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Research Article

The HIV Testing Trends and Outcomes at a Johannesburg Trauma ICU unit: A Retrospective Cohort Study

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Abstract

Introduction: South Africa, a country afflicted by numerous socio-political factors impacting healthcare, carries the highest burden of Human Immunodeficiency Virus (HIV) worldwide(1-6). These same factors contribute to the high burden of trauma in the country from interpersonal and accidental injury. Patients may benefit from knowing their HIV status for holistic treatment. Despite this, testing, offered through provider-initiated HIV counselling, is non-routine. This study aims to assess HIV testing trends, prevalence, and outcome of patients tested in a Trauma critical care unit.

Methods: A retrospective review of patient admission records at a Johannesburg Trauma ICU from 01 Jan 2017 until 31 December 2018. Demographics, mechanism, severity of injury, HIV status (positive, negative, or unknown), sepsis-related complications and mortality were included for all patients. Statistical analysis was done using STATA version 15 for continuous and categorical variables. P-value of 0,05 was considered significant. Ethics approval number: M190543. ClinicalTrials NCT05484947

Results: Of the 722 individuals, 48% had penetrating trauma, with 218 individuals (30%) sustaining gunshot wounds. Voluntary HIV testing was done in 194 (24.9%); 30% of whom tested positive and 70% negative. The length of stay in HIV-negative patients (24.1 days) was less than those who tested positive (28.9), despite similar RTS, ISS and NISS levels. Septic complication rates were similar. Overall mortality was 10.73%, with no statistical difference between the HIV positive and HIV negative groups. The ISS, NISS, and RTS were worse in those that died in hospital.

Conclusion: Nearly one in five volunteered for HIV testing in our setting. Mortality was associated with worse RTS, ISS, NISS, and the need for Damage Control Surgery, and was not directly related to the HIV status in those tested. Routine HIV testing should be encouraged.

Keywords: Critical care; HIV; Outcomes; Trauma

Introduction / Background

More than 35 million people globally live with Human Immunodeficiency Virus (HIV) infection. Of these, approximately 23 million are based in sub-Saharan Africa [1-6]. South Africa (RSA) has 6.8 million people living with HIV, one of the largest figures worldwide, making up 19% of the global burden. An estimated 1000 new infections occur daily in adults aged 15 to 49 [2].

The risk factors associated with acute trauma injury are identical to those for HIV transmission: male gender, age between 15 and 49 years old, and high-risk behaviour [7]. A study conducted at Charlotte Maxeke Hospital trauma unit by Bowley et al. in 2011 revealed an HIV seroprevalence rate of 37% in priority one injured patients [8]. Early detection of HIV allows for expedited initiation of treatment in individuals, extending their life expectancy and reducing transmission rates [3]. In 2005, mandatory testing and treatment for HIV during pregnancy were instituted in South Africa to prevent mother-to-child transmission [9]. This reduced vertical transmission from an expected 30% to 2.7% in 2011(9). It also led to other positive consequences, such as a reduction in maternal mortality and increased access to support services and health education [9].

Similarly, offering routine testing to the trauma population would be the ideal opportunity to improve the quality of life in infected persons [4]. Furthermore, physicians performing acute surgical care and trauma surgeries are at higher risk of sustaining an injury on duty, such as a needle stick or splash. This increased risk is particularly relevant in the African context, where a study by Bowa et al. documented a 15-fold increased risk of occupational HIV transmission in surgeons practicing on the continent [10]. This was attributable to a higher general prevalence and lower adherence to universal precaution and safe surgical practice techniques (secondary to resource and time limitations). Therefore, clinicians benefit by knowing their patient's HIV status as it relates to their health. It can encourage extra precaution when engaging in high-risk activities (i.e., drawing blood, suturing, surgery) and reduce anxiety. It can direct appropriate intervention in the case of an injury-on-duty, i.e., allow for the omission of post-exposure prophylaxis, with its associated side effects, if a patient's status is known to be negative [5,8]. A higher HIVVL (Human Immunodeficiency Virus viral load) in a patient from whom an injury-on-duty is obtained is associated with a higher risk of transmission, causing increased anxiety for the health care professional. Institution of, and compliance with, antiretroviral medication, are associated with a reduction of viral loads [9].

