7.24 | <7.15 |
| Serum sodium (mmol/l) | ≥180 | 160-179 | 155-159 | 150-1:54 | 130-149 | | 120-129 | L ll-ll9 | ≤110 |
| Serum potassium (mmol/l) | ≥7 | 6-6.9 | | 5.5-5.9 | 3.5-5.4 | 3-3.4 | 2.5-2.9 | | <2.5 |
| Serum creatinine (mg/dl, double point Score: for acute renal failure) | ≥3.5 | 2-3.4 | 1.5-1.9 | | 0.6-1.4 | | <0.6 | | |
| Hematocrit (%) | ≥60 | | 50-:59.9 | 4649.9 | 30-45.9 | | 20-29.9 | | <20 |
| White blood Count in 1000 /$mm^3$) | ≥40 | | 20-39.9 | 15-19.9 | 3-14.9 | | 1-2.9 | | <l |
| Glasgow-coma-Scale (C-CS) | Score =15 minus actual GCS | | | | | | | | |
| Serum HC03 (venous, mmol/l, use if no ABGS. | ≥52 | 41- 51.9 | | 32-40.9 | 22-31.9 | | 18-21.9 | 15-17.9 | <15 |
| A = Total acute Physiology score aps | Sum of the 12 individual variable points | | | | | | | | |
| B = Age points<br>≤44 years 0 points<br>45-54 years 2 points<br>55-64 years 3 points<br>65-74 years 5 points<br>≥75 years 6 points | C = chronic health points<br>If the patient has a history of severe organ system insufficiency or is immunocompromised assign points as follows:<br>For non-operative or emergency postoperative patients: - 5 points<br>For elective postoperative patients -2 points | | | | | | | | |
| APACHE II score = sum of A (APS points) + B (Age points) + C (Chronic health points) | | | | | | | | | |

## RESULTS

Study included 100 CD patients, age ranged between 15to 80 years old and mean age were 52.6 ±12.4 years. Study patients shows male predominance about 72%. Main etiologic factor of CKD was T2 DM 56%, chronic glomerulonephritis was 20%, drug induced were 12%, remaining others consists of 8%.

Other risk factors on CD patients shows DLP 52%, CAD were 29%, previous history of APO was 8% of patients on study. Study patients were having mean duration of dialysis of 3.3 ±1.7years about 41% patients were having duration of dialysis less than 2 years, 30% were for 3-4years. Majority of patient show compliance to dialysis and drugs; only 4% of patients showed non-compliance to dialysis stoppage drugs and 2% of patient showed stoppage of antihypertensive

In our study showed average interdialytic weight gain with mean 2.4 ±0.4kg, there were 48.5% patients ≥ 3kg weight gain after previous dialysis session, mean arterial BP in our study shows 126 ±22mmHg, serum potassium value in our study mean 4.8 ±0.7mmol/l.

**Table 3: SOFA score.**

| Sofa score | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Respirationa pao2/fio2 (mm hg) sao2/fio2 | >400 | <400 221–301 | <300 142–220 | <200 67–141 | <100 <67 |
| Coagulation platelets 103/mm3 | >150 | <150 | <100 | <50 | <20 |
| Liver bilirubin (mg/dl) | <1.2 | 1.2–1.9 | 2.0–5.9 | 6.0–11.9 | >12.0 |
| Cardiovascularb hypotension | No hypotension | Map <70 | Dopamine </=5 or dobutamine (any) | Dopamine >5 or norepinephrine </=0.1 | Dopamine >15 or norepinephrine >0.1 |
| CNS Glasgow comascore | 15 | 13–14 | 10–12 | 6–9 | <6 |
| Renal creatinine (mg/dl) or urine output (ml/d) | <1.2 | 1.2–1.9 | 2.0–3.4 | 3.5–4.9 or <500 | >5.0 or <200 |

