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Volumetric Arc Therapy in the Treatment of Cervical Cancer: Experience of the Radiotherapy Department of Bogodogo University Hospital

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Abstract

Background: Cervical cancer remains a major public health problem, particularly in resource-limited countries where locally advanced forms are common. Volumetric modulated arc therapy (VMAT) represents a technological advancement that allows for more conformal irradiation of target volumes while limiting the dose to organs at risk. **Objective:** To describe the clinical, tumor, therapeutic, and outcome characteristics of patients irradiated for cervical cancer at the Bogodogo radiotherapy department. **Methods:** This was a retrospective, single-center cohort study with data collection conducted between March 2023 and October 2025. All patients irradiated for cervical cancer during the study period were included. Data were collected from medical records, department registers, and treatment planning documents, and then analyzed using IBM SPSS Statistics 2025. **Results:** Fifty-two patients were included. Hypertension was observed in 23.1% of cases, diabetes in 7.7%, and HIV in 5.8%. Invasive squamous cell carcinoma accounted for 96.2% of cases, 30.8% of patients had lymph node involvement, and 55.8% were classified as FIGO 2018 ≥ IIIA. All patients received chemoradiotherapy concurrent chemoradiotherapy; 46.2% had received induction chemotherapy and 11.5% had undergone surgery. At the last follow-up date, 88.5% of the patients were alive. **Conclusion:** This single-institution series suggests that VMAT-based concurrent chemoradiotherapy for cervical cancer is feasible in our setting and that most patients can complete treatment, with encouraging survival at early follow-up. Further prospective work with detailed dosimetric, toxicity, and long-

term outcome data is needed.

Keywords

Cancer, Cervix, VMAT, CHU Bogodogo

1. Introduction

Cervical cancer remains a major global health problem and continues to disproportionately affect low- and middle-income countries, particularly in sub-Saharan Africa, where high incidence and mortality rates coexist with limited access to specialized cancer care [1] [2]. This situation is linked to several factors, including diagnostic delays, insufficient screening, incomplete human papillomavirus vaccination coverage, and inequalities in access to surgery, external beam radiotherapy, and brachytherapy [1] [2].

Standard treatment for locally advanced cervical cancer relies on platinum-based concurrent chemoradiotherapy followed by brachytherapy, which remains an essential component of curative treatment [3]-[7]. Historical randomized trials have shown that combining cisplatin-based chemotherapy with radiotherapy significantly improves overall survival and progression-free survival compared to radiotherapy alone [3] [8]. These data have subsequently been consolidated by meta-analyses confirming the benefit of concurrent chemoradiotherapy in the treatment of locally advanced cervical cancer [5]. At the same time, international guidelines emphasize that brachytherapy cannot be omitted or replaced by external beam radiotherapy alone, even when it relies on modern irradiation techniques [6] [7].

Technological advances in radiation oncology have led to the development of intensity-modulated radiotherapy and, subsequently, volumetric modulated arc therapy (VMAT), an advanced delivery technique that provides dynamic dose modulation during gantry rotation [9] [10]. VMAT enables dynamic dose delivery through continuous rotation of the accelerator arm, modulation of the dose rate, and synchronized movement of the multileaf collimator blades [9] [10]. This technique offers several potential advantages, including improved dose conformation to the target volume, better protection of organs at risk, reduced treatment time, and greater delivery efficiency compared to some conventional approaches or static IMRT plans [9]-[11].

In cervical cancer, VMAT has shown promising dosimetric advantages, including improved target volume coverage and reduced irradiation of organs at risk such as the bladder, rectum, bowel, pelvic bone marrow, and femoral heads [11]-[14]. However, the magnitude of its clinical benefit may vary according to local expertise, treatment workflow, and integration with brachytherapy [9] [11] [14].