Although HIV status does not influence immediate decision-making in trauma care, the knowledge of a patient's comorbid conditions is vital in the holistic management of a critically ill patient. It can assist in the formulation of a differential diagnosis for overlapping presentation (e.g., low GCS, respiratory compromise), guide the search for opportunistic infections, and direct therapy for atypical organisms complicating trauma-related sepsis [11,12]. It is also relevant in appreciating the associated alterations of physiology and micronutrient homeostasis, which are standard components in the management of critical care patients. It also prevents treatment interruption for patients already on antiretroviral treatment (ART)(11). Despite the benefits of testing, hesitancy is widespread as stigma related to this disease remains a reality despite the advances made with HIV education. As such, the clinician is guided by ethics that recognize the patient's autonomy in this regard.

In SA, a country with an estimated population of 59 million, there were approximately 3.3 million people taking ART in the public sector in 2015, making it the most extensive program worldwide [1-6]. Presently, in SA, testing is offered through provider-initiated HIV counselling and testing. Trained HIV counsellors are necessary, and the process is time-consuming. It is thus not routinely available at all emergency departments [11]. In one study, the rate of HIV infection in orthopaedic trauma patients at CMJAH was 23% [13]. However, this result is obscured by the low participation rate as most patients declined to be tested in the acute trauma setting: of the 648 patients counselled for HIV testing, only 39%, 246 patients, agreed to be tested [13]. The current unit policy at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) trauma is to only offer HIV counselling and testing to patients suspected of a possible positive infection, either due to stigmata of HIV or recurrent opportunistic infectious complications during a stay. As such, routine counselling and testing are not offered. Patients testing positive for HIV will have a further cluster of differentiation 4 (CD4) cell count and HIVVL tests. These patients will be initiated on treatment during their stay or referred for appropriate treatment.

In this study, we sought to gather the data surrounding HIV prevalence in trauma care and use this to frame insights into current practice. This information could open avenues for future research and guide informed policy into routine HIV testing and treatment in the trauma population, while considering medical ethics.

Study Objectives

Primary objective: Determine the testing trends and prevalence of HIV in major trauma subjects admitted to a Johannesburg Trauma ICU

Secondary objectives:

1. Determine the in-hospital mortality of HIV in major trauma patients

2. Determine the septic-related complications in the study group

3. Observe the testing practices in the unit

Methods

A retrospective record review was conducted in the CMJAH intensive care trauma unit of patients admitted from 01 Jan 2017 until 31 December 2018. Patients under the age of 18 and those with incomplete data were excluded. HIV testing data was extracted, and patients were grouped as HIV positive, HIV negative, and HIV unknown. All standard methods of testing HIV at the National Health Laboratory Services (NHLS) were included, i.e., antibody, antigen, or HIV nucleic acid Ribonucleic Acid (RNA) testing. Current methods utilize HIV rapid, enzyme-linked immunosorbent assay (ELISA) and Polymerase Chain Reaction (PCR) testing. The data for CD4 count and HIVVL was checked for those who tested positive with the calculation of means and medians. Demographics, mechanism of injury, and physiological data included lactate and Base excess Revised Trauma score (RTS), Injury severity scores (ISS), New Injury Severity Score (NISS), infection-related complication, and in-hospital mortality were all documented. The continuous variables (CD4 count and HIVVL) were compared to both categorical (mortality, complication rate) and continuous (length of stay) variables on bivariate analysis. Outcomes on bivariate analysis will be considered statistically significant if the p-value <0.05. STATA version 15 was used for statistical analysis. Study reported according to STROCSS criteria [14]. Human Research Ethics Committee approval number: M190543. ClinicalTrials registration NCT05484947

Results

Eight hundred and sixty-seven (867) patients were admitted to our ICU during the study period, most of whom were men (96,31%, n=835). The cohort's median age was 31year(26-37years), similar to the HIV tested and HIV unknown groups. Penetrating trauma accounted for most of the injuries seen, with gunshot injuries accounting for 34.21% and stab injuries accounting for 18,91%. Blunt assault accounted for 9,87% of the cases. Similar trends were noted in the HIV positive, HIV negative and HIV unknown groups (Table 1). Injury Severity Scores, New Injury Severity Scores and Revised Trauma scores were similar between the different groups in the study at a median of 16 (IQR14-25), 22(IQR14-25) and 7,1 (IQR 6-7,8), respectively. The abdomen and the chest were the most common injured regions of the body, accounting for 62.5% of the study (Figure1). The overall median hospital length of stay was 11 (5-28), with an overall mortality of 93 out of 867 (10,73%) (Table 2). There were statistically significant differences between ISS, NISS and RTS of survivors and non-survivors, with worse figures noted in the non-survivors (Table 2). The need for Damage Control Surgery (DCS) was also significantly different between the survivors and non-survivors (higher in the deceased). Only 194 patients were tested for HIV status, with only 57 testing positive. This accounted for a 22.38% testing rate with a 29.38% positive rate in those tested for HIV. Males made up 95.88% of this group. ISS, NISS and RTS were similar in this sub-cohort (Table1). The abdominal injuries and chest accounted for most of the injuries. The HIV-positive patients have a longer stay than their HIV-negative counterparts, with a survival rate greater than 80% across the board. Complications were similar in the tested group irrespective of the HIV status. This included the anastomotic leak rate, superficial sepsis, deep sepsis and chest-related sepsis. (Figure 2). However, the sepsis-related complication rate was higher in the non-survivors than in the study group survivors. There were 39 recorded septic-related complications in 93 deceased patients compared to 19 in the 774 alive patients (p-value <0,0001). Overall mortality was The length of hospital stay was increased in the HIV-positive group of patients (Table 1). The median CD4 count in the HIV-positive group was 246,5 cells/mm^3(range=28-742 cells/mm^3), with 29 patients having a CD4 count of less than 200 cells/mm^3. Viral load was less than 20 in only 13 subjects, with a median of 57200 (copies/mL) (Range= 21-3250000 copies/mL) in those with levels greater than 20 copies/mL,77% of the cases (Table 3).

Variable		Overall	HIV unknown	HIV Positive	HIV Negative	p-value
		N=867(%)	N=673(%)	N=57(%)	N=137(%)	
Age	Median (IQR)	31 (26 - 37)	31 (26 - 37.5)	32 (28 - 39)	31 (25 - 35)	0.49
Gender	Male	835 (96.31)	649 (96.43)	53 (92.98)	13 (97.08)	0.40
	Female	32 (3.69)	24 (3.57)	4 (7.02)	4 (2.92)	
Mechanism	Stab	115 (18.91)	91 (19.16)	6 (17.65)	18 (18.18)	0.80
	GSW	208 (34.21)	154 (32.42)	13 (38.24)	41 (41.41)	
	PVC	101 (16.61)	87 (18.32)	6 (17.65)	8 (8.08)	
	MVC	59 (9.70)	45 (9.47)	3 (8.82)	11 (11.11)	
	FFH	30 (4.93)	24 (5.05)	2 (5.88)	4 (4.04)	
	Burn	8 (1.32)	7 (1.47)	0 (0.00)	1 (1.01)	
	Blunt Assault	60 (9.87)	44 (9.26)	4 (11.76)	12 (12.12)	
	MBC	9 (1.48)	8 (1.68)	0 (0.00)	1 (1.01)	
	Other	18 (2.96)	15 (3.16)	0 (0.00)	3 (3.03)	
ISS	Median (IQR)	16 (10 - 25)	16 (10 - 25)	17 (14.5 - 25)	17 (14 - 23.5)	0.81

NISS	Median (IQR)	22 (14 - 22)	21 (13 - 29)	24 (16.5 - 33.5)	22 (17 - 29)	0.21
RTS	Median (IQR)	7.1 (6 - 7.8)	7.1 (5.6 - 7.8)	7.1 (6 - 7.8)	7.6 (6 - 7.8)	0.39
BE	Median (IQR)	-7.3 (-11.5 - -3.8)	-6.8 (-11.3 - -3.6)	-9.75 (-13 - -6)	-7.75 (-11.65 - -4.05)	0.02
Lactate	Median (IQR)	4.5 (2.8 - 7.2)	4.4 (2.6 - 7.2)	5.3 (3.8 - 7.5)	4.6 (3.35 - 7.8)	0.14
pH	Median (IQR)	7.28 (7.2 - 7.35)	7.29 (7.2 - 7.35)	7.26 (7.2 - 7.3)	7.28 (7.21 - 7.35)	0.33
LOS	Median (IQR)	11 (5 - 28)	9 (4 - 21)	28.5 (16.5 - 53.5)	26 (11 - 56)	<0.001
Outcome	Dead	93 (10.73)	66 (9.81)	11 (19.30)	16 (11.68)	0.078
	Alive	774 (89.27)	607 (90.19)	46 (80.70)	121 (88.32)	

