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ORIGINAL PAPER

# Survival outcomes in patients with advanced cervical cancer undergoing ureteral stent insertion

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**Summary** *Introduction: Cervical cancer ranks 4th globally in cancer-related female deaths, with a 10-40% rise in the past 30 years, more pronounced in lower-middle-income countries. Indonesia is third with 21,003 deaths (9%) and an incidence rate of 68.43 per 100,000. Advanced cases often result in complications, including renal failure, thrombosis, hemorrhages, and urinary tract obstruction (11-44%). Age represents a fundamental biological determinant of treatment response and resilience to cancer burden, yet its prognostic role in the context of advanced cervical cancer with hydronephrosis remains underexplored. Urinary diversion stands as the preferred treatment for cervical cancer patients with urinary tract obstruction. This study seeks to investigate the influence of patient age on the survival rate in individuals with advanced cervical cancer and hydronephrosis undergoing ureteral stent insertion.*

*Materials and methods: This retrospective cohort study included patients with FIGO stage IIIB-IVB cervical cancer, imaging-confirmed hydronephrosis, and ureteral stent insertion at Saiful Anwar General Hospital between May 2016 and June 2025. Associations between age groups and categorical clinical characteristics were assessed using the Fisher-Freeman-Halton exact test and Cramér's V. Overall survival was estimated using the Kaplan-Meier method. A multivariable Cox proportional hazards model evaluated the association between age group and overall survival after adjustment for FIGO stage, comorbidity status, hydronephrosis laterality and grade, and histologic subtype. Adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) were reported. Analyses were performed using IBM SPSS Statistics version 21, with $p < 0.05$ considered statistically significant.*

*Results: A total of 188 patients were included. The mean age of the patients was 50.95 ± 8.76 years (range 29-75 years), with the majority aged 50-59 years (43.1%) and diagnosed at FIGO stage IIIB (70.7%). The overall mortality rate was 81.9%. Kaplan-Meier analysis demonstrated a significant difference in overall survival across age groups (log-rank $\chi^2 = 50.505$, $df = 5$, $p < 0.001$). Median survival was not reached in patients aged 30-39 years. Among the groups with an estimable median, the highest median survival was observed in patients aged 50-59 years (318 days), while the lowest was observed in those aged 70-79 years (15 days). The multivariable Cox proportional hazards model was statistically significant (likelihood-ratio $\chi^2 = 38.724$, $df = 13$, $p < 0.001$), and age group was independently associated with overall survival (overall Wald $\chi^2 = 23.667$, $df = 5$, $p < 0.001$). Compared with patients aged < 30 years, those aged 40-49 years had a lower hazard of death (adjusted HR 0.128, 95% CI 0.031-0.528, $p = 0.004$), whereas those aged 70-79 years had a higher hazard of death (adjusted HR 11.617, 95% CI 2.850-47.362, $p < 0.001$). FIGO stage, comorbidity status, hydronephrosis laterality, hydronephrosis grade, and histologic subtype were not independently associated with overall survival.*

*Conclusions: Age plays a significant role as as prognostic factor in survival outcomes for advanced cervical cancer patients with hydronephrosis who undergo ureteral stenting. This finding underscores the importance of age-stratified management and prognostic counselling in clinical practice.*

KEY WORDS: *Cervical cancer; Hydronephrosis; Ureteral stent; Survival analysis.*

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## INTRODUCTION

Cervical cancer is a major global health issue, ranking as the fourth most common cancer in women worldwide. In 2018 alone, it accounted for more than 570,000 new cases and over 311,000 deaths globally, with more than 85% of these deaths occurring in low- and middle-income countries (1, 2). The disparity is largely attributed to limited access to early screening, HPV vaccination, and timely intervention in resource-limited settings (3, 4).

In Indonesia, cervical cancer is the second most prevalent malignancy among women after breast cancer, with an estimated 36,000 new cases and approximately 18,000 deaths annually (5). Unfortunately, due to a lack of organized screening and health-seeking delays, many patients present in advanced stages of the disease, particularly at FIGO stage IIIB or higher (6).

A common complication of advanced cervical cancer is obstructive uropathy, which occurs when the tumor invades or compresses the ureters, leading to hydronephrosis and renal dysfunction. The prevalence of hydronephrosis in cervical cancer patients ranges from 11% to 57%, and is significantly associated with poorer survival outcomes (7). In the FIGO staging system, the presence of hydronephrosis alone categorizes a patient as stage IIIB or higher, underscoring its prognostic significance (8).