In Africa, implementation of advanced radiotherapy techniques remains challenged by equipment shortages, limited brachytherapy capacity, and human resource constraints [2] [15]. In Burkina Faso, published data on the use of VMAT

for cervical cancer remain scarce. The present study therefore aimed to report the experience of the Radiotherapy Department of Bogodogo University Hospital in the management of cervical cancer with VMAT in a cohort of 52 patients.

2. Materials and Methods

2.1. Study Design and Setting

This was a retrospective, descriptive, single-center cohort study conducted at the Radiotherapy Department of Bogodogo University Hospital, Ouagadougou, Burkina Faso, from March 2023 to October 2025. The study was designed in accordance with the reporting principles for observational studies and focused on all patients treated with VMAT for cervical cancer during the study period.

2.2. Study Period

The study population consisted of all patients irradiated for cervical cancer during the study period. **Inclusion criteria** were: 1) histologically confirmed cervical cancer; 2) treatment with VMAT in our department between March 2023 and October 2025; and 3) availability of minimum required data on baseline characteristics, treatment, and follow-up. **Exclusion criteria** were: 1) absence of histologic confirmation; or 2) medical records lacking key baseline or follow-up information.

Over the study period, 56 patients initiated VMAT for cervical cancer. Four were excluded (two with incomplete baseline records and two without post-treatment follow-up), leaving 52 patients for analysis.

2.3. Data Collection and Staging Procedures

Data were collected retrospectively using a standardized extraction form from medical charts, departmental records, and radiotherapy planning documents. Variables included medical history and comorbidities, clinicopathological features, treatment characteristics, and outcome status at the time of last news.

FIGO 2018 staging was assigned using clinical examination (speculum and bimanual/rectovaginal examination) and cross-sectional imaging. Pelvic MRI was the preferred modality; pelvic CT was used when MRI was not available. Abdominal and thoracic CT were performed when indicated. Nodal status (N0/N1) was determined from MRI and/or CT using radiologic criteria for pathologic lymph nodes (short-axis diameter and morphology).

2.4. Radiotherapy Treatment Parameters and Target Volumes

External beam radiotherapy was delivered using VMAT on a linear accelerator. The prescribed dose to the pelvis was 45 - 50.4 Gy in 25 - 28 daily fractions of 1.8 - 2.0 Gy, 5 fractions per week. The clinical target volume (CTV) included the primary tumor (when visible), cervix, uterus, parametria, upper vagina, and pelvic lymph node regions (common, external, internal iliac and obturator chains; para-aortic nodes in selected cases), in line with guideline-based contouring recommendations. Planning target volumes were generated by adding 7 - 10 mm margins to the CTV,

adjusted according to departmental practice [6] [7] [16]. Organs at risk included at least the bladder, rectum, small bowel or bowel bag, and femoral heads [7] [16]. Concurrent chemotherapy consisted of weekly cisplatin 40 mg/m^2, planned for five to six cycles depending on tolerance.

Because intracavitary brachytherapy is not yet available in our institution, all patients received an external beam boost of 16 - 20 Gy to the cervix and involved lymph nodes. Nodal disease was treated with a simultaneous integrated boost in line with guidelines [6].

2.5. Follow-Up

Patients were assessed weekly during treatment, then at 1 month after treatment completion, and subsequently every 3 months. Outcome assessment in the present study was primarily based on vital status at last follow-up.

2.6. Statistical Analysis

Data were analyzed using IBM SPSS Statistics 2025. Categorical variables were summarized as frequencies and percentages. Mean survival time was reported when available in the source manuscript. Overall survival was estimated using the Kaplan-Meier method. Patients who were alive at last contact were censored on that date. Median follow-up was calculated using the reverse Kaplan-Meier method.

2.7. Primary and Secondary Endpoints

The primary endpoint was overall survival (OS), defined as the time from histologic diagnosis to death from any cause or last contact. Patients alive at last contact were censored on that date. Secondary endpoints were descriptive and included baseline clinico-pathological characteristics, treatment characteristics, and vital status at last follow-up.

