Original Research Article

**Predictive value of RAPID score** **to determine postoperative morbidity and mortality in patients undergoing pulmonary decortication for pleural empyema**

**Abstract:**

**Background:** Pleural empyema is a common and often fatal illness that causes one million hospitalizations worldwide each year. Considering its link to substantial morbidity ae well as perioperative and anesthetic mortality, the judicial use of surgical intervention in all pleural infection cases is required. For patients with pleural infection at presentation, the RAPID score (Renal, Age, Fluid Purulence, Infection source, Dietary [albumin]) is currently a validated scoring system that enables risk classification. The aim of this research is to evaluate the RAPID score as a predictor of morbidity and death after pulmonary decortication in a retrospective cohort of Bangladeshi patients with pleural empyema.

**Materials and method:** This retrospective study was conducted in Department of Thoracic Surgery of Dhaka Medical College and Hospital, Dhaka, Bangladesh from January 2024 to June 2025. The authors retrospectively analyzed the medical records of the patients from database of thoracic surgery department who had pulmonary decortication for primary empyema during the study period. RAPID score was calculated for each patient after data collection in a preformed questionnaire. However during our study period, the RAPID score was not utilized to determine the clinical management of the patient.

**Results:** A total number of 27 patients were included in the study after fulfilling the inclusion and exclusion criteria. Mean age was 56±5.2 years with a male female ratio of 2:1. Diabetes mellitus was the most common associated co-morbidities (62.44%). According to the RAPID score, 8 patients (29.62 %) were stratified as low-risk, 10(37.03%) patients as medium-risk and 9 as high-risk (33.33 %). ( The high-risk group had a 3-month mortality of 33.33%, while the moderate-risk group had 10 %, and low risk had no deaths within 90 days, showing a good correlation between the RAPID score and 3-month survival (p < 0.05). Rapid score was also correlated to secondary outcomes of our study which was statistically significant (p<0.05). Sensitivity and specificity for the primary endpoint at high-risk score were 92.89% % and 81.82%, respectively. On the other hand sensitivity for low risk and medium risk group were 89.89% and 95.51% respectively.

**Conclusion:** The present study demonstrated a strong association between 3 month mortality and RAPID scores. Besides, the RAPID score was significantly correlated 90-days morbidity of the patients who underwent surgical intervention for pleural infection.

**Key words:** *predictive value, RAPID score, pulmonary decortication, pleural empyema*

**Introduction:**

Pleural empyema is a common and often fatal illness that causes one million hospitalizations worldwide each year.1 This condition is linked to significant death rates of up to 20%.2 Timely drainage, clinical care, and adequate antibiotic medication are the cornerstones of the management of pleural infections. Surgery is used as a rescue therapy in about 30% of cases.3 It is especially important for patients of both stage 2 (fibropurulent) and stage 3 (organizing) empyema in order to improve clinical results and decrease hospitalization.4

Nevertheless, the best approach for treating stage II or III empyema through pulmonary decortication is complicated, particularly for critically ill patients who are unable to endure the procedure due to its invasive nature.5 The other alternative to pulmonary decortication primarily include extended tube drainage or open thoracostomy, both of which can considerably affect quality of life.5

Considering its link to substantial morbidity as well as perioperative and anesthetic mortality, the judicial use of surgical intervention in all pleural infection cases is required.6 It is still unclear what criteria should be used to choose individuals who would benefit most from surgery because they are more likely to have clinical treatment failure. Clinical practices differ dependent on individual surgical preferences, and there is no clear definition of whether a surgical intervention is suitable given the patient's clinical condition.6

