THE MALIGNANT EPIDEMIC — CHANGING PATTERNS OF TRAUMA

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Objectives and Setting. The worldwide burden of trauma is increasing, but is unequally distributed between nations. Trauma in South Africa targets the young and productive in society and imposes a major burden on the health infrastructure. We undertook a review of injury trends among patients attending the Johannesburg Hospital Trauma Unit (JHTU) and the Johannesburg Medicolegal Laboratory (JMLL) in order to document the evolution in patterns of trauma over a 17-year period of great social and political change.

Design, subjects and outcome measures. This was a retrospective review of all priority-one patients attending the JHTU from January 1985 to December 2001. The JHTU trauma database was used to retrieve information on patient demographics, wound mechanism and injury severity. The database at the JMLL, maintained since 1996, was examined and the manner and place of death were analysed.

Results. The JHTU has seen an unprecedented increase in the number of trauma patients over the last 17 years. The patients' demographic profiles have altered and injury is now predominantly due to interpersonal violence. Unnatural deaths examined at the JMLL have declined by 19% since 1996; however, the proportion of those deaths due to gunshot wounds has risen.

Conclusions. The social and political changes in South Africa in recent years have led to changes in the injury profiles seen at the JHTU. Part of the increase can be explained by desegregation and a reduction in the provision of local hospital services; however, the impact of urbanisation within South Africa, cross-border migration and the high incidence of substance abuse are recognised.

Evidence supports the implementation of legislative, environmental, social and behavioural interventions to contain and reduce the incidence and impact of violence and injury. Concerted efforts must be made at all levels to curb South Africa's trauma epidemic.

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In 1990, about 5 million people died worldwide as a result of injury.[1] It is estimated that by the year 2020, 8.4 million people will die every year from injury, and injuries from road traffic accidents will be the third most common cause of disability worldwide.[2] The problem of trauma is most acute in sub-Saharan Africa, where the proportion of such deaths from trauma is higher than in any other region of the world and where the risk of death from injury is greatest, particularly for men in the age group 15 - 29 years.[2] In South Africa, trauma has been described as a 'malignant epidemic'.[3]

In contrast to the remorseless rise in trauma worldwide, some nations are experiencing reductions in the burden of trauma. The USA has seen a nationwide decrease in the annual non-fatal firearm-related injury rate of 40.3% between 1993 and 1997. This has been accompanied by a 21% decline in the annual firearm-related death rate during the same period.[4] A recent epidemiological study[5] documented significant decreases in penetrating violence over the last 15 years at a level 1 trauma centre in San Diego, California. In addition, Californian trauma patients are getting older and presenting with lower injury severity scores.[5]

The aim of this study was to analyse the trends in traumatic injury seen at the Johannesburg Hospital Trauma Unit (JHTU) and the Johannesburg Medicolegal Laboratory (JMLL) over a period of great social and political change.

MATERIALS AND METHODS

The JHTU is recognised as meeting the requirements for a level 1 trauma centre as laid down by the Committee on Trauma of the American College of Surgeons. It serves a primary population of approximately 2 million people in the Greater Johannesburg area and is a tertiary referral centre for the province of Gauteng. Johannesburg Hospital (JH) became desegregated in 1986 and when the nearby Hillbrow Hospital closed in 1998, JH absorbed the majority of its workload,

although the rise in the number of trauma patients at the JHTU preceded Hillbrow's closure.

Patients attending the JHTU are classified as 'priority one' (P1) if there is perceived to be an immediate threat to life and the patient requires resuscitation, as 'priority two' if they are stretcher cases not in need of immediate resuscitation, and as 'priority three' if they are 'walking-wounded'. From January 1985, all patients have been entered onto a resuscitation trauma register, and from January 1997 to the present day the same details have been captured on a computerised database, the National Trauma Registry of the American College of Surgeons (NTRACS).