2.8. Ethical Considerations

The study was approved by the Ethics Committee of Bogodogo University Hospital and was conducted in accordance with data confidentiality and anonymity requirements.

3. Results

A total of 52 patients irradiated for cervical cancer at the radiotherapy department of the Bogodogo University Hospital between March 2023 and October 2025 were included in the analysis. The mean age was 56.12 years, with a range of 30 to 83 years, and the median age was 55 years.

3.1. Medical History and Comorbidities

In terms of medical history, hypertension was reported in more than 20% of the cohort, while diabetes was present in a few patients. Asthma and HIV (Human Immunodeficiency Virus) were reported in some patients. Menopause at the time

of diagnosis was noted in more than 70% of patients.

Regarding lifestyle habits, no patient reported smoking or alcohol consumption. Surgical history was absent in most patients, while a hysterectomy was reported in approximately 10%. A family history of cancer was absent in 90% of cases; two patients reported breast cancer in a sister and one patient reported a family history of cervical cancer in her mother. Table 1 summarizes the medical, surgical, and family history of patients treated with volumetric arc therapy for cervical cancer.

Table 1. Medical, surgical and family history of patients treated with volumetric arc therapy for cervical cancer (n = 52).

Variable	Category	n	%
High blood pressure	Yes	12	23.1
Diabetes	Yes	4	7.7
Asthma	Yes	1	1.9
Alcohol consumption	No	52	100.0
Smoking	No	52	100.0
Menopause at diagnosis	Yes	38	73.1
Surgical history	Nothing	47	90.4
Family history of cancer	Nothing	49	94.2
HIV	Positive	3	5.8

3.2. Clinicopathological Characteristics

Histopathological examination showed a clear predominance of invasive squamous cell carcinoma, while adenocarcinoma accounted for only 2 cases. The histological grade was moderately differentiated in 2/3 of the patients.

Regarding disease extent, lymph node involvement was found in one-third of the patients. No patient had distant metastases at diagnosis, with the entire cohort classified as M0. Overall, the patients' general condition was preserved, with a WHO performance status of 0 in almost half of the cases. According to the 2018 FIGO classification, the majority of patients had tumors at stage IIIA or higher. Table 2 summarizes the clinico-tumor characteristics of patients treated with volumetric arc therapy for cervical cancer. Figure 1 shows the distribution of patients according to their 2018 FIGO stage.

3.3. Treatment Characteristics

Induction chemotherapy had been administered to slightly less than half of the patients. Surgery for cervical cancer had been performed on a few patients.

All patients received external beam radiotherapy and concurrent chemoradiotherapy. Table 3 presents the treatment characteristics and vital status at the last follow-up.

Table 2. Clinicopathological characteristics of patients treated with volumetric arc therapy for cervical cancer (n = 52 for each variable).

Variable	Category	n	%
Histological type	Infiltrating squamous cell carcinoma	50	96.2
Histological type	Adenocarcinoma	2	3.8
Histological grade	Clearly differentiated	11	21.2
Histological grade	Moderately differentiated	33	63.5
Histological grade	Undifferentiated	8	15.4
Lymph node stage	N0	36	69.2
Lymph node stage	N1	16	30.8
Metastatic stage	M0	52	100.0
PS WHO	0	25	48.1
PS WHO	1	25	48.1
PS WHO	2	2	3.8
FIGO Staging 2018	≤IIb	23	44.2
FIGO Staging 2018	≥IIIA	29	55.8

PS WHO: Performance status of World Health Organization; FIGO: International Federation of Gynaecologic and Obstetric.