**Table 4: Descriptive statistics for selected variables.**

| | Average interdialytic weight gain | Present weight gain after previous dialysis | Mean arterial BP | Serum potassium | Estimated glomerular filtration rate |
|---|---|---|---|---|---|
| Mean | 2.4 | 3.0 | 126.1 | 4.8 | 9.3 |
| SD | 0.4 | 0.6 | 22.0 | 0.7 | 2.4 |
| Median | 2.5 | 2.9 | 124.0 | 5.0 | 9.5 |
| Maximum | 3.0 | 5.0 | 176.0 | 6.4 | 15.0 |
| Minimum | 1.5 | 1.9 | 47.0 | 3.1 | 4.6 |

**Table 5: Comparison of Apache score based on outcome of patient.**

| Apache score | Survived | | Expired | | $\chi^2$ | p |
|---|---|---|---|---|---|---|
| | Count | Percent | Count | Percent | | |
| 15 – 19 | 4 | 100.0 | 0 | 0.0 | 47.16** | <0.001 |
| 20 – 24 | 39 | 100.0 | 0 | 0.0 | | |
| 25 – 29 | 38 | 100.0 | 0 | 0.0 | | |
| 30 – 34 | 6 | 46.2 | 7 | 53.8 | | |
| >34 | 1 | 50.0 | 1 | 50.0 | | |

**: - Significant at 0.01 level

Mean eGFR value in present study were 9.3 ±2.4ml/min/1.73m2, (Table 4) about 85% patients had showed negative cardiac marker (CKMB, TROPONIN), 15% patients showed positive value.

Etiology of APO in this study showed as 34% are due to excessive interdialytic weight gain, 18% shows due to hypertensive crisis, inappropriate dry weight estimation was 18%, (Figure 1). Mean APACHE II score were 25.5 ±4 only 4 patients were assessed by SOFA score and mean SOFA Score in our study were 8.8 ±2.5. Sepsis patients with high sofa score no patients had expired. In our study mortality rate was 8%. Study shows only 100% patients survived when APACHE II score is less than 29, and 50% patients expired when APACHE II score is more than 34 (significant P value <0.001), (Table 5).

**Table 6: Comparison of Apache score based on outcome of patient (b)**

| Outcome | Mean | SD | N | T | p |
|---|---|---|---|---|---|
| Survived | 24.8 | 3.4 | 88 | 6.58** | <0.001 |
| Expired | 32.9 | 2.5 | 8 | | |

**: - Significant at 0.01 level

This test result show APACHE II score is predictor of outcome in APO in CD patients, (Table 6). In our study no patient had expired with sofa score, could not compare with outcome of APO, (Table 7).

## DISCUSSION

This study includes 100 chronic dialysis patients study. This study which includes 100 chronic dialysis patients who had acute pulmonary edema was diagnosed to find

out cause and clinical outcome. There are very limited studies to show comparison.

**Table 7: Comparison of SOFA score based on outcome of patient.**

| Sofa score | Survived | | Expired | |
|---|---|---|---|---|
| | Count | Percent | Count | Percent |
| 0 – 6 | 1 | 100.0 | 0 | 0.0 |
| 7 – 9 | 2 | 100.0 | 0 | 0.0 |
| 10 – 12 | 1 | 100.0 | 0 | 0.0 |

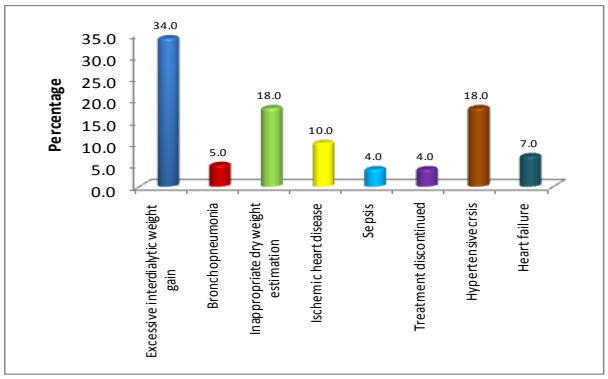


**Figure 1: Percentage distribution of the sample according to etiology for acute pulmonary oedema.**

***Incidence of ICU admission on cd patients***

On our study 100 patients got admitted in ICU due to APO in CD patient during Jan 2015 to Dec 2015. Marlies Osterman.[1] Study during 2013 on Kings College London showed 2% of CD patient got admitted under ICU. Bradjort Strijack, Julie Mojica.[2] study on Canada I winnnipeg ICU's Outcome of chronic dialysis patient admitted to intensive care unit show an incidence of 6 per 100 patient with ESRD per year study group consist of 1173 patient.