Between 1 January 1985 and 31 December 2001, a total of 16 393 P1 patients were identified and included in the study. Demographic data, wound mechanism and injury severity were analysed. The JMLL investigates unnatural deaths that occur in the Greater Johannesburg, Sandton and Midrand areas and is only one of 13 medicolegal laboratories or mortuaries in Gauteng. The JMLL began to compile a computerised database in 1996; the database was used to retrieve the total number of unnatural deaths, the manner and place of death defined as either pre-hospital or after receiving hospital treatment. The geographical 'catchment area' of the three main hospitals (Johannesburg, Chris Hani Baragwanath and Helen Joseph hospitals) and the JMLL has not materially altered during the period of study.

Results

In 2001, over 18 000 patients attended the JHTU; there were 1 725 resuscitations for trauma (approximately 140 P1 casualties per month), compared with 409 resuscitations in 1985 (Fig. 1). The majority of the increase is due to the effects of interpersonal violence, for although the number of resuscitations for trauma due to accidents more than doubled during the study period (312 to 678), this is dwarfed by the more than 10-fold increase in resuscitations for penetrating trauma, which have increased from 85 in 1985 to 957 in the year 2001. Penetrating trauma now represents 55% of the total resuscitations compared with 21% in 1985, and the proportion of resuscitations due to assault has shown a rise from 24% of the total in 1985 to 60% of all resuscitations in the year 2001 (Fig. 2).

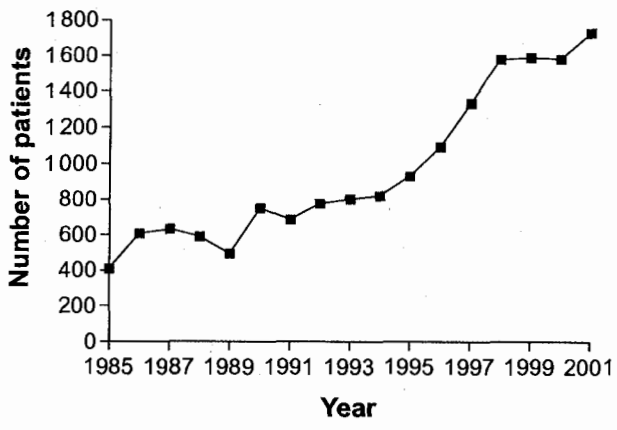

Fig. 1. Total resuscitations.

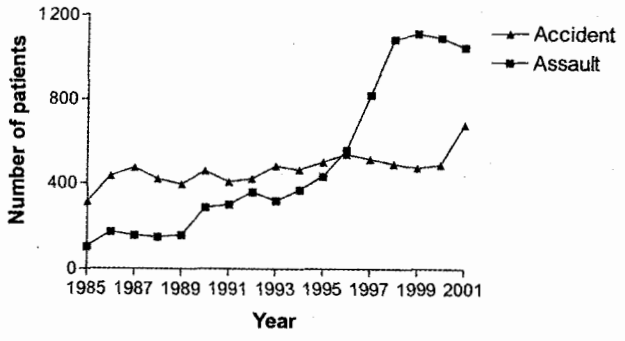

Fig. 2. Accident v. assault.

The trauma unit saw only 55 P1 patients with gunshot wounds in 1985; during 2001, 664 such patients were admitted (Fig. 3). P1 patients with stab wounds rose from 30 in 1985 to 293 in 2001 (Fig. 3). The JHTU has also seen an almost 10-fold increase in P1 pedestrian vehicle accidents (PVAs), from 22 in 1985 to 205 in the year 2001 (Fig. 4). Motorbike accidents have shown a steady decline in incidence from 50 in 1985 to 12 in 2001, and motor vehicle accidents (MVAs) have also declined in incidence over the last 5 years after a peak in 1996 (Fig. 5). The average age of our P1 trauma patients in the year 2001 was 27.4. The mean Injury Severity Score (ISS) for all resuscitations in 2001 was 16.18, for blunt trauma the mean ISS was 21.48 and for penetrating injury, 14.3. The number of unnatural deaths investigated by the JMLL has declined approximately 19% from a total of 4 319 in 1996 to 3 488 in 2001. However, the number of gunshot-related fatalities has remained fairly constant at around 1 000 per year (Table I). The ratio of gunshot-related fatalities has risen from 25% in 1996 to represent 29% of all unnatural deaths in the year 2001. Of the