Ureteral stent insertion or *percutaneous nephrostomy* (PCN) are the primary methods of urinary diversion used

to relieve obstruction and restore renal function. Both modalities aim to reduce the risks of sepsis, uremia, and electrolyte imbalances, while enabling patients to continue receiving oncologic treatments such as chemotherapy or radiotherapy (9, 10). Studies have demonstrated that urinary diversion in these patients not only improves renal function but can also prolong survival and improve quality of life (11, 12).

Several prognostic factors such as disease stage, tumor burden, performance status, and particularly patient age have been implicated in influencing clinical outcomes. Age is biologically relevant, as older individuals tend to present with lower physiological reserve, increased comorbidity burden, and reduced tolerance to invasive procedures and systemic therapies (13, 14). Furthermore, age may correlate with more advanced disease at diagnosis, including higher-stage tumors and more severe or bilateral hydronephrosis, potentially reflecting both tumor aggressiveness and delays in care.

Despite its clinical significance, limited studies have examined how age interacts with other critical factors such as staging, laterality and severity of hydronephrosis, and how these collectively affect survival following ureteral stent insertion. Most prior literature has focused narrowly on survival or renal function post-diversion, without stratifying patients by age-related differences.

Therefore, this study aims to evaluate the role of age as a primary prognostic factor in patients with advanced cervical cancer and hydronephrosis undergoing ureteral stenting. Additionally, this study explores how age relates to disease staging and hydronephrosis characteristics, with the ultimate goal of enhancing risk stratification, patient selection, and prognostic counselling in this high-risk population.

## Methods

### *Ethical considerations*

This retrospective study was approved by *The Ethics Commission of General Hospital Dr. Saiful Anwar* (No.400/046/K.3/102.7/2026) given the non-interventional design and use of existing medical records. All data were extracted and analysed in a de-identified form to protect patient privacy.

### *Study design and patient selection*

A retrospective cohort design was employed, and the study was conducted at *Saiful Anwar General Hospital, Malang, Indonesia*. Medical records from May 2016 to June 2025 were reviewed. Eligible participants were female patients diagnosed with FIGO stage IIIB to IVB cervical cancer who developed hydronephrosis confirmed by imaging and subsequently underwent ureteral stent placement. Patients were excluded if they had undergone percutaneous nephrostomy instead of ureteral stenting, lacked imaging-confirmed hydronephrosis, or had incomplete clinical records.

### *Procedures*

Ureteral stent insertion was performed by a urologist under local or general anesthesia, using cystoscopic guidance. A double-J stent was placed unilaterally or bilaterally based on the location and severity of obstruction. The purpose of the procedure was to relieve ureteral compression, restore urine flow from the kidneys to the bladder, and improve renal function. Post-procedure, patients were monitored for urine output, renal function, infection, and stent-related complications. Stent changes were scheduled every 3-6 months as needed, unless contraindicated by disease progression or clinical deterioration.

### *Data collection*

Clinical data collected included the patient's age at the time of stent insertion, cancer staging, hydronephrosis laterality, comorbid conditions (particularly chronic kidney disease), date of stent insertion, date of last follow-up or death, and total survival duration in months.

### *Outcome measures*

All analyses were performed using IBM SPSS Statistics version 21. Continuous variables were summarized using means and standard deviations, whereas categorical variables were presented as frequencies and percentages. Associations between age group and categorical clinical characteristics were evaluated using the Fisher-Freeman-Halton exact test for RxC contingency tables because of small expected cell counts. Cramér's V was used to quantify the strength of association.

Overall survival was estimated using the Kaplan-Meier method, and survival distributions across age groups were compared using the log-rank (Mantel-Cox) test. A multivariable Cox proportional hazards model was used to evaluate the association between age group and overall survival after adjustment for FIGO cancer stage, comorbidity status, hydronephrosis laterality, hydronephrosis grade, and histologic subtype. Results were reported as adjusted hazard ratios with 95% confidence intervals. The overall model was evaluated using the likelihood-ratio test, while individual predictors were assessed using Wald tests. A two-sided p-value of $< 0.05$ was considered statistically significant

## Results

A total of 188 patients with advanced-stage cervical cancer and hydronephrosis who underwent ureteral stent insertion were included in this study (Table 1). The majority of patients were aged between 50-59 years (43.1%), followed by those in the 40-49 years iterval (31.9%). Only a small proportion of patients were under 30 years (1.1%) or over 70 years (1.6%). The mean age of the patients was 50.95 ± 8.76 years (range 29-75 years).