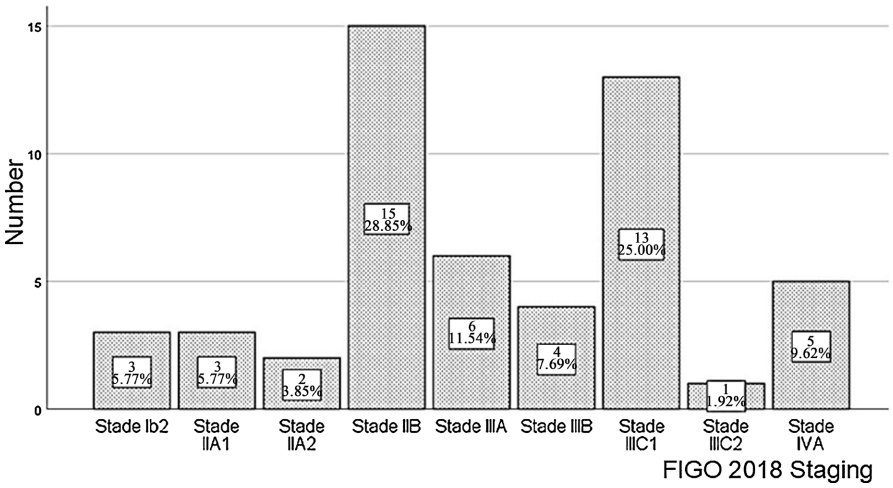

Figure 1. Patient distribution according to FIGO 2018 tumor staging.

Table 3. Therapeutic characteristics and vital status at last follow-up (n = 52).

Variable	Category	n	%
Induction chemotherapy	Yes	24	46.2
Induction chemotherapy	No	28	53.8
Surgery	Yes	6	11.5
Surgery	No	46	88.5

Continued

Radiotherapy	Yes	52	100.0
Concurrent chemoradiation	Yes	52	100.0
State according to the latest news	Alive	46	88.5
State according to the latest news	Deceased	6	11.5

3.4. Outcome at Last Follow-Up

Overall survival, defined as the primary endpoint of this study, was 88.5% (46 patients were alive and 6 (11.5%) had died). The mean survival time was 1405 days (approximately 3.8 years; 95% CI 1289 - 1521 days) for the entire cohort. The median follow-up was 793.50 days (240 to 1564 days). Figure 2 shows the survival curve.

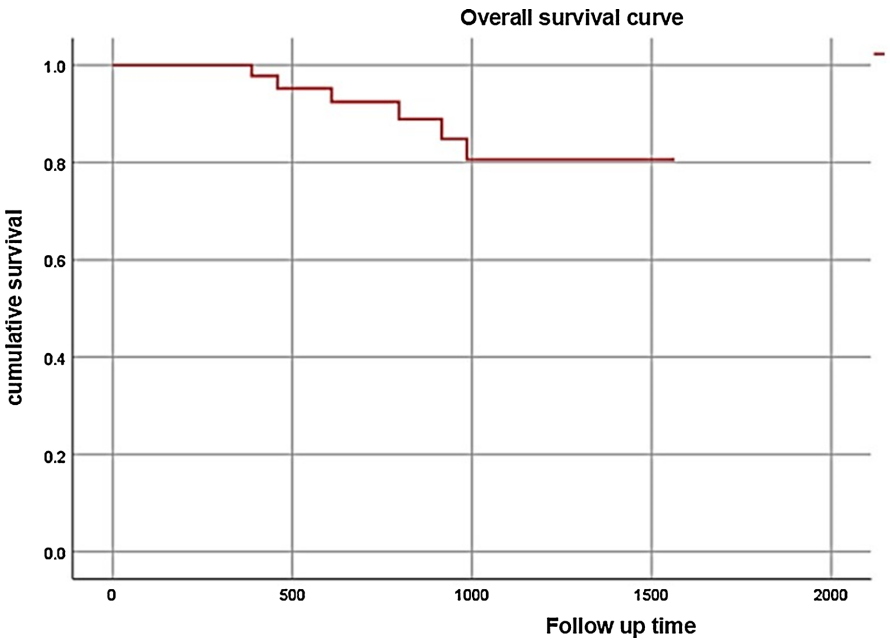

Figure 2. Overall survival curve for the study cohort.

4. Discussion

This study presents the initial experience of the Bogodogo Radiotherapy Department with VMAT in the treatment of cervical cancer and shows that most patients were managed for locally advanced disease. More than half of the cohort had FIGO 2018 stage IIIA or higher disease, and nearly one-third had nodal involvement. This pattern is consistent with reports from sub-Saharan Africa, where limited screening coverage, delayed diagnosis, and barriers to referral contribute to the predominance of advanced-stage presentation [2] [17] [18].

In sub-Saharan Africa, cervical cancer remains one of the leading reasons for gynecological radiotherapy, but its management is still heavily dependent on the availability of equipment, specialized personnel, and brachytherapy [2] [19]. A

recent systematic review showed that access to radiotherapy in sub-Saharan Africa remains limited by financial, geographic, logistical, and human constraints, with a direct impact on the quality and completeness of treatments [2]. In this context, the implementation of an advanced technique such as VMAT in a West African center represents a significant organizational and technological advancement [19].

The marked predominance of invasive squamous cell carcinoma in the present series is also consistent with regional and international data [19] [20]. In addition, most patients had preserved performance status, which likely contributed to the feasibility of concurrent chemoradiotherapy in this cohort. All patients received radiotherapy and concurrent chemoradiotherapy, suggesting relative consistency of treatment delivery at the institutional level.

The treatment modalities observed in this study are consistent with contemporary standards. All patients received concurrent radiotherapy and chemoradiotherapy, while induction chemotherapy was used in only a portion of the cohort, and surgery remained a minority procedure [7] [21]. This distribution is logical in a population dominated by locally advanced forms of the disease, for which chemoradiotherapy followed by brachytherapy is the standard treatment [6] [7] [21]. However, several African studies show that, beyond the recommendations, the actual implementation of this therapeutic standard remains inconsistent, particularly due to access delays, treatment interruptions, and the variable availability of brachytherapy [2] [18] [22].

The growing use of VMAT in radiation oncology is mainly supported by dosimetric and logistical advantages, including improved dose conformity, sparing of pelvic organs at risk, and shorter treatment times in selected settings [9] [10] [12] [13]. The literature also suggests that VMAT can help reduce certain treatment times and improve logistical feasibility in high-volume departments [9] [14]. However, the current study does not yet provide detailed dosimetric data, toxicity outcomes, brachytherapy information, or full time-to-event analyses, which limits the ability to draw strong conclusions regarding long-term oncologic benefit [7] [23].

In this retrospective cohort, overall survival was prespecified as the primary endpoint, and our analysis remains essentially descriptive and hypothesis-generating rather than designed to demonstrate definitive treatment benefit. The proportion of patients alive at last follow-up appears encouraging. Nevertheless, this result should be interpreted cautiously because the study did not provide a complete actuarial survival analysis, median follow-up duration, or detailed progression-related outcomes. For comparison, the experience of the National Radiotherapy Center in Accra, Ghana, involving 250 patients treated with external beam radiotherapy and brachytherapy, reported a 3-year overall survival rate of 86% with a median follow-up of 2.4 years [24]. This comparison suggests that the Bogodogo results are promising, but it also highlights the need for methodological refinement of the manuscript by adding data on survival, toxicities, brachytherapy,

overall treatment time, and dosimetric parameters in order to more accurately assess the oncological and technical performance of this institutional experience [2] [7] [24].

Limits of the study: First, the retrospective design and our inclusion of only 52 of the 56 patients who initiated VMAT may have introduced selection bias, because four patients with incomplete baseline data or missing follow-up were excluded from the analysis. This restriction to patients with more complete records and documented follow-up may overestimate treatment completion and survival, and our results should therefore be interpreted as exploratory institutional observations rather than population-level estimates.

5. Conclusion

VMAT-based management of cervical cancer at the Bogodogo Radiotherapy Department mainly involved patients with locally advanced disease and relied primarily on concurrent chemoradiotherapy. The study supports the feasibility of implementing VMAT in a low-resource African setting, but additional studies are required to better define toxicity, local control, and survival.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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