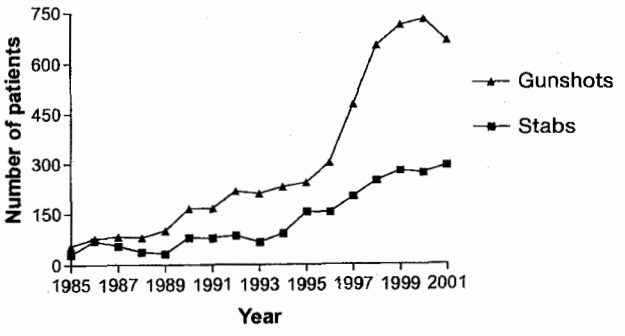

Fig. 3. Penetrating trauma.

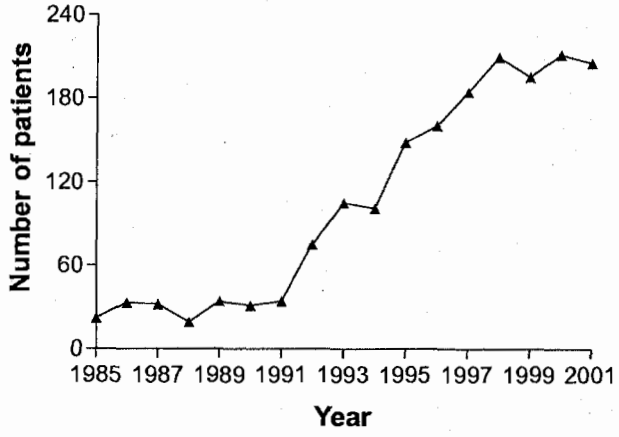

Fig. 4. Pedestrian vehicle accidents.

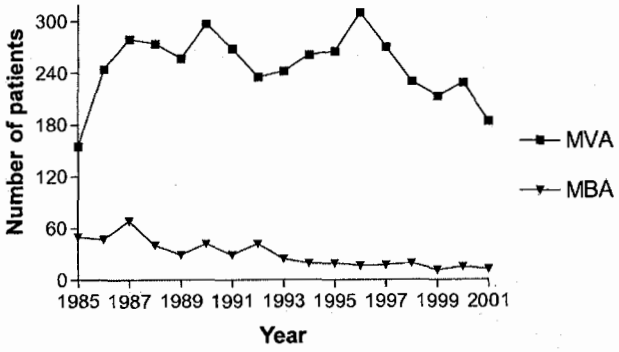

Fig. 5. Motor vehicle and motorbike accidents.

gunshot-related deaths a mean of 77% of victims die at the scene and 23% die in hospital, a proportion that has remained remarkably constant since 1996.

Discussion

Fatal injuries caused by interpersonal violence and motor vehicle collisions are a major public health problem in South Africa. The Medical Research Council of South Africa has commissioned a National Injury Mortality Surveillance System (NIMSS).[6] The total number of deaths that occur in South Africa due to unnatural causes is estimated to range from 65 000 to 80 000 per annum (accounting for between 12% and 15% of the more than 500 000 deaths that occur annually from all causes).[6] South Africa's national per capita violence mortality rate is six times that of the USA,[7] while the traffic death rate per unit distance is surpassed only by Korea, Kenya and Morocco.[8]

Most of the deaths from injuries in South Africa occur among non-white males in the economically active age range of 15 - 44 years.[6] The leading cause of these deaths for males is homicide, while among females accidents are the leading cause. More than half of all the homicides are inflicted by firearms, and one-third by sharp instruments. The most common scene for homicide is in and around the home.[6]

The most prominent unnatural causes of death in other age groups include burns for infants and children younger than 5 years, PVAs in the case of children aged between 5 and 14 years, and firearm injuries from 15 years onwards.[6]

The dramatic rise in PVAs documented in this study began in 1991, coinciding with the repeal of the Group Areas Act

Table I. Breakdown of manners of death examined at the JMLL (*N*)