Regarding survival outcomes, 154 patients (81.9%) died, while 34 patients (18.1%) were alive at the end of follow-up. There was a statistically significant difference in survival outcomes across age groups ($p < 0.001$), with a Cramér's V of 0.567 indicating that survival was affected by patient age (Table 2).

Based on FIGO classification, stage IIIB was the most prevalent (70.7%), followed by stage IVA (22.9%) and stage IVB (6.4%). After applying the exact test for the RxC contingency table, FIGO stage was not significantly associated with age group ($p = 0.121$; Cramér's V = 0.194).

***Table 1.***
*Characteristic of study.*

| Characteristic | N | Percentage (%) | Mean ± SD |
|---|---|---|---|
| Age (years) | | | 50.95 ± 8.76 |
| < 30 | 2 | 1.1 | |
| 30-39 | 16 | 8.5 | |
| 40-49 | 60 | 31.9 | |
| 50-59 | 81 | 43.1 | |
| 60-69 | 26 | 13.8 | |
| 70-79 | 3 | 1.6 | |
| Total | 188 | 100 | |
| Survival | | | 382.18 ± 367.45 |
| Dead | 154 | 81.9 | |
| Alive | 34 | 18.1 | |
| Total | 188 | 100 | |
| Cancer Stage | | | |
| IIIB | 133 | 70.7 | |
| IVA | 43 | 22.9 | |
| IVB | 12 | 6.4 | |
| Total | 188 | 100 | |
| Comorbid | | | |
| With Comorbids (DM, AKI, CKD, HT) | 173 | 92.0 | |
| No Comorbid | 15 | 8.0 | |
| Total | 188 | 100 | |
| Hydronephrosis Side | | | |
| Unilateral | 22 | 11.7 | |
| Bilateral | 166 | 88.3 | |
| Total | 188 | 100 | |
| Hydronephrosis Grade | | | |
| Mild | 11 | 5.9 | |
| Moderate | 139 | 73.9 | |
| Severe | 38 | 20.2 | |
| Total | 188 | 100 | |
| Histology | | | |
| Squamous Cell Carcinoma | 155 | 82.4 | |
| Adenocarcinoma | 29 | 15.4 | |
| Small Cell Carcinoma | 4 | 2.2 | |
| Total | 188 | 100 | |

***Table 2.***
*Distribution of Clinical Risk Factors by Age Group and Fisher–Freeman–Halton exact test and Cramér's V.*

| Risk Factors | Age groups | | | | | | p-value | Cramér's V |
|---|---|---|---|---|---|---|---|---|
| | < 30 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | | |
| Survival | | | | | | | < 0.001* | 0.567 |
| Dead | 1 | 2 | 52 | 71 | 25 | 3 | | |
| Alive | 1 | 14 | 8 | 10 | 1 | 0 | | |
| Cancer Stage | | | | | | | 0.121 | 0,194 |
| IIIB | 2 | 16 | 44 | 52 | 18 | 1 | | |
| IVA | 0 | 0 | 14 | 21 | 6 | 2 | | |
| IVB | 0 | 0 | 2 | 8 | 2 | 0 | | |
| Comorbidity | | | | | | | 0.237 | 0.170 |
| With Comorbid(s) | 2 | 14 | 58 | 73 | 24 | 2 | | |
| No Comorbid | 0 | 2 | 2 | 8 | 2 | 1 | | |
| Hydronephrosis Side | | | | | | | 0.651 | 0.140 |
| Unilateral | 0 | 2 | 10 | 9 | 1 | 0 | | |
| Bilateral | 2 | 14 | 50 | 72 | 25 | 3 | | |
| Hydronephrosis Grade | | | | | | | 0.376 | 0.171 |
| Mild | 0 | 0 | 2 | 8 | 1 | 0 | | |
| Moderate | 1 | 15 | 48 | 54 | 18 | 3 | | |
| Severe | 1 | 1 | 10 | 19 | 7 | 0 | | |
| Histology Type | | | | | | | 0.102 | 0.240 |
| Squamous | 1 | 14 | 46 | 68 | 24 | 2 | | |
| Adenocarcinoma | 1 | 2 | 13 | 12 | 1 | 0 | | |
| Small Cell | 0 | 0 | 1 | 1 | 1 | 1 | | |

** significant.*

Comorbid conditions were common, with 92.0% of patients having at least one comorbidity (including diabetes mellitus, acute kidney injury, chronic kidney disease, or hypertension). However, the presence of comorbidities was not significantly associated with age group (p = 0.237; Cramér's V = 0.170).

In terms of hydronephrosis characteristics, bilateral hydronephrosis was predominant, occurring in 88.3% of patients, while only 11.7% had unilateral involvement. The distribution of hydronephrosis laterality did not significantly differ between age groups (p = 0.651; Cramér's V = 0.140).

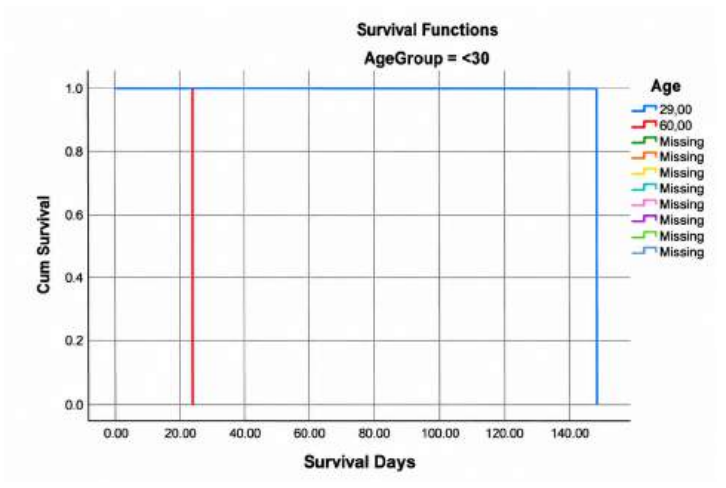
Similarly, hydronephrosis grade – mild (5.9%), moderate (73.9%), or severe (20.2%) – was not significantly associated with age group (p = 0.376; Cramér's V = 0.171).

Histopathologically, squamous cell carcinoma was the most common subtype (82.4%), followed by adenocarcinoma (15.4%) and small cell carcinoma (2.1%).

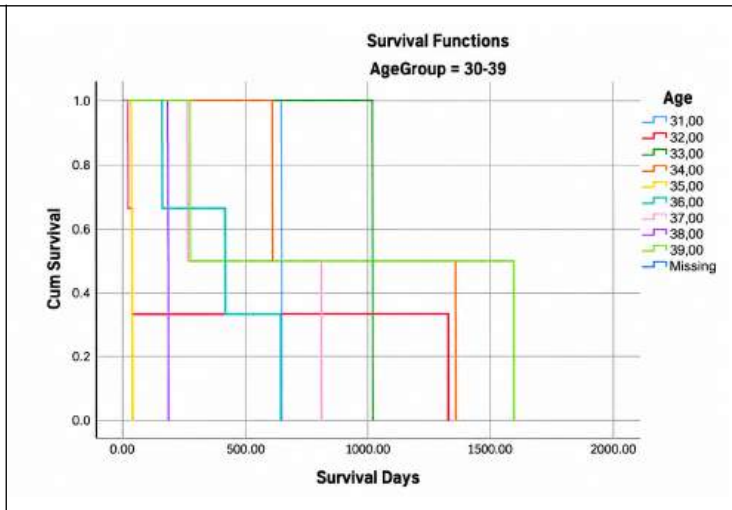
The distribution of histological types did not differ significantly among age groups (p = 0.102; Cramér's V = 0.240).

Kaplan-Meier survival analysis demonstrated a statistically significant difference in overall survival distributions across age groups (log-rank $\chi^2$ = 50.505, df = 5, p < 0.001; Figure 1). Median survival was not reached in patients aged 30-39 years. Among the age groups with an estimable median, the longest median survival was observed in patients aged 50-59 years at 318 days (95% CI 296.353-339.647), whereas the shortest was observed in those aged 70-79 years at 15 days (95% CI 0.000-31.003).

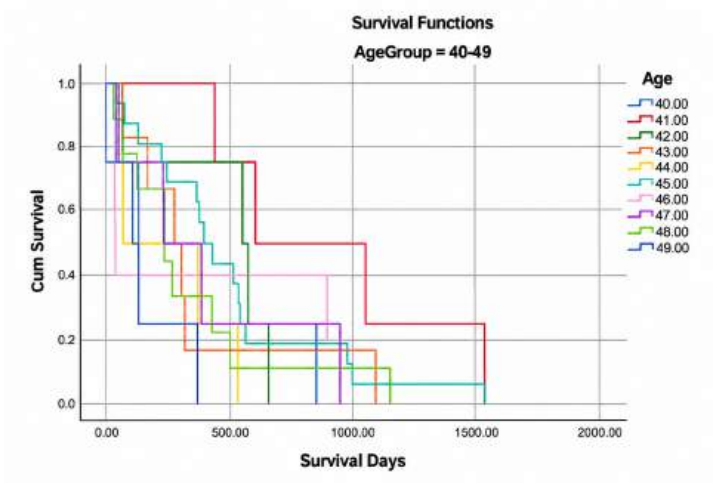
The multivariable Cox proportional hazards model was statistically significant (likelihood-ratio $\chi^2$ = 38.724, df = 13, p < 0.001). After adjustment for FIGO stage, comorbidity status, hydronephrosis laterality, hydronephrosis grade, and histologic subtype, age group remained independently associated with overall survival (overall Wald $\chi^2$ = 23.667, df = 5, p < 0.001). Compared with patients aged <30 years, those aged 40-49 years had a lower hazard of death (adjusted HR 0.128, 95% CI 0.031-0.528, p = 0.004), whereas those aged 70-79 years had a higher hazard of death (adjusted HR 11.617, 95% CI 2.850-47.362, p < 0.001). FIGO stage, comorbidity status, hydronephrosis laterality, hydronephrosis grade, and histologic subtype were not independently associated with overall survival.



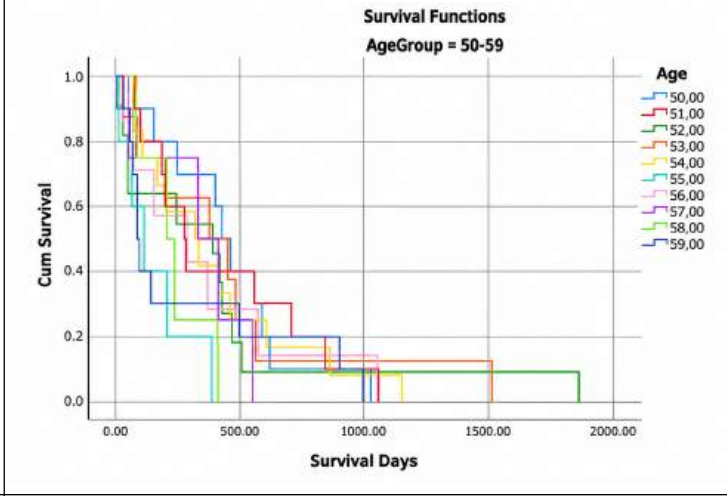

Age Group < 30



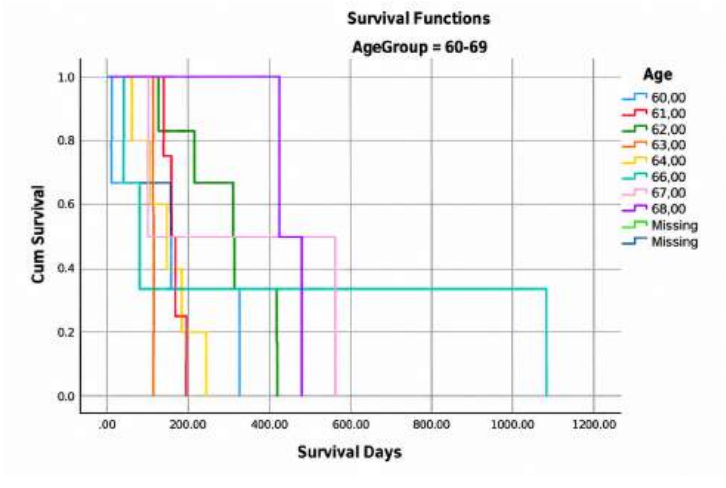

Age Group 30-39



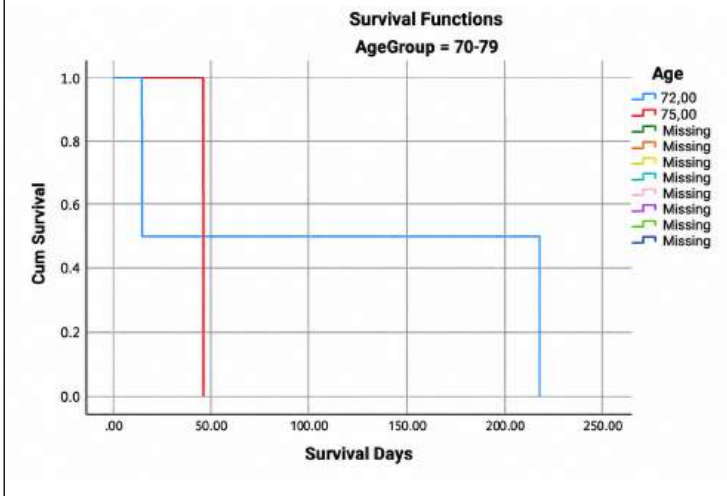

Age Group 40-49




Age Group 50-59




Age Group 60-69




Age Group 70-79

***Figure 1.***
*Kaplan-Meier survival analysis.*

***Table 3.***
*Multivariable Cox proportional hazards analysis of factors associated with overall survival.*

| Variable | Adjusted HR | 95% CI | p-value |
|---|---|---|---|
| Age group | | | < 0.001* |
| < 30 years | | | |
| 30-39 years | 0.390 | 0.053-2.890 | 0.357 |
| 40-49 years | 0.128 | 0.031-0.528 | 0.004* |
| 50-59 years | 1.316 | 0.896-1.933 | 0.161 |
| 60-69 years | 1.177 | 0.741-1.868 | 0.490 |
| 70-79 years | 11.617 | 2.850-47.362 | < 0.001* |
| FIGO cancer stage | | | 0.640 |
| IIIB | | | |
| IVA | 0.991 | 0.671-1.463 | 0.964 |
| IVB | 0.716 | 0.358-1.433 | 0.346 |
| Comorbidity status | | | |
| With comorbidity | | | |
| No comorbidity | 1.085 | 0.577-2.040 | 0.800 |
| Hydronephrosis laterality | | | |
| Unilateral | | | |
| Bilateral | 0.808 | 0.477-1.369 | 0.428 |
| Hydronephrosis grade | | | 0.831 |
| Mild | | | |
| Moderate | 1.009 | 0.476-2.141 | 0.981 |
| Severe | 1.138 | 0.512-2.531 | 0.751 |
| Histologic subtype | | | 0.447 |
| Squamous cell carcinoma | | | |
| Adenocarcinoma | 1.014 | 0.637-1.613 | 0.954 |
| Small cell carcinoma | 2.180 | 0.653-7.272 | 0.205 |

*Model likelihood-ratio $\chi^2$=38.724, df=13, p < 0.001; 154 deaths were observed.*
*HR: hazard ratio; CI: confidence interval. Reference categories are shown explicitly. * p < 0.05.*

## Discussion

This study investigated the role of age in the survival outcomes of advanced cervical cancer patients with hydronephrosis undergoing ureteral stent insertion. Kaplan-Meier analysis demonstrated significant differences in overall survival across age groups (log-rank $\chi^2$ = 50.505, df=5, p < 0.001). Median survival was not reached in patients aged 30-39 years. Among groups with an estimable median, patients aged 50-59 years had the longest median survival of 318 days, whereas those aged 70-79 years had the shortest median survival of 15 days. Therefore, the observed survival pattern did not indicate a uniformly progressive decline with increasing age.

The multivariable Cox proportional hazards model was statistically significant and showed that age group remained independently associated with overall survival after adjustment for FIGO stage, comorbidity status, hydronephrosis laterality, hydronephrosis grade, and histologic subtype. Compared with patients aged < 30 years, those aged 40-49 years had a lower adjusted hazard of death, whereas those aged 70-79 years had a markedly higher adjusted hazard. Nevertheless, these estimates should be interpreted cautiously because the reference group aged < 30 years and the group aged 70-79 years contained only two and three patients, respectively, resulting in wide confidence intervals and potentially unstable hazard-ratio estimates.

Age is a well-established prognostic factor in oncology. In the context of cervical cancer, advanced age may be associated with a lower physiological reserve, more comorbid conditions, and delayed access to health care, all contributing to poorer outcomes (3, 15). Additionally, older patients may have a diminished ability to tolerate systemic treatments such as chemotherapy and radiation, which are standard components of cervical cancer management at advanced stages (16). However, the present findings suggest that the relationship between age and survival may not be strictly linear and may also be influenced by differences in clinical condition, treatment eligibility, and disease characteristics among age groups.