Table 1: Showing the Total group, Unknown, HIV positive, HIV neg with p-values between the HIV positive and the negative (GSW=Gunshot wound, PVC=pedestrian vehicle collision, MVC=motor vehicle collision, MBC=motor bike collision, ISS =injury severity score, NISS (new injury severity score, RTS=Revised Trauma score, BE= Base excess, LOS=length of hospital stay, IQR=interquartile range)).

Variable		Overall	Dead	Alive	p-value
		N=867(100%)	N=93(10, 73%)	N=774(89, 27%)	
Age	Median (IQR)	31 (26 - 37)	33 (27 - 41)	31 (26 - 37)	0.098
Gender	Male	835 (96.31)	87 (93.55)	748 (96.64)	0.14
	Female	32 (3.69)	6 (6.45)	26 (3.36)	
Mechanism	Stab	115 (18.91)	4 (5.48)	111 (20.75)	0.006
	GSW	208 (34.21)	24 (32.88)	184 (34.39)	
	PVC	101 (16.61)	16 (21.92)	85 (15.89)	
	MVC	59 (9.70)	7 (9.59)	52 (9.72)	
	FFH	30 (4.93)	3 (4.11)	27 (5.05)	
	Burn	8 (1.32)	2 (2.74)	6 (1.12)	
	Blunt Assault	60 (9.87)	10 (13.70)	50 (9.35)	
	MBC	9 (1.48)	4 (5.48)	5 (0.93)	
	Other	18 (2.96)	3 (4.11)	15 (2.80)	
ISS	Median (IQR)	16 (10 - 25)	26 (16 - 32)	16 (10 - 25)	<0.001
NISS	Median (IQR)	22 (14 - 22)	32 (25 - 41)	20 (13 - 27)	<0.001
RTS	Median (IQR)	7.1 (6 - 7.8)	6 (4 - 7.8)	7.1 (6 - 7.8)	<0.001
BE	Median (IQR)	-7.3 (-11.5 - -3.8)	-7.3 (-12 - -3.2)	-7.25 (-11.3 - -3.95)	0.83
Lactate	Median (IQR)	24.5 (2.8 - 7.2)	4.6 (2.7 - 8.5)	4.5 (2.8 - 7.1)	0.46
PH	Median (IQR)	7.28 (7.2 - 7.35)	7.27 (7.19 - 7.35)	7.28 (7.2 - 7.35)	0.49
Surgery	Damage Control Surgery	130 (14.99)	30 (32.26)	100 (12.92)	<0.001
	Definitive Surgery	317 (36.56)	24 (25.81)	293 (37.86)	

	No surgery	420 (48.45)	39 (41.93)	381 (49.22)	
LOS	Median (IQR)	11 (5 - 28)	6 (3 - 16)	6 (12 - 30)	<0.001

Table 2: Overall group, dead and alive groups. (GSW=Gunshot wound, PVC=pedestrian vehicle collision, MVC=motor vehicle collision, MBC=motor bike collision, ISS =injury severity score, NISS=new injury severity score, RTS=Revised Trauma score, BE= Base excess, LOS=length of hospital stay, IQR=Interquartile range).

Variable		Overall Positive	Dead	Alive	p-value
CD4 count		246.5 (145 - 414)	131 (86 - 284)	252 (165 - 414)	0.19
Viral load	< 200	25 (51.02)	4 (44.44)	21 (52.50)	0.66
	>=200	24 (48.98)	5 (55.56)	19 (47.50)	

Table 3: HIV Positive (n=57).

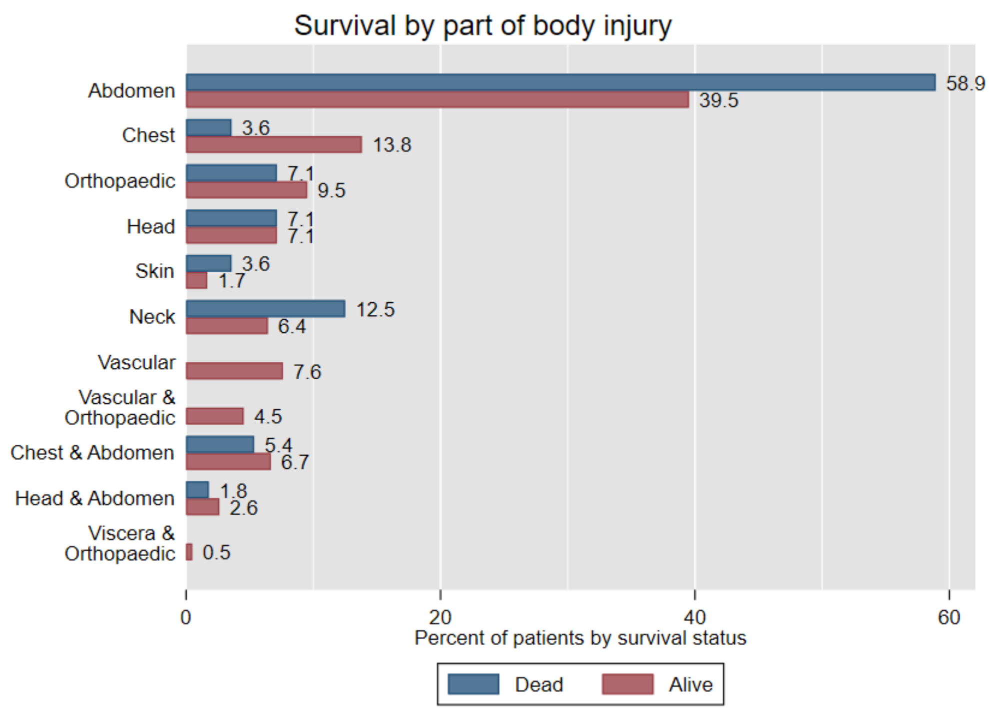

Figure 1: Injury body regions and in-hospital mortality outcomes.

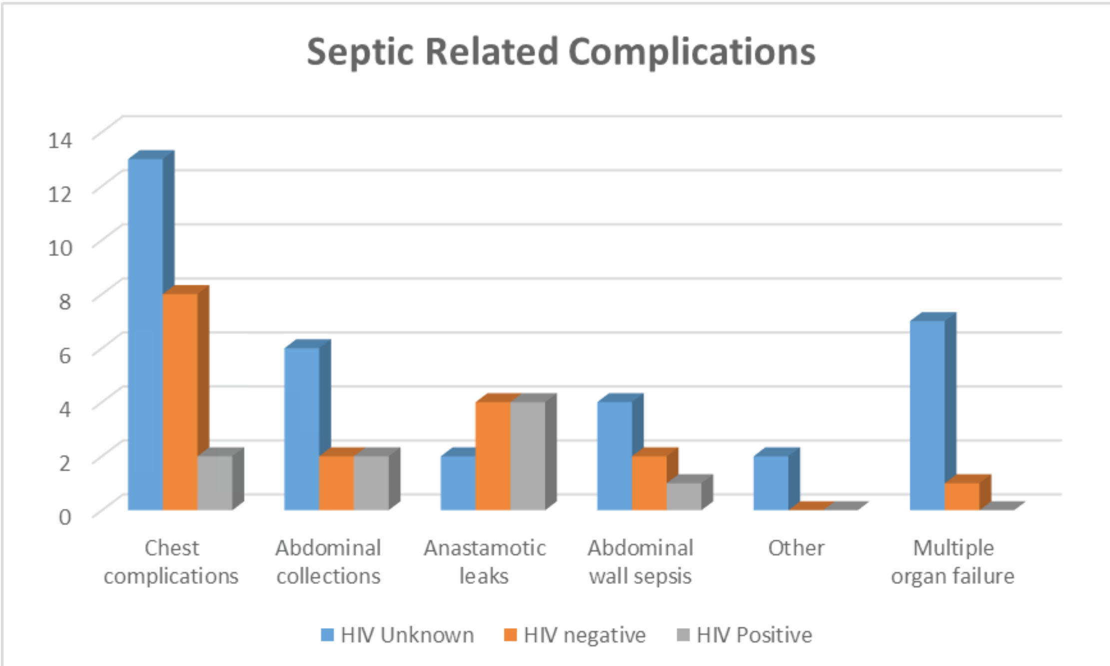

Figure 2: Recorded complications showing only septic complications in the cohort: P-value of 0.24 between all groups and 0.65 between the HIV positive and HIV negative groups.

Discussion

South Africa is a country with a high [1-6] burden of HIV. Although HIV incidence decreased from 10.3% to 7.1% in the 15 to 24-year age group, this number has shown signs of an increase in the 25 to 49-year group [2]. The median age of 31 years (IQR 26-37) and the male predominance in our study are in keeping with the demographics of trauma in low to middle-income countries. Therefore, this age group is relevant and appropriate for sampling as they constitute the country's HIV prevalence risk group. The susceptibility of this age group is attributable to high-risk behaviour such as unsafe sexual activity, substance use, etc., in the context of their socio-economic vulnerability [15]. The same social context (exposure to violence, wealth disparity, poverty, poor public service delivery, social stress, etc.) makes it unsurprising that penetrating trauma remains the leading cause of trauma in the country, opposite to what is experienced in first-world countries [15].

Although penetrating stabs usually predominate overall trauma admissions at our institution, it was noted in the study that most of the penetrating ICU admission were gunshot related. The gunshot-related mechanism has a higher energy transfer than stabs, which may further explain this trend [16]. Abdominal trauma was the most common injury location noted in the study group, accounting for 53% of the cohort. This is expected as abdominal trauma is approximated to account for 1/3rd of all injuries and is associated with increased severity due to numerous vital organs [17]. This group had a higher representation in our study, with severity representing a confounder as the sample was restricted to the critical care unit. This finding is represented by the severity scores, with median ISS and NISS scores of 16 and 22, respectively (moderate injury= 16-24). It is also supported by the physiological evidence of a median Base Excess of -7.3 and lactate of 4. This highlights the reality of resource constraints in LMIC, which tend to have only significantly injured cases acquiring critical care beds. A 2007 study found that over 25% of medical admissions in South Africa meet the criteria for critical care admission [18]. Despite this, only 6.6% of total hospital beds in Cape Town are allocated to critical care, preserving this limited resource for a very select group [18].

Consent to HIV testing was obtained only in 194 of the study group, constituting a 22,38% voluntary testing rate. Failure to obtain consent for testing highlights the ongoing consequence of not having routine testing in the unit. Hardcastle et al. made a strong case for introducing an opt-out HIV testing system in our country, in line with the 2006 US Centre for Disease Control (CDC) mandate [11]. They argued that this would increase access to the service and help destigmatize the disease [11]. Furthermore, the increased costs associated with the increased testing could potentially be counteracted by the cost savings of the accumulative disease-adjusted life years (DALY) after the initiation of treatment

[11]. The potential benefit would be more pronounced in South Africa, with a higher yield due to the higher prevalence, estimated to be about 36% in ED patients [11,19]. A study in Uganda found the ED positivity rate to be 50%, of which 83% were newly diagnosed [20,21]. As such, the omission of testing offers a missed opportunity that trauma, as an emergency service, should exploit. In countries like the USA and Zimbabwe, the opt-out approach at hospitals has allowed for better documentation of the HIV load [22-25]. This change in approach would contribute to efforts to reach the 90-90-90 WHO goal of having 90% of people living with HIV knowing their status, on antiretroviral therapy, and virologically suppressed [26,27]. South Africa is still far from reaching these treatment goals [27].

Most of our study participants were male, keeping the usual patterns in our trauma departments. Studies suggest that females are more reluctant to consent to testing [2,5]. This is important in South Africa, where social conditioning would support this trend [11]. Testing the predominant male trauma population could indirectly bring awareness to their female partners, who could seek health support and treatment. Compared to a study by Hansoti et al., where 53.5% of the patients tested in a South African ED were taking ARV with a viral load suppression of 48.5%, our study found 24% suppression in those who had their viral loads assessed [19,28]. The high HIV-positive rate in the tested group is in keeping with the young age group that presents in our trauma system and is similar to a study done in 2011 [8]. This rate is higher than the overall positive rate but comparable to studies in other parts of the world [23,29]. There was no median age and gender differentiation between the HIV-positive and negative groups. They had similar injury patterns and physiological parameters as indicated by the lactate and Base excess levels. Although 50% had a CD4 count of less than 200, none of the cases were noted to have AIDS-defining illnesses. Furthermore, there was no difference in the mortality outcomes concerning CD4 count or viral load. This might reflect a bias as most of the study population were physically active and in a general good functional state before the trauma. Furthermore, their indication for admission was trauma related, unlike general surgical ICU's where septic complications constitute up to 30% of admissions [29]. In these patients, Green et al. noted mortality of 60% in those with a CD4 count less than 200 [30]. Although the role of CD4 remains controversial concerning post-operative outcomes, multiple studies have reported a negative correlation by at least one metric [31-38]. In the era of antiretroviral therapy, we should expect improved outcomes in well-controlled cases [38].

The study group had minimal septic complications, including superficial, deep tissue, and chest sepsis. The anastomotic complication rates were also insignificant between the HIV- positive and HIV-negative groups. This lack of correlation is in keeping with other findings in the literature, with some of them in the South African context [30,31,36]. However, another study has suggested a higher organ failure rate and increased wound complications, contrary to our findings [39]. Overall mortality rate of 10.72% is acceptable in our circumstances. It was more pronounced in those with worse physiological and injury parameters, an association seen in other studies, as in the study by Crawford et al. [39]. However, this trend was not reflected in the median BE and lactate levels. Unfortunately, the study did not measure the central venous oxygen saturation as it may have correlated with mortality trends [40]. The need for more damage control surgery in the non-survivors was indicative of the burden of disease, with associated high mortality [41]. The anastomotic leak rate, wound sepsis, deep abdominal sepsis, and chest sepsis were all worse in the mortality group. The increased complication rate is in keeping with the increased DCS in this group, which is associated with higher complications due to the nature of the surgery [41]. Wound sepsis occurs in 50-100% of patients undergoing DCS and intra-abdominal collection in 25-85% [42].

Mortality between the HIV positive, HIV negative, and HIV-unknown groups was similar. In the HIV-tested group, the in-hospital survival was 86.06%. This finding is in keeping with international studies, which have reported a trauma ICU survival rate of 86.2%, with a head injury, age >50, and simplified acute physiology score (SAPS) II being significant predictors of mortality [4,40]. An association between the body region involved and mortality was noted in our study, with worse outcomes seen in those who sustained abdominal and neck trauma. This is expected due to vital structures in those body regions, and patients with major isolated head trauma being admitted to a dedicated neurosurgical ICU in our institution. We look forward to the new 95-95-95 strategy as proposed by WHO for 2030 to be fully implemented, so that we can see an end to the HIV pandemic in our trauma cases [43].

Study Limitations

This is a retrospective study in a single centre with potential bias. The number of subjects with unknown HIV status was disappointing, though understandable in the voluntary testing circumstances. Some of the complications could have been missed in the study, thus giving a low complication rate in these high acuity trauma cases.

Conclusion

The study highlights a need for increased surveillance and encouragement for testing within the population, as slightly more than one in five subjects underwent voluntary testing. Mortality was more related to the worse RTS, ISS and NISS. Despite the absence of a direct correlation between HIV and outcomes in our study, Trauma units still offer a potential ideal setting for HIV testing in SA. By taking advantage of the high prevalence of trauma and male predominance in this group, an opt-out system would increase coverage of HIV testing. This may lead to increased awareness, early initiation of treatment, and de-stigmatization of the disease. Much like the success seen with the introduction of mandatory antenatal testing, this might help in the fight against this public health crisis. We recommend a prospective study of routine testing in the trauma unit and further qualitative studies exploring the knowledge, attitudes, and behaviours associated with HIV testing. We recommend continued health education initiatives to inform the public and destigmatize the disease.

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