Manner of death	1996	1997	1998	1999	2000	2001
Violent deaths						
Firearm	1 086	1 188	1 171	1 096	1 007	1 006
Sharp instrument	383	328	265	219	211	199
Blunt assault	250	280	213	217	191	180
Motor transport-related	915	889	880	795	730	734
Burns	62	89	65	80	86	77
Drowning	66	46	52	49	59	43
Hanging	58	89	78	86	92	101
Fall/jump	118	135	111	115	102	108
Poison/drugs	192	181	173	178	140	129
Other*	44	67	51	29	18	80
Death on the operating table†	145	126	137	83	108	109
Undetermined/natural deaths						
Natural	929	829	908	745	609	681
Neonatal	71	47	51	48	50	41
Total	4 319	4 294	4 155	3 736	3 403	3 488

* Other manners of death include work accidents (including mining), lightning, bites and stings, stampedes and freak accidents.
† The majority of the deaths on the table are after traumatic injuries.

which restricted the movements of rural inhabitants of the country. Repeal of the Act accelerated the rate of urbanisation in South Africa and this process has been exacerbated by an influx of foreign nationals; however, accurate assessment of the contribution of cross-border migration to overpopulation of the high-crime areas of central Johannesburg is difficult to quantify.

Migration from the countryside and growth of major metropolitan cities is a key characteristic of the developing world.[9] In May 2002, the Executive Director of the United Nations Human Settlements Programme (UN-HABITAT) described the global trend in urbanisation as 'simply too fast to manage'.[10] Worldwide, the number of urban dwellers living without adequate shelter and basic services is expected to reach 2 billion by 2025. Urbanisation in this manner leads to mass unemployment, lack of adequate shelter and basic infrastructure and when combined with weak social services and obvious disparities between the 'haves' and 'have-nots', results in a high degree of social exclusion leading to overall social dysfunction, crime and violence.[10] Urbanisation in South Africa is also associated with high-risk behaviours that increase the chance of injury. Flisher and Chalton[9] have recently documented the relationship between urbanisation and alcohol and drug abuse, being a victim of violence, perpetration of an act of violence, and suicidality.

Urbanisation leads to household crowding and poverty, recognised risk factors for pedestrian accidents.[11] School-age children are at particular risk as they often live in areas with high traffic volumes and density, with few alternatives but the street for play and inadequate parental supervision.[11] Previous studies have shown a dose-response relationship between degree of deprivation and child pedestrian accident rates,[12] as poor children have to walk more than rich ones.[11] The increase in pedestrian accidents seen at the JHTU is in direct contrast to the situation in more affluent nations; a 49% reduction in the number of deaths of child pedestrians has been documented in the USA between 1978 and 1992.[11]

In a recent study from Cape Town, Peden *et al.*[13] found that 60% of trauma patients had positive alcohol levels on breath analysis, 28% could be classified as problem drinkers or possible chronic alcoholics on the basis of a questionnaire, and on urine analysis, 40% of patients were found to have used at least one illicit drug in the recent past. In that study, while alcohol was associated with both accidental injury and interpersonal violence, illicit drug use showed a strong association with interpersonal violence. In South Africa, 76% of all deaths after interpersonal violence have been shown to be alcohol-related.[7] Alcohol and other forms of substance abuse are also major associated factors in the high trauma rates on South Africa's roads. Seven per cent of drivers with illegal blood alcohol levels account for nearly 30% of non-fatal and 47% of fatal driver deaths,[7] but injury due to drunken pedestrians shows even greater alcohol relatedness, as pedestrian accidents account for 72% of adult traffic deaths.[7]

A study[14] from a level 1 trauma centre in Texas showed evidence of acute and/or chronic alcohol use in 48.2% of trauma patients. In addition, a strong association was demonstrated between problem drinking and high-risk behaviour such as dangerous driving, violent and aggressive behaviour and suicidal ideation. Trauma centre patients who test positive for alcohol are 3.5 times more likely to be readmitted for a second injury compared with other patients.[15]

Crime often leads to injury among victims and perpetrators. Figures published by the South African Police Service show a very strong upward pressure on many of the crime trends since 1998, although three crime trends, namely murder, attempted murder and arson (accounting for 2.7% of all serious crime) have decreased recently.[16] Although the homicide rate has decreased in recent years, in 1999, the most recent year for which figures are available, the murder rate throughout the country ran up to 37 per 100 000 of the population,[16] approximately six times greater than the USA rate.[7]