The high mortality rate in this cohort (81.9%) reflects the advanced stage of disease presentation, consistent with other Indonesian studies reporting late-stage diagnosis due to lack of effective screening and public health awareness (17, 18). In Indonesia, cervical cancer remains the second most common cancer among women, with the majority of cases diagnosed at FIGO stage IIIB or higher (5). The presence of hydronephrosis further indicates local invasion and ureteral obstruction, which significantly worsens prognosis (19).

Ureteral stenting, as a method of urinary diversion, plays a critical role in relieving obstructive uropathy, restoring renal function, and allowing the continuation of cancer-directed therapies. Multiple studies have shown that patients undergoing urinary diversion (stenting or percutaneous nephrostomy) have better survival outcomes compared to those who refuse or are unable to undergo the procedure (12, 18). However, despite its benefits, stent failure or progression of disease often limits long-term efficacy.

In this study, most patients presented with bilateral hydronephrosis (88.3%) and moderate to severe obstruction, indicating a high tumor burden. Previous research has shown that bilateral hydronephrosis is an independent predictor of poor prognosis, particularly in patients with concurrent *chronic kidney disease* (CKD) or *acute kidney injury* (AKI), which were also prevalent in our cohort (7, 20). In the present multivariable analysis, however, neither hydronephrosis laterality nor hydronephrosis grade was independently associated with overall survival. This discrepancy may reflect the predominance of bilateral and moderate hydronephrosis in the cohort, which reduced variability between comparison groups.

Although the histopathological subtype was not significantly associated with survival in this study, squamous cell carcinoma was the most common variant (82.4%), aligning with global trends (21). Histologic subtype was not independently associated with overall survival in the Cox model. Although histologic subtype may influence tumor behavior, treatment response, and recurrence, its prognostic effect in this cohort may have been outweighed by advanced disease, obstructive uropathy, and other unmeasured clinical factors.

The present study has several limitations. Its retrospective, single-center design may have introduced selection bias and limited the completeness of clinical data.

Important prognostic variables, including performance status, renal function, nutritional status, tumor burden, biomarkers, chemotherapy or radiotherapy exposure, and stent-related outcomes, were not consistently available and therefore could not be included in the adjusted model. In addition, the very small number of patients in the youngest and oldest age groups may have produced unstable hazard-ratio estimates. Consequently, the findings should be interpreted as evidence of an association rather than a definitive causal effect of age on survival.
Clinically, these findings support the inclusion of age as one component of prognostic assessment in patients with advanced cervical cancer undergoing ureteral stenting. Nevertheless, age should not be considered in isolation, and individualized decision-making should also incorporate performance status, comorbidity burden, renal function, disease extent, anticipated oncologic treatment, and patient preferences. Close collaboration between urological and oncological teams remains essential for optimizing urinary diversion, treatment continuation, and prognostic counselling in this high-risk population

## Conclusions

This study demonstrates that age group was independently associated with overall survival in patients with advanced cervical cancer and hydronephrosis undergoing ureteral stent insertion. Patients aged 70-79 years had the shortest median survival and a substantially higher adjusted hazard of death; however, the survival pattern was not uniformly progressive across age groups. These findings support incorporating age into prognostic assessment and individualized clinical counselling, while considering other clinical factors and the small number of patients in the youngest and oldest age groups. Early detection and timely management of obstructive uropathy remain important in optimizing outcomes in this high-risk population.

## Declarations

***Ethical approval and consent for participate:*** *The author has ethical clearance No. 400/046/K.3/102.7/2026 from Health Research Ethics Committee, Saiful Anwar General Hospital, Malang, Indonesia.*

***Consent for publication:*** *Not applicable.*

***Availability of data and material:*** *All data underlying the results are available as part of the article and no additional source of data are required.*

***Competing interests:*** *The authors declare that they have no competing interests.*

***Funding:*** *The authors report no funding.*

***Authors' contributions:*** *DGS: Conceptualization, methodology, investigation, validation, data curation, analysis, visualization, writing – review & editing; BD: Conceptualization, methodology, investigation, analysis, visualization, writing – review & editing, supervision; AFP: Conceptualization, methodology, analysis, writing – review & editing, project administration, supervision.*

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