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Testicular germ cell cancer in Africa: A survey on patterns of practice

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Background: Testicular germ cell tumours (GCTs) are rare malignancies most prevalent in 15–40-year-old men. Incidence rates of testicular cancer on a global level show marked geographic variation with higher incidence rates reported in predominantly Caucasian populations. African data on GCT management show low incidence rates but an advanced stage at presentation and high mortality rates.

Aim: The aim of the study was to explore patterns of practice in the management of testicual GCTs.

Setting: The study was conducted in an African oncology care setting.

Methods: A cross-sectional web-based survey was distributed to doctors or nurses providing oncology care for patients with testicular GCT in Africa. Data on staging procedures, chemotherapy and radiotherapy (RT) treatment schedules across institutions are reported and discussed in the context of international treatment guidelines and local resources.

Results: Eleven African countries contributed data. Epidemiological estimates were received from 20 institutions and management and outcome data from 18 institutions. The estimated ratio of seminoma to non-seminoma was 1:1.3. The stage at presentation was tumour-node-metastases-serum marker (TNM-S) Stage III at half of the institutions surveyed. Chemotherapy regimens mostly followed international guidelines, but certain essential drugs were not consistently accessible at all centres. Radiotherapy services were available to all but one respondent, with three-dimensional planning being widely used. There was marked variation in RT doses and treatment fields.

Conclusion: The resources to effectively manage testicular GCT appear to be accessible to most institutions surveyed. Regional management guidelines, sharing of clinical expertise within Africa through online platforms and centralised data collection on epidemiology, management and treatment efficacy are advocated to better allocate resources and improve the outcomes reported in this rare but potentially curable condition.

Keywords: testicular germ cell tumour; testicular cancer; Africa; multidisciplinary management; quality improvement.

Background

Testicular germ cell tumours (GCTs) are rare malignancies most prevalent in 15–40-year-old men.[1] Global incidence rates of testicular cancer show marked geographic variation (Table 1). Based on GLOBOCAN 2012 data, Australia–New Zealand and Europe have the highest-aged standardised incidence rates (6.8 and 5.6) and Africa the lowest (0.4).[2] Although incidence rates are reported to be rising globally, the rate of escalation in high-incidence countries seems to be slowing down while rates in low-incidence countries are increasing more rapidly.[3,4]

Ethnicity has been implicated in the variation of age-standardised incidence rate (ASIR) globally, with countries with predominantly Caucasian populations having the highest incidence. Distinct differences in the testicular cancer incidence rates in white and black Americans, with significantly higher rates in white people, have been reported.[1,4] Scandinavian data suggest that immigrants retain the incidence patterns of their region of origin, even after residing in a different geographical region for some time.[5] Age-standardised incidence rate variation is also seen across African regions with Southern and Northern Africa having double the ASIR of Western, Middle and East Africa.[2]

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TABLE 1: Testicular cancer incidence versus mortality rates across regions.

World region	ASIR/ASMR†	Ratio
World	1.5/0.3	5.0
Australia & New Zealand	6.8/0.2	34.0
Western Europe	8.7/0.3	29.0
North America	5/0.2	25.0
Asia	0.7/0.3	2.3
Africa	0.4/0.3	1.3

Source: Adapted form Znaor A, Lortet-Tieulent J, Jemal A, Bray F. International variations and trends in testicular cancer incidence and mortality. Eur Urol. 2014;65(6):1095–1106. https://doi.org/10.1016/j.eururo.2013.11.004

ASIR, age-standardised incidence rate; ASMR, age-standardised mortality rate.

†, as per GLOBOCAN 2012 data.

In a cohort of 225 testicular GCT cases treated at two tertiary referral hospitals in the Western Cape province of South Africa 57.8% of men self-reported as being of Mixed Ancestry (MA), 39% as Caucasian and 0.02% as Black African (BA). This distribution does not align with the demographics of the province where 49% of the population describe themselves as being of MA, and 33% as BA. A rise in the number of cases diagnosed annually between 2000 and 2015 was only seen in Caucasian men and men of MA.[6]

Rare cancers are often associated with high mortality rates because of late diagnosis, lack of data to support evidence-based treatment protocols and lack of incentive to develop and stock drugs for treatment.[7] Testicular cancer, although deadly when left untreated, does not follow this pattern. Treatment approaches are well defined, evidence based and have seen very little change over the past few decades. Orchidectomy with or without cisplatinum-based chemotherapy has been established as the gold-standard treatment approach for the majority of testicular GCT. When treated early, survival rates of > 95% can be achieved.[8,9,10,11] This high potential for cure has led to public awareness campaigns in Africa to reduce awkwardness and stigma among young men and increase the rate of self-examination, early diagnosis and treatment.[12,13]

The efficacy of testicular cancer treatment can be approximated by the ratio of the ASIR to age-standardised mortality rate (ASMR). Of concern is that the cure rate in Africa is lagging far behind countries with higher incidence rates with an ASIR–ASMR ratio of 1.3 reported for Africa versus 39 for Western Europe, 25.5 for North America and five for the world (Table 1).[1]

A recent review by Cassel et al. synthesised the published data on testicular cancer from sub-Saharan Africa (SSA). Eight retrospective cohorts from five countries spanning a combined 41 years (1974–2015) were included.[14] Three cohorts included patients diagnosed after 2005. Germ cell tumour made up 68.8% of the cohort (185 of 269). The ratio of seminoma to non-seminoma was 1.1:1. The review pointed out significant variations in staging investigation, staging and prognostic systems and treatment regimens employed. Three cohorts reported on disease stage, with two making use of the Royal Marsden system and one of the International Union Against Cancer (UICC) system. Four studies provided selected data on treatment approaches with three of these (representing 87 patients) reporting on stage as well. This heterogeneity makes an assessment of treatment efficacy and survival outcomes between regions and for the region overall very difficult. The authors conclude that improvements in testicular cancer care in SSA will require multidisciplinary input into feasible treatment guidelines along with cooperation between policymakers, health care funders and pharmaceutical companies to support the implementation of such guidelines in terms of staffing, medications and health technology. They go on to propose such a treatment guideline for testicular GCT for the SSA region.[14]

As a first collaborative step towards improving testicular cancer care in SSA, a survey was conducted to assess the burden of disease and patterns of care of testicular cancer in Africa. Survey responses will help inform the feasibility of implementing a regional treatment guideline such as the one proposed by Cassel et al. This project is supported by the African Organization for Research and Training in Cancer (AORTIC).

Methods

The study population included doctors or nurses providing oncology care for patients with testicular cancer in Africa, regardless of subspeciality. Informed consent was obtained from respondents, and survey responses were de-identified. Participants provided their contact details only if they agreed to be contacted for follow-up studies on testicular GCT.

This cross-sectional web-based study captured participant demographic information and data on practice characteristics, best estimations of data on epidemiology, diagnostic and staging procedures, management protocols, availability of treatment modalities and survival outcomes at the respondent's centre. Questions on practice characteristics were based on international treatment guidelines.[9,10] The questionnaire was compiled in English by L.I., T.R. and H.B. and reviewed by all the authors and the AORTIC Research Committee before distribution.

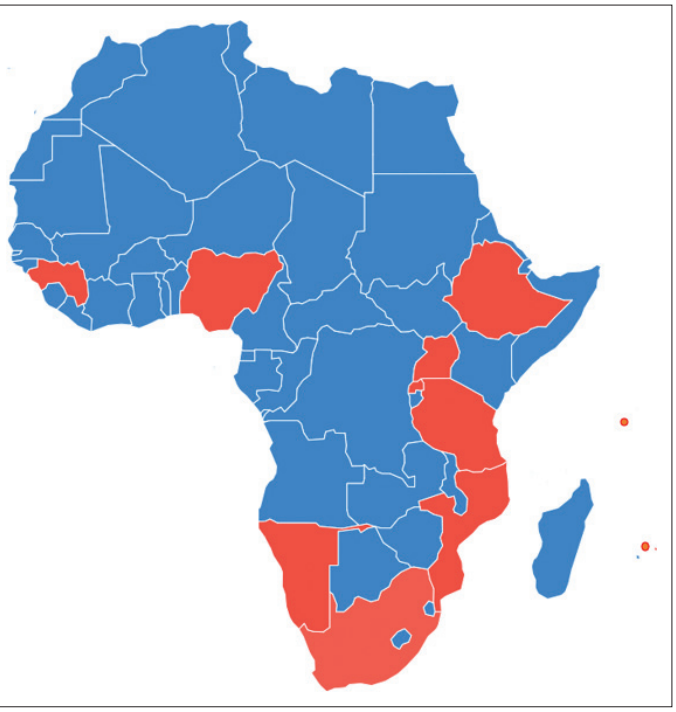
The questionnaire was distributed over a 6-week period in May 2021 and June 2021 through the AORTIC Listserv member network, as well as through a snowball sampling method using social media. The AORTIC Listserv network includes multidisciplinary members from 40 countries across Africa.

Simple descriptive statistics were reported to summarise data. Missing responses were indicated as such in the descriptive tables. Where there were duplicate responses from a single institution, the most complete data set was used. Numerical responses were rounded up to the next integer.

Ethical considerations

This is an observational survey-based study. The research study was granted an exemption by the Institutional Review Board of St. Catherine University, St. Paul, Minnesota, United

Country (red)	Number of centres	New cases per year (median)	15–40 year old male population
Nigeria	4	14	39 242 879
Ethiopia	2	50	23 465 899
South Africa	5	25	12 605 594
Tanzania	1	12	11 377 780
Uganda	1	2	8 546 442
Mozambique	1	4	5 894 641
Rwanda	2	28	2 570 506
Guinea	1	3	2 539 066
Namibia	1	7	520 112
Mauritius	1	4	236 148
Seychelles	1	1	18 444



Source: Adapted from PopulationPyramid.net. [home page on the internet]. 2019 Dec [cited 2022 Apr 9]. Available from: https:/www.populationpyramid.net

FIGURE 1: Respondent countries and new case numbers.

TABLE 2: Demographic characteristics of respondents (n = 20).

Descriptive variable by centre	*n*	%
Medical discipline		
Surgeon (urologist or general)	4	20
Oncologist (clinical, radiation or medical)	11	55
Palliative physician	1	5
Nurse (oncology or palliative)	3	15
Missing data	1	5
Gender		
Male	11	55
Female	9	45
Age		
31–40	8	40
41–50	7	35
51–60	3	15
> 60	2	10

TABLE 3: Epidemiological data (n = 20).

Descriptive variable by centre	*n*	%
Most common histological diagnosis		
Seminoma	8	40
Non-seminoma	10	50
Unknown	2	10
Most common risk factors reported		
Cryptorchidism	10	50
Family history of testicular tumour	4	20
Contralateral testis tumour	3	15
Infertility	2	10
Testicular atrophy	2	10
Testicular trauma	2	10
Hormone exposure	1	5
Unknown	5	55
Missing data	2	10

States of America. Written informed consent for study participation and publication of findings was obtained from all survey participants.

Results

Responses were received from 20 institutions representing 11 African countries (Figure 1)[15]. The responses from two palliative care institutions were only included in epidemiological data due to significant missing data on treatment approaches. Respondents included oncologists, oncological surgeons, nurses and a palliative physician (Table 2).

The median number of new GCT cases seen per year at an institution was seven (range: 1–50, interquartile range: 3–25, three centres unknown) (Figure 1). The most common histological diagnosis was non-seminomatous GCT (NSGCT) for 10 and seminoma for eight centres (Table 3). Ten centres reported cryptorchidism as the most prevalent risk factor.

Table 4 shows the findings on availability and patterns of use of radiological staging investigations and serum tumour markers, stage at presentation, postorchidectomy chemotherapy and radiotherapy (RT) regimens of choice per GCT type and stage, as well as follow-up and survival outcomes. All stage data have been converted to the tumour-node-metastases-serum marker (TNM-S) system. The most prevalent presenting stage was Stage III (50%). Half of institutions routinely offered sperm banking to patients before receiving chemotherapy. All 20 institutions reported having chemotherapy services and two-thirds (66%) mostly gave chemotherapy on an outpatient basis. The most common treatment modality offered after orchidectomy for the different types and stages of GCT are shown in Table 4. Respondents were asked to classify the relevant chemotherapy

TABLE 4: Patterns of staging, treatment† and follow-up (n = 18).

Descriptive variable by centre	*n*	%
Most prevalent stage at diagnosis (TNM-S)		
Stage 1	2	11.1
Stage 2	5	27.8
Stage 3	9	50.0
Unknown	2	11.1
Access to diagnostic and staging investigations		
CXR	17	94.4
CT	18	100.0
US	17	94.4
PET-CT	7	38.9
MRI	14	77.8
Diagnostic and staging investigations routinely used		
CXR	7	38.9
CT abdomen and pelvis	1	5.6
CT chest, abdomen and pelvis	17	94.4
MRI	1	5.6
Tumour markers routinely used in diagnosis, staging and FU		
bHCG	18	100.0
AFP	17	94.4
LDH	17	94.4
Most common treatment modality for Stage I seminoma		
Surveillance	8	44.45
Chemotherapy	8	44.45
RT	2	11.1
Most common treatment modality for Stage II seminoma		
Chemotherapy	14	77.8
RT	0	0.0
CRT	4	22.2
Most common treatment modality for Stage I non-seminoma		
Surveillance	9	50.0
Chemotherapy	5	27.8
RT	0	0.0
CRT	0	0.0
RPLND	2	11.1
Unknown	2	11.1
Most common treatment modality for Stage II–III non-seminoma		
Chemotherapy	11	61.1
RT	0	0.0
Chemoradiotherapy	5	27.8
RPLND	2	11.1
Chemotherapy for Stage I seminoma: drug regimen of choice		
Carboplatin 1 cycle	6	33.3
Carboplatin 2 cycles	7	38.9
Cisplatin	1	5.6
Missing data	4	22.2
Chemotherapy for Stage II seminoma: drug regimen of choice		
BEPX3	14	77.8
BEPX4	3	16.6
Unknown	1	5.6
Chemotherapy for Stage I non-seminoma: drug regimen of choice		
BEPX1	3	16.6
BEPX3‡	1	5.6
BEPX4	1	5.6
Missing data	13	72.2
Chemotherapy for Stage II–III non-seminoma: drug regimen of choice		
BEPX3†	3	16.6
BEPX4	14	77.8
Unknown	1	5.6
RT dose Stage I seminoma		
20 Gy	7	38.9
26 Gy	0	0.0
30 Gy	4	22.2
Unknown	6	33.3
No access to RT	1	5.6

Table 4 continues in the next Column →

TABLE 4 (Continues...): Patterns of staging, treatment† and follow-up (n = 18).

Descriptive variable by centre	*n*	%
RT dose Stage IIA seminoma		
26 Gy	1	5.6
30 Gy	7	38.9
36 Gy	3	16.6
Unknown	6	33.3
No access to RT	1	5.6
RT dose Stage IIB seminoma		
30 Gy	3	16.7
36 Gy	8	44.4
Unknown	6	33.3
No access to RT	1	5.6
Stage I seminoma RT nodal basins		
Para-aortic only	7	38.8
Para-aortic and ipsilateral iliac	1	5.6
Para-aortic and bilateral iliac and inguinal	1	5.6
Ipsilateral iliac	1	5.6
Ipsilateral inguinal	1	5.6
Ipsilateral iliac and inguinal	1	5.6
Unknown	5	27.7
No access to RT	1	5.6
Stage II seminoma RT nodal basins		
Para-aortic only	1	5.6
Para-aortic and ipsilateral iliac	4	22.2
Para-aortic and ipsilateral iliac and inguinal	3	16.6
Para-aortic and bilateral iliac and inguinal and involved nodes	3	16.6
Para-aortic and ipsilateral iliac and involved nodes	1	5.6
Unknown	5	27.8
No access to RT	1	5.6
RT dose per fraction curative		
1.8 Gy	2	11.1
2 Gy	8	44.4
Unknown	7	38.9
No access to RT	1	5.6
Simulation technique		
Two-dimensional	2	11.1
Three-dimensional	11	61.1
Functional (PET-CT)	1	5.6
Unknown	3	16.6
No access to RT	1	5.6
Planning technique		
Two-dimensional	4	22.2
Three-dimensional CRT	6	33.3
VMAT/IMRT	3	16.7
Unknown	4	22.2
No access to RT	1	5.6
Length of follow-up		
2 years	1	5.6
5 years	11	61.1
7 years	1	5.6
10 years	3	16.6
> 10 years	2	11.1
Follow-up test modalities used		
Serum tumour markers	17	94.4
CXR	7	38.8
CT abdomen and pelvis	1	5.6
CT chest, abdomen and pelvis	14	77.7
Abdominal US	9	50
Testicular US	6	33.3

TNM-S, tumour-node-metastases-serum marker; CXR, chest radiograph; CT, computer tomography scan; US, ultrasound scan; MRI, magnetic resonance imaging; PET-CT, positron emission tomography with CT; bHCG, beta-human chorionic gonadotropin; AFP, alpha-foeto protein; LDH, lactate dehydrogenase; FU, follow-up; BEP, bleomycin, etoposide, cisplatin combination chemotherapy; Gy, Gray; RT, radiotherapy; CRT, chemo-radiotherapy; VMAT, volumetric arc radiotherapy; IMRT, intensity modulated radiotherapy; RPLND, retroperitoneal lymph node dissection.

†, All, treatment pertains to postorchidectomy therapy; ‡, Three cycles of BEP can be substituted by four cycles of EP.

TABLE 5: Availability of chemotherapy drugs (n = 18).

Drug by centre	Mostly available		Availability unpredictable		Mostly unavailable		Missing data	
	n	%	*n*	%	*n*	%	*n*	%
Bleomycin	13	72.2	3	16.6	1	5.6	1	5.6
Etoposide IV formulation	11	61.1	4	22.2	2	11.1	1	5.6
Cisplatin	14	77.7	2	11.1	1	5.6	1	5.6
Carboplatin	13	72.2	2	11.1	2	11.1	1	5.6
Ifosfamide	9	50.0	4	22.2	3	16.7	2	11.1

drugs according to availability. Cisplatin, etoposide and bleomycin (BEP) were mostly available at 77.8%, 61.1% and 72.2% of institutions, respectively (Table 5).

Radiotherapy was mostly delivered with 3D simulation and treatment techniques using standard fractionation. The most prevalent RT dose according to seminoma stage was 20 Gy for Stage I, 30 Gy for Stage IIA and 36 Gy for Stage IIB. Most institutions prescribed RT to the para-aortic nodes only for Stage I seminoma and to the para-aortic and ipsilateral iliac nodes for Stage II seminoma (Table 4).

Follow-up continued for at least five years at 17 (94.4%) institutions and for at least 10 years at five (27.8%) institutions. Computer tomography (CT) of the abdomen and pelvis and serum tumour markers were routinely used for detection of recurrence in 15 (83.3%) and 17 (94.4%) institutions, respectively. Estimated five-year overall survival for seminoma and NSGCT was reported by 14 and 13 institutions, respectively. The median five-year OS was 78.0% (range: 30.0% – 100.0%) for seminoma and 69.0% (range: 30.0% – 100.0%) for NSGCT.

Data on International Germ Cell Cancer Collaborative Group (IGCCCG) risk grouping, orchidectomy and postchemotherapy or salvage management approaches were not collected in this survey.

Discussion

This survey assessed the patterns of care in testicular GCT in SSA. Resources for and approaches to staging, postorchidectomy treatment and follow-up were investigated. The reported yearly number of new GCT cases at the institutions surveyed ranged from 1 to 50. The wide range reported here makes it unlikely to be a reliable estimate of the burden of disease in Africa and emphasises the importance of prospective data collection on GCT.

Cryptorchidism was reported as the most prevalent risk factor by 10 centres. It is important to note that African patients with cryptorchidism tend to present at a late age, if at all, and a significant portion of repairs are done in postpubertal patients.[16] Patients who had postpubertal repair of their cryptorchidism have a significantly higher relative risk for developing testicular cancer than patients who had repairs done before the age of 13 years.[17]

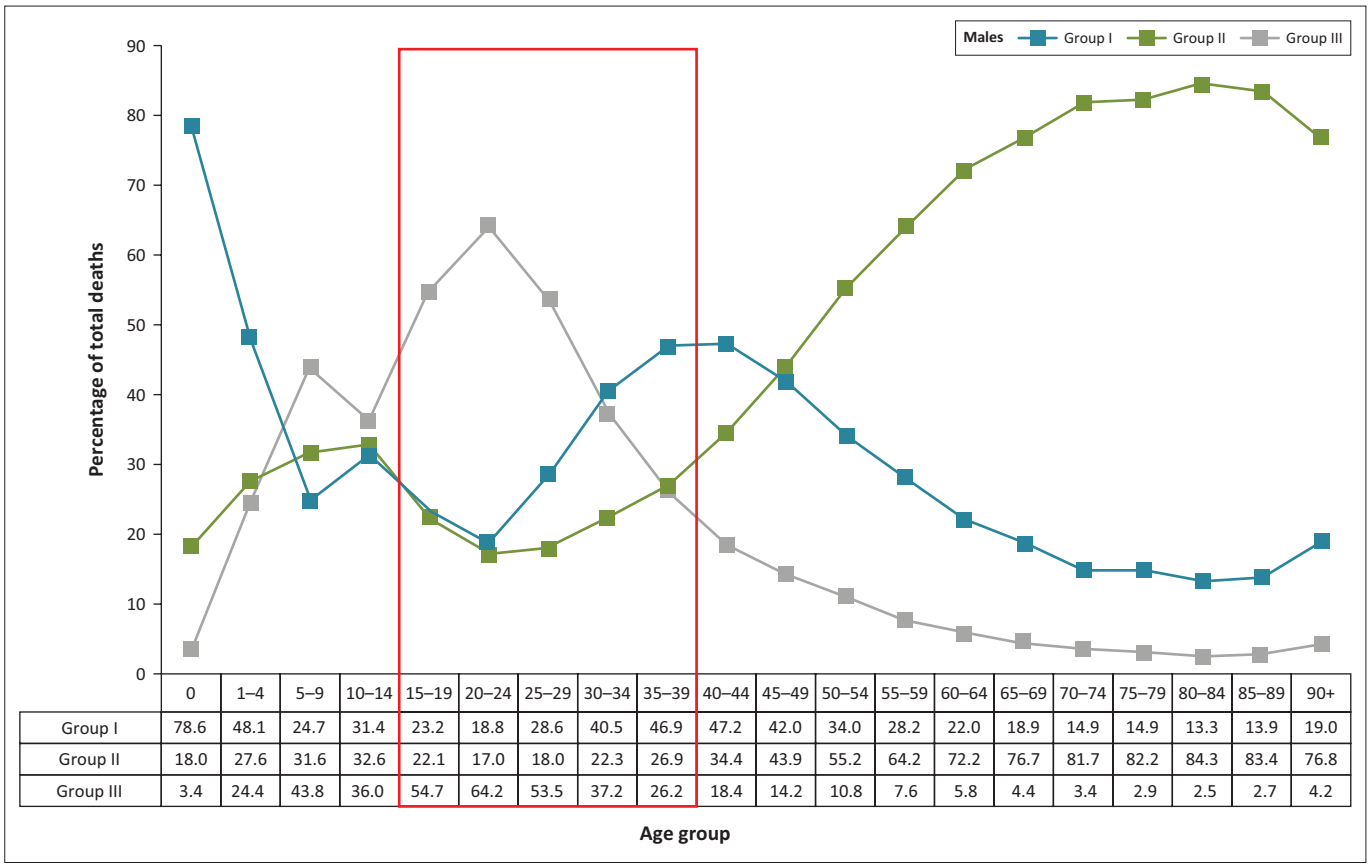
Several factors need to be considered when trying to understand the low reported incidence rates and relatively low cure rates for testicular cancer reported in Africa. In Africa, 39.6% (519 577 928) of the population are between the ages of 15 and 39 years old, while this age bracket represents only 30.5% (229 513 670) of the population in Europe.[15] Therefore, a lower ASIR should be seen in the context of a bigger absolute population, with a relatively larger at-risk population.

In South Africa for example, mortality in this age group is dominated by trauma, violence and communicable diseases like tuberculosis, HIV and related infections (Figure 2).[18] In 2017 the HIV prevalence rate for all adults aged 15 to 49 years was 19.0%. Testicular cancer has thus far not been classified as an AIDS-related cancer.

The quality of epidemiological and outcome data on cancer varies widely between African countries.[19,20] Cassel et al. motivate for the establishment of national GCT registries to improve data quality. The low reported incidence of testicular cancer in SSA makes it unlikely that dedicated GCT registries on a national level will collect sufficient data to guide practice. With collaboration across borders, however, limited resources can be effectively shared to accurately determine disease burden, quality of care and cancer outcomes. This information is vital to the design and monitoring of treatment programs and advocacy for resource allocation. Recent improvements in the security and accessibility of cloud-based databases for the prospective collection of clinical data further enable the ethical collection of international patient-level data.

In Western populations, 75% – 80% of seminoma patients and about 55% – 64% of NSGCT patients have Stage I disease at diagnosis. Stage at presentation appears to be higher in SSA with more than 50% of patients in the review by Cassel et al. presenting with UICC Stage III disease.[14] In this survey, the most prevalent stage at presentation was Stage III (50%) as well. Advanced cancer stage at presentation is a well-recognised challenge in cancer control in SSA. Its cause is multifactorial and significantly influenced by geographic and socio-economic factors.[21,22]

It is well known that access to surgical, medical and radiation oncology services is limited in the SSA region.[23] In the review by Cassel et al., CT was used for staging in only two cohorts. This survey demonstrates that more than 94% of respondents had access to and routinely used gold-standard staging investigations, namely chest radiograph, abdominal and scrotal ultrasound, CT scans and serum tumour markers, allowing for a risk-adapted approach to staging. In keeping



	0	1–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90+
Group I	78.6	48.1	24.7	31.4	23.2	18.8	28.6	40.5	46.9	47.2	42.0	34.0	28.2	22.0	18.9	14.9	14.9	13.3	13.9	19.0
Group II	18.0	27.6	31.6	32.6	22.1	17.0	18.0	22.3	26.9	34.4	43.9	55.2	64.2	72.2	76.7	81.7	82.2	84.3	83.4	76.8
Group III	3.4	24.4	43.8	36.0	54.7	64.2	53.5	37.2	26.2	18.4	14.2	10.8	7.6	5.8	4.4	3.4	2.9	2.5	2.7	4.2

Source: Adapted from Stats SA. Mortality and causes of death in South Africa: Findings from death notification. Statistics South Africa; 2017

FIGURE 2: Percentage of deaths due to communicable diseases (group I), noncommunicable diseases (group II) and injuries (group III) by gender and age group in South Africa, 2017 (redistributed unknown age and ill-defined diseases R00–R99 proportionately to causes in group I and group II).

with the findings of Cassel et al., the TNM-S staging system was not uniformly used by respondents. The TNM-S system, in combination with the prognostic risk groups defined by the IGCCCG, is widely advocated as the standard for prognostication and treatment selection. A uniform language is essential when aiming to standardise treatment outcomes across institutions.

Even though the stigma of childlessness leads to significant socio-economic consequences in African populations, assisted reproductive services (ARSs) including sperm banking are unavailable to most people. In 2019, 78 ARS facilities were self-registered in SSA, 63% of which were in South Africa or Nigeria. In most countries, ARSs are not part of subsidised healthcare, making it unaffordable for the majority of the population.[24] The fact that half of responding institutions were able to offer their patients sperm banking is therefore remarkable. It is, however, unknown whether these patients would have access to ARSs when needed.

Retroperitoneal lymph node dissection (RPLND) was listed as treatment modality of choice for Stage I non-seminoma by two centres and for Stage II–III non-seminoma by eight centres. Retroperitoneal lymph node dissection is not recommended as the preferred treatment modality for Stage I NSGCT postorchidectomy and should only be considered for selected cases of marker negative Stage IIA NSGCT. Retroperitoneal lymph node dissection has an important role in the management of residual metastatic GCT after chemotherapy, but it is considered an advanced surgical procedure that is best performed in high-volume treatment centres. In the review by Cassel et al., RPLND was uniformly declined by patients for fear of ejaculatory complications.

In Stage I, 44.4% and 50.0% of centres selected surveillance as a treatment of choice for seminoma and NSGCT. In view of the poor follow-up trends in SSA, these could be regarded as high rates.

Chemotherapy was the most used postorchidectomy treatment modality in Stage II seminoma (77.8%) and Stage II–IV non-seminoma (61.1%). Chemotherapy regimens were mostly used according to published guidelines.[9,10] Two cycles of carboplatin chemotherapy were favoured for Stage I seminoma despite guidelines advocating that a single cycle is sufficient. For metastatic GCT, the standard-of-care combination of intravenous bleomycin, etoposide and cisplatin (BEP) was reliably available at only 61.1% of institutions.

Reasons for unreliable availability of drugs were not investigated in this study, but challenges with health care funding and supply-chain management are common in SSA. Outpatient chemotherapy administration predominated, which shows a pragmatic response to challenges with transport and admission capacity. Despite more than 50% of patients in the review by Cassel et al. presenting with UICC

Stage III disease, only eight (9%) received platinum-based chemotherapy. Further investigation is needed of the discrepancy between intended rates of chemotherapy administration and the actual number of patients receiving it.

Radiotherapy use was reported in three cohorts in the Cassel et al. review. Challenges with the accessibility and cost of delivering postorchidectomy therapies were widespread.[14] In this survey, RT was the most commonly used treatment option for Stage I seminoma at two (11.1%) institutions. Radiotherapy in combination with chemotherapy was the most common treatment option for Stage II seminoma in four (22.2%) centres and for Stage II–III non-seminoma in five (27.8%) centres. This approach is not evidence based; however, further detail was not collected in this study. Radiotherapy doses were mostly aligned with guidelines, but treatment fields differed widely among institutions.

The greatest risk for GCT relapse is in the first two years, but no definitive evidence exists to support the frequency of such tests.[9] Nearly all institutions reported the capacity to follow-up with patients for at least five years using recommended radiology and biochemistry tests.

Five-year overall survival estimates in this survey varied significantly, with values for seminoma and NSGCT ranging from 30% to 100% (Table 4). As with the estimates of GCT incidence, this is likely to reflect poor-quality data collection.

This study has a few important limitations. The survey included data from 11 countries in SSA, with most countries represented by one institution only. Equivalent resources and management strategies at other cancer centres in Africa cannot be assumed. Reported data are based on survey responses, and therefore the accuracy and completeness of submitted data could be influenced by the quality of record-keeping at participating institutions, as well as time pressures resulting from high workload and inadequate staffing in participating centres. Future research should explore the apparent discrepancy between intended rates of chemotherapy administration and the actual number of patients receiving it, as well as other causes for the poor treatment outcomes reported for testicular GCT despite the apparent availability of most treatment modalities.

Conclusion

Testicular cancer in Africa represents a unique opportunity where basic improvements in the quality of care may yield large dividends in survival outcomes and quality-adjusted life-years in an economically viable population subgroup.[8] Sub-Saharan Africa may have low numbers of GCT patients, but they appear to present at more advanced stages than their Western counterparts. This survey indicates that the resources to effectively manage testicular GCT appear to be available at most SSA institutions surveyed. Management strategies are, however, not consistently aligned with international guidelines.

In the absence of high-volume treatment centres and with large geographical service areas that impede early diagnosis and access to treatment, online collaboration between different institutions in SSA should be strengthened. This can be done through the establishment of reliable data registries, the standardisation of treatment approaches, the sharing of clinical expertise through regular multidisciplinary tumour-board discussions and regional quality improvement programs.

This is the first time that individual treatment centres have collaborated to contribute data on patterns of care of testicular GCT in Africa. It is hoped that such collaboration will lead to the standardisation of treatment approaches and ultimately improve patient outcomes in this rare disease.

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Competing interests

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Authors' contributions

H.B. contributed to protocol and project development, data collection or management, data analysis and manuscript writing and editing; T.J.R. contributed to protocol and project development, data collection or management, data analysis and manuscript writing and editing; L.I. contributed to protocol and project development, data analysis and manuscript writing and editing; V.D.V. contributed to conceptualisation and manuscript writing and editing; A.K.C. contributed to conceptualisation and manuscript writing and editing; P.V.S. contributed to manuscript writing and editing.

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Data availability

The data that support the findings of this study are available from the corresponding author, H.B., upon reasonable request.

Disclaimer

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