The economic impact of this trauma is immense. Cook and Ludwig[17] have estimated that the overall cost of gun violence in the USA in 1998 was $100 billion. The societal costs of traffic accidents is even higher; the American National Highway Traffic Safety Administration has calculated that for each individual killed in a car crash, 45 require emergency department treatment and 9 require hospital admission.[18] Currently in the USA, societal costs of vehicular crashes are estimated to be almost three times higher than those associated with gunshot wounds.[19]

The World Health Organisation has recently assessed the performance of health systems of its 191 member countries. The primary measure of population health used is disability-adjusted life expectancy (DALE), which measures the equivalent number of years of life expected to be lived in full health.[20] Japan leads the world with an average healthy life expectancy of 74.5 years. After Japan follow a number of industrialised nations in Western Europe, with the UK ranking at 14 with a DALE of 71.7 years. South Africa appears at rank 160, with a DALE of only 39.82 years.[20] The appalling number of deaths from injuries occurring among the economically active section of South African society contributes significantly to this low figure.

At their level 1 trauma centre in California, Engelhardt *et al.*[5] found that the average age of their patients had risen from 31.1 years in 1985 to 39.3 years in 1999. The average ISS had decreased from 15.9 to 10.7. Less than 10% of admissions had suffered penetrating trauma, with an average of only 4.4 P1 admissions due to gunshot wounds per month.[5] Currently, approximately 60 such patients are admitted per month to the JHTU. The injury severity of JHTU's patients is high by comparison (16.16 versus 10.7) and our population of trauma patients remains on average well under the age of 30 years.

Engelhardt and her colleagues[5] cite safer vehicles and improved driving practices coupled with improvements in emergency medical services as reasons for the reduction in motor vehicle-related injuries and deaths. They speculate that improved economic conditions, an ageing population, a decrease in crack cocaine use, violence prevention programmes and changes in law-enforcement practices and sentencing guidelines have led to the decrease in violent crime and gun-related trauma.

Medical practitioners in South Africa can do much to improve the local situation. The association between alcohol, substance abuse and trauma is clear and the potential role for physicians in emergency departments to intervene positively has been emphasised by workers in the USA. Gentilello *et al.*[21] noted that 'trauma centres are uniquely positioned to implement programs of alcohol screening, intervention and referral', but that 'despite emphasis on injury control and prevention, little has been done to incorporate alcohol intervention programs into the care of the injured patient'. Doctors should recognise their responsibilities in promoting substance abuse and injury prevention education; in addition they must recognise a responsibility to identify substance abuse and attempt to intervene.[19,21] Preventable hospital morbidity and mortality must also be identified by a thorough audit structure, and a commitment to improvement in all aspects of trauma care is required. A commitment to continued improvements in pre-hospital and emergency room care has great potential to improve survival after trauma.

We believe that the Government could also do more. Governmental intervention has been shown to be effective in traffic-related trauma; a reduction in South African road mortality was achieved between 1996 and the first half of 1998 by modest increases in control measures.[7] The problems have been well characterised and, in a recent *SAMJ* editorial,[7] Van der Spuy has called for active law enforcement measures to target drunken drivers. The contribution of the Arrive Alive campaign is recognised, but enforcement outside of peak holiday time is poor and increased interventions are necessary.[7]

Conclusion

The demand for hospital care due to trauma has greatly increased at the JHTU over the last few years. One factor altering the injury profile at the JHTU has been the growth of private sector trauma services, which have caused changes in the demographic (and thus injury) patterns of patients attending the JHTU. Increasing urbanisation from within South Africa and migration from without have led to overpopulation of the flatlands slums close to the JHTU and the continuing growth of the Johannesburg mega-city is likely to increase the burden on the State's medical infrastructure in the future even if per capita injury rates decline. The proportionally greater contribution of gunshot wounds to the numbers of patients at both the JHTU and the JMLL is a cause of great concern. The impact of abuse of alcohol and illicit drugs is recognised as a major contributor to trauma in our society, and enhancement of interventions aimed at lessening this impact is urgently required.