For patients with pleural infection at presentation, the RAPID score (Renal, Age, Fluid Purulence, Infection source, Dietary [albumin]) is currently a validated scoring system that enables risk classification (Table-1). Rahman et al. created this predictive model in 2014 to forecast 3-month death in patients who were diagnosed with pleural infections. Data from the MIST1 clinical trial was used to develop the model, which was then validated on the MIST2 and PILOT cohorts.7 The grading system does not directly address individuals with surgically treated empyema, yet it does accurately predict short-term death. In this regard, this study is the first to assess the RAPID scoring system's performance characteristics in retrospect for a group of 34 pleural infection patients who had pulmonary decortication.7

| **Parameter** | **Score** |
| --- | --- |
| Renal (urea) mg/dL |  |
| < 14 | 0 |
| 14‒23 | 1 |
| > 23 | 2 |
| Age(years) |  |
| < 50 | 0 |
| 50‒70 | 1 |
| > 70 | 2 |
| Purulence of pleural fluid |  |
| Purulent | 0 |
| Non-purulent | 1 |
| Infection setting |  |
| Community-acquired | 0 |
| Hospital = Acquired | 1 |
| Dietary factors (serum albumin) mg/dL |  |
| ≥ 2.7 | 0 |
| < 2.7 | 1 |

**Table-1 showing parameters of RAPID score**

In this scoring system, patients are divided into three risk categories based on their score: low (0–2), medium (3–4), and high (5–7).7 Longer hospital stays and higher 3- and 12-month mortality rates are associated with higher scores. Although studies evaluating the RAPID score have shown encouraging results, its use in clinical practice is still rare and unvalidated in a variety of demographics, including the Bangladeshi population. The RAPID score also has the potential to help surgeons choose between surgical decortication and other treatments for patients with pleural empyema.8 Thus, the aim of this research is to evaluate the RAPID score as a predictor of morbidity and death after pulmonary decortication in a retrospective cohort of Bangladeshi patients with pleural empyema so that appropriate case selection can be done for surgical intervention to provide a better outcome to the patients.

**Materials and method:**

This retrospective study was conducted in Department of Thoracic Surgery of Dhaka Medical College and Hospital, Dhaka, Bangladesh from January 2024 to June 2025. The authors retrospectively analyzed the medical records of the patients from database of thoracic surgery department who had pulmonary decortication for primary empyema during the study period. An ethical approval was taken from Institutional Review Board. The study population consisted of all patients who underwent decortication for empyema secondary to pneumonia.

**Inclusion criteria:**

* Patients presented with purulent pleural fluid or positive culture test
* Patients with a clinical picture highly suggestive of pleural empyema but who had not undergone any pleural fluid analysis

**Exclusion criteria**

* Patients younger than 18 years of age
* Previous pulmonary resection
* History of primary pulmonary neoplasm
* Non-Para pneumonic etiology
* Incomplete records

A team of certified thoracic surgeons performed all the operations. Patients were put under general anesthesia using a double-lumen endotracheal tube that allowed for selective single-lung breathing. Patients were placed in lateral decubitus position. As determined by the surgeon, either thoracotomy or videothoracoscopy (VATS) was used to execute the procedure. Empyema fluid components were evacuated first, then the lung was decorticated and the capsule of the parietal, mediastinal, and diaphragmatic pleura was dissected. One or two chest tubes were placed according to surgeons’ choice. When air leakage stopped, the fluid collection was less than 100 mL per day, the X-ray showed sufficient lung expansion, and the chest tubes were gradually removed.

Demographic data were taken from medical records, such as age, sex, comorbidities and history of smoking. Data regarding surgical technique, antibiotic therapy, duration of chest tubes, length of hospital and intensive care unit(ICU) stay, reintervention, 30-day hospital readmission, and 3-month survival were obtained. RAPID score was calculated for each patient. Using the RAPID (Renal, Age, Fluid Purulence, Infection source, and Dietary) score at baseline presentation, the patients were classified into three risk categories for analysis: low, medium, and high. The primary outcome was 3-month mortality. Length of hospital stay, readmission rate, and the need for pleural re-intervention were secondary outcomes. However during our study period, the RAPID score was not utilized to determine the clinical management of the patient. All patients underwent follow-up for 6 months. After every 3 months they were evaluated clinically by physical examination and investigations as per clinician’s choice.

Statistical analyses were performed using windows-based computer software devised with Statistical Packages for Social Sciences (SPSS-27) (SPSS Inc, Chicago, IL, USA).In descriptive statistics, continuous data were summarized by mean ± SD and categorical data were summarized into frequency distribution and percentage. Fisher's exact test was used to identify association between rapid scores and primary and secondary outcomes. A p value of ≤ 0.05 was considered statistically significant.

**Results:**

A total number of 27 patients were included in the study after fulfilling the inclusion and exclusion criteria. Mean age was 56±5.2 years with a male female ratio of 2:1. Diabetes mellitus was the most common associated co-morbidities (62.44%).Most of the patients were smokers (21 out of 27).

|  |  |
| --- | --- |
| **Variable** | **Value** |
| Age (Mean±SD) | 56±5.2 years |
| Sex:MaleFemale | 18(66.67%)9(33.33%) |
| Smoking | 21(77.78%) |
| Co-morbidities: |  |
| Diabetes mellitus | 17(62.44%) |
| Hypertension | 4(18.19%) |
| Dyslipidemia | 1(3.7%) |
| Ischemic heart Disease | 1(3.7%) |
| Others | 4(18.19%) |

**Table-2 Showing demographic variables of the patients**

92.6% patients suffered from community acquired pneumonia. Mean WBC count was 15.243 ± 6.84 cell/mm3. Mean serum albumin and urea were 2.4 ± 0.6 mg/dl and 8.32±4.6 mg/dl respectively. Most of the discharge type was purulent (20 0ut of 27). (Table-2)

Fever and Cough were the most common presentations respectively (92.59% and 81.48 %%).21 out of 27 patients had previous pleural fluid drainage either by aspiration or tube thoracostomy. According to the RAPID score, 8 patients (29.62 %) were stratified as low-risk, 10(37.03%) patients as medium-risk and 9 as high-risk (33.33 %). (Figure-1)

|  |  |
| --- | --- |
| **Variable** | **Value** |
| **Presentation**FeverCoughDyspneaHemoptysis  | 25(92.59%)22(81.48%)21(77.77%)8(29.62%) |
| **Laboratorial analyses** |  |
| WBC (cell/mm3) | 15.243 ± 6.84 |
| Reactive C-protein (mg/L) | 65.2 ± 14.0 |
| Serum albumin (mg/dL) | 2.4 ± 0.6 |
| Serum urea (mg/dl) | 8.32±4.6 |
| Pleural fluidPneumonia type : Community acquired Hospital acquired Discharge Type Purulent: Non-purulent: | 25(92.6%)2(8.4%)20(74.07%)7(25.92%) |

**Table-3 showing clinical variables of the patient**

**Figure-1 Risk Stratification of patients according to RAPID score**

A total number of 9 patients required reintervention where 5 of them belonged to high risk group. 5 patients were readmitted and all of them were in high risk group according to Rapid score category. Three patients were admitted to ICU from high risk category. Rapid score was correlated to secondary outcomes of our study which was statistically significant (p<0.05).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable n (%)** | **Low risk** | **Medium risk** | **High-risk** | **P-value** |
| Reintervention | 1 | 3 | 5 | 0.004 |
| Readmissions in (90-day period) | 0 | 0 | 4 | 0.001 |
| Hospital stay(Mean±SD) | 15±7.2 days | 21±4.1 days | 42±5.4days | 0.003 |
| Requirement of ICU stay | 0 | 0 | 3 | 0.004 |

**Table-4 Secondary outcomes according to RAPID risk category**

The high-risk group had a 3-month mortality of 33.33%, while the moderate-risk group had 10 %, and low risk had no deaths within 90 days, showing a good correlation between the RAPID score and 3-month survival (p < 0.05).(Table-5)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Survival n (%)** | **Low risk** | **Medium risk** | **High risk** | **Total** | **P value** |
| > 3-month | 8 (100.0) | 9 (90.0%) | 6 (66.66%) | 23(85.18%) | 0.034 |

**Table-5 Association between RAPID score and 3-month mortality**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Low risk** | **Medium risk** | **High risk** |
| Sensitivity | 89.89%(76.32%-91.99%) | 95.51%(85.90% -98.49%) | 92.89%(86.32%-97.99%) |
| Specificity | 63.64%(30.79%-89.07%) | 85.82%(75.87%-91.21%) | 81.82%(76.75%-86.62%) |

**Table-6 Showing predictive values of RAPID scoring system** (**All Values are calculated at 95% confidence interval)**

Sensitivity and specificity for the primary endpoint at high-risk score were 92.89% % and 81.82%, respectively. On the other hand sensitivity for low risk and medium risk group were 89.89% and 95.51% respectively. (Table-6)

**Discussion:**

Worldwide, the prevalence of pleural infection or empyema thoracis, a condition linked to higher mortality, is increasing day by day. In order to identify patients who are at a high risk of dying, a validated clinical risk score should be developed at presentation.9 This would facilitate patient triage and potentially aid in the development of early care measures. Based on five clinical baseline criteria, the RAPID score (renal, age, purulence, infection source, and dietary component) is a predictive tool used to group patients into risk categories.10 The purpose of the study was to validate the RAPID score as a prognostic evaluation tool for pleural infection patients in our setting, specifically in terms of mortality.

It is still unclear when surgery is appropriate for pleural infections because different thoracic surgery associations throughout the world have different standards. The first line of treatment for all operable stage II patients is decortication by video-assisted thoracoscopic surgery (VATS), according to the American Association for Thoracic Surgery (AATS).11 In situations of persistent sepsis and collection despite the best possible antibiotic and chest tube therapy, the British Thoracic Society (BTS) states that surgical intervention should be the last option (6).12 For patients in stage I, the European Association for Cardio-Thoracic Surgery (EACTS) suggests medical therapy using percutaneous drainage while who are operable in stages II and III, VATS surgery is advised.13

Numerous studies have looked for factors linked to poor outcomes in pleural infections, indicating that fluid purulence, delayed access to surgery, and ultrasound parameters might be involved in predicting future outcome of the patients.14,15,16 However, because these studies were retrospective in nature, the results are not very reliable. The RAPID (Renal (urea), Age, fluid Purulence, Infection source, Dietary (albumin)) score is reliable predictive tool to stratify the risk for the patients undergoing intervention for pleural infection.16 In this study, baseline serum urea, patient age, pleural fluid purulence, infection source (community-acquired infection versus hospital-acquired infection), and serum albumin were all linked to mortality at three months.

Based on information from patients enrolling in the multicenter UK pleural infection study (first Multicenter Intrapleural Sepsis experiment [MIST1], n=411), RAPID score was created.17 A model selection process was used to identify variables that were predictive of a poor clinical outcome from a set of 22 baseline clinical features. Validation of the resulting score system RAPID (renal, age, purulence, infection source, and dietary variables) was conducted with 191 patients who were enrolled in the subsequent MIST2 experiment.17

A recent study of the Society of Thoracic Surgeons database included a retrospective referral of 7312 patients who had pulmonary decortication for parapneumonic empyema.18 According to the multivariate analysis of their data, authors found that a number of parameters are linked to unfavorable outcomes following pulmonary decortication. The factors discovered by Tower et al. are objectively covered by the RAPID score. The author revealed that patients in the high-risk category had a considerably higher risk of postoperative mortality than those in the low- and medium-risk categories. The present study also found a strong correlation between the RAPID score and the length of hospital stay, length of intensive care unit stay, 90-day readmission, and reintervention and 90-day mortality.18

In the PILOT (Pleural Infection Longitudinal OuTcome) study, conducted in 29 centres in four countries (the UK, the US, Australia and South Africa) shows that RAPID score can stratify adults with pleural infection into categories according to increasing risk of 3-month. Three-month mortality in the PILOT study was 3% for the low-risk group, 9% for the medium risk group and 31% for the high risk group respectively.19 Similar results were also observed in our study.

The present study had some limitations. It was a single center study with a very small sample size over a short period of time. Further large scale randomized multicenter studies should be conducted to provide better management to the patients suffering from pleural infection.

**Conclusion:**

The present study demonstrated a strong association between 3 month mortality and RAPID scores. Besides, the RAPID score was significantly correlated 90-days morbidity of the patients who underwent surgical intervention for pleural infection. The patients who had low RAPID scores showed better results. The results of current study will help to determine to predict the prognosis of the patients who will receive surgical intervention for pleural empyema.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

**References:**

1. Christensen T.D., Bendixen M., Skaarup S.H., Jensen J.U., Petersen R.H., Christensen M., et al. Intrapleural fibrinolysis and DNase versus video-assisted thoracic surgery (VATS) for the treatment of pleural empyema (FIVERVATS): protocol for a randomized, controlled trial - Surgery as first-line treatment. BMJ Open. 2022;12(3) doi: 10.1136/bmjopen-2021-054236.
2. Colice G.L., Curtis A., Deslauriers J., Heffner J., Light R., Littenberg B., et al. Medical and surgical treatment of parapneumonic effusions: an evidence-based guideline. Chest. 2000;118(4):1158–1171.
3. Semenkovich T.R., Olsen M.A., Puri V., Meyers B.F., Kozower B.D. Current State of Empyema Management. Ann Thorac Surg. 2018;105(6):1589–1596
4. Towe C.W., Carr S.R., Donahue J.M., Burrows W.M., Perry Y., Kim S., et al. Morbidity and 30-day mortality after decortication for parapneumonic empyema and pleural effusion among patients in the Society of Thoracic Surgeons’ General Thoracic Surgery Database. J Thorac Cardiovasc Surg. 2019;157(3):1288–1297.
5. Nayak R., Brogly S.B., Lajkosz K., Diane Lougheed M., Petsikas D. Outcomes of Operative and Nonoperative Treatment of Thoracic Empyema: a Population-Based Study. Ann Thorac Surg. 2019;108(5):1456–1463.
6. White HD, Henry C, Stock EM, et al. Predicting Long-Term Outcomes in Pleural Infections. RAPID Score for Risk Stratification. Ann Am Thorac Soc 2015;12:1310-6.
7. Rahman NM, Kahan BC, Miller RF, et al. A clinical score (RAPID) to identify those at risk for poor outcome at presentation in patients with pleural infection. Chest 2014;145:848-55.
8. Touray S, Sood RN, Lindstrom D, et al. Risk Stratification in Patients with Complicated Parapneumonic Effusions and Empyema Using the RAPID Score. Lung 2018;196:623-9.
9. Scarci M, Abah U, Solli P, et al. EACTS expert consensus statement for surgical management of pleural empyema. Eur J Cardiothorac Surg 2015;48:642-53.
10. Shen KR, Bribriesco A, Crabtree T, et al. The American Association for Thoracic Surgery consensus guidelines for the management of empyema. J Thorac Cardiovasc Surg 2017;153:e129-46
11. Chaddha U, Agrawal A, Feller-Kopman D, et al. Use of fibrinolytics and deoxyribonuclease in adult patients with pleural empyema: a consensus statement. Lancet Respir Med 2021;9:1050-64.
12. Wilson H, Mohite P, Hall A, et al. Timing and Efficacy of VATS Debridement in the Treatment of Parapneumonic Empyema. Arch Pulmonol Respir Care 2016;2:016-019.
13. Pereira RR, Alvim CG, Andrade CR, et al. Parapneumonic pleural effusion: early versus late thoracoscopy. J Bras Pneumol 2017;43:344-50.
14. Rahman NM, Maskell NA, West A, et al. Intrapleural use of tissue plasminogen activator and DNase in pleural infection. N Engl J Med 2011;365:518-26.
15. Davies HE, Davies RJ, Davies CW, et al. Management of pleural infection in adults: British Thoracic Society Pleural Disease Guideline 2010. Thorax 2010;65:ii41-53.
16. Wilshire CL, Jackson AS, Meggyesy AM, et al. Comparing Initial Surgery versus Fibrinolytics for Pleural Space Infections: A Retrospective Multicenter Cohort Study. Ann Am Thorac Soc 2022;19:1827-33.
17. Marks D.J.B., Fisk M.D., Koo C.Y., Pavlou M., Peck L., Lee S.F., et al. Thoracic empyema: a 12-year study from a UK tertiary cardiothoracic referral centre. PLoS One. 2012;7(1):e30074. doi: 10.1371/journal.pone.0030074.
18. Davies H.E., Davies R.J.O., Davies C.W.H. Management of pleural infection in adults: british Thoracic Society pleural disease guideline 2010. Thorax. 2010;65(Suppl. 2) doi: 10.1136/thx.2010.137000. ii41-53.
19. Corcoran JP, Psallidas I, Gerry S, et al. Prospective validation of the RAPID clinical risk prediction score in adult patients with pleural infection: the PILOT study. Eur Respir J 2020;56:2000130