***Etiology of APO in chronic dialysis patients***

Progress and treatment of pulmonary oedema depend on its cause. As because high prevalence of cardiovascular risk on CKD patient's cardiovascular disease was an important cause of pulmonary edema in review study done by N Arul kumaran, NMP Annear, M Singer.[3]

In our study excessive interdialytic weight gain 34%, inappropriate dry weight estimation (18%), acute pulmonary infection (15%), heart failure (7%) and Hypertension crisis (18%) were the causes of acute pulmonary edema in chronic dialysis patients. The study conducted by Marie Patrice Halle et al, in 2007 at Frame.[4] Acute pulmonary infection (26%), Excessive interdialytic weight grain (25%) and inappropriate dry weight prescription (23%) were leading cause of Acute pulmonary edema. Cardiovascular disorder were are of the leading cause of pulmonary edema in our study- 10 %, Goldberger JJ in his study on prognostic factors in acute pulmonary edema on 94 patient show: 25.5 % case of progressively worsening congestive heart failure.[5]

Fluid and salt over use has been showed as most common cause of pulmonary edema in patient on renal replacements therapy.[6] High percentage of patient of poor dietary compliance in our study. However, extracellular volume expansion and fluid overload secondary to poor compliance to die and inappropriate estimation of dry weight were most patient etiology of pulmonary edema. In our study excessive interdialytic weight gain were 34% and inappropriate dry weight estimation were 18%. Foley RN et al during 1998, found out cardio vascular mortality approximately 9 % per year.[7] Showed 20 times higher mortality due to cardiovascular disease than general population in CD patients. Proper dry weight estimation, dry weight estimation is a difficult task, most of the time is clinically estimated.

***Severity of acute pulmonary edema***

In our study severity is assessed by APACHE II and SOFA score study showed survived patients got mean APACHE II score of 24±3.4 and expired patients got mean APACHE II score of 32.9±2.5 .Marie patrice Halle, study showed mean APACHE score of 28 in survivors and mean score of 27 in non survivors.[4] Devan juneja et al, study during 2010 on outcome of patients with end stage renal disease admitted to an intensive care unit, 73 patient they observed and mean APACHE II score were 26 (14-49), SOFA score were 7(4-17).[8] In M P Halle et al, study mean sofa score in survivors were 6 and non survivors were 8.In present study mean sofa score were 8.8 ± 2.5.[4]

***Outcome predictors***

This study brings out the importance of pulmonary edema as a cause of intensive care admission in CD patients-with as much in 8 % mortality, similar study of M-P Halle et al at France, shows 10 % mortality.[4]

Most of the patients responded to medical treatment including vasodilators nitration, diuretic and NIV and only three patients treated by mechanical ventilation.

In our study used APACHE II score and SOFA score as outcome predictors study showed survived patients got mean APACHE II score of 24±3.4 and expired patients got mean APACHE II score of 32.9±2.5. This test result show APACHE II score is predictor of outcome in APO in CD patients.

Study showed sepsis patient with high sofa score were survived, could not compare with outcome of APO. Study shows if APACHE II score more than 30 there is high chance of mortality. In MP Halle, study out outcome predictors are, patients on transferred patients, need for mechanical ventilation, sofa score.[4] He also included different patients from different dialysis schedule. In this

study no transferred case were included, and patients were on same dialysis schedule. In Sivagnanavel Senthuran et al study on 70 CD patients on CD, admitted during 2000-2006 showed mean APACHE II score on survivors 25±8.6 and on non-survivors 30.8±8.3.[9]

ESRD patients shows 4-fold increase in the risk of development of critical illness and prompting ICU admission and acute RRT.

There remain important unanswered questions about the ESRD population who experience an episode of critical illness prompting in an ICU so far, no study has explored the hypothesis that ESRD patients may still be susceptible to AKI, particularly those with documented residual renal function.

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