The increasing affluence of society and changes in law-enforcement practices and sentencing guidelines that have been credited with the decrease in road traffic deaths, violent crime and gun-related trauma in North America would be greatly welcomed in South Africa.

References

1. Murray CJL, Lopez AD. Mortality by cause for eight regions of the world. Global Burden of Disease. *Lancet* 1997; **349:** 1269-1276.
2. Murray CJL, Lopez AD. Alternative projections of mortality and disability by cause 1990 - 2020: global burden of disease study. *Lancet* 1997; **349:** 1498-1504.
3. Muckart DJ. Trauma: The malignant epidemic. *S Afr Med J* 1991; **79:** 93-95.
4. Centers for Disease Control and Prevention. Nonfatal and fatal firearm-related injuries: United States, 1993 - 1997. *Mor Mortal Wkly Rep* 1999; **48:** 45.
5. Engelhardt S, Hoyt D, Coimbra R, Fortlage D, Holbrook T. The fifteen-year evolution of a trauma center: what does the future hold for the trauma surgeon? *J Trauma* 2001; **51:** 633-638.
6. Medical Research Council of South Africa. Latest statics on fatal injuries in South Africa. **www.mrc.ac.za/pressreleases/2001/18press2001.htm** (accessed 3 Sep 2002).
7. van der Spuy JW. Trauma, alcohol and other substances. *S Afr Med J* 2000; **90:** 244-246.
8. van der Spuy JW. South African road traffic statistics: 1950 - 1994. *Trauma and Emergency Medicine* 1996; **13:** 35-38.
9. Flisher AJ, Chalton DO. Urbanisation and adolescent risk behaviour. *S Afr Med J* 2001; **91:** 243.
10. Tibaijuka AK. UN-HABITAT's role in promoting good governance and strengthening local authorities. **http://www.metropolis.org/metropolis/meteleclib.nsf/2a6bd98dee287482ca256915001cff0c/c03d4f2559001a30ca256bdc001bf6d8/$FILE/Keynote%20speech%20UN%20Habitat.pdf** (accessed 3 Sep 2002)
11. Rivara FP, Grossman DC, Cummings P. Injury prevention. First of two parts. *N Engl J Med* 1997; **337:** 543-548.
12. Kendrick D. Prevention of pedestrian accidents. *Arch Dis Child* 1993; **68:** 669-672.
13. Peden M, van der Spuy J, Smith P, Bautz P. Substance abuse and trauma in Cape Town *S Afr Med J* 2000; **90:** 251-255.
14. Field CA, Claassen CA, O'Keefe G. Association of alcohol use and other high-risk behaviours among trauma patients. *J Trauma* 2001; **50:** 13-19.
15. Rivara FP, Koepsell TD, Jurkovich GJ, Gurney JG, Soderberg R. The effects of alcohol abuse on readmission for trauma. *JAMA* 1993; **270:** 1962-1964.
16. Crime Information Analysis Centre — South African Police Services **http://www.saps.org.za/8_crimeinfo/20111/crime/murder.htm** (accessed 3 Sep 2002).
17. Cook PJ, Ludwig J. *Gun Violence: The Real Costs.* New York: Oxford University Press, 2000.
18. National Highway Traffic Safety Administration. *National Automotive Sampling System Crash Worthiness Data System: 1992 - 1994.* Washington, DC: US Department of Transportation, 1997. Publication DOT HS 808 538.
19. Soderstrom CA, Cole FJ, Porter JM. Injury in America: the role of alcohol and other drugs — an EAST position paper prepared by the injury control and violence prevention committee. *J Trauma* 2001; **50:** 1-12.
20. Mathers CD, Sadana R, Salomon JA, Murray CJL, Lopez AD. Healthy life expectancy in 191 countries, 1999. *Lancet* 2001; **357:** 1685-1691.
21. Gentilello LM, Donovan DM, Dunn CW, Rivara FP. Alcohol interventions in trauma centers: current practice and future directions. *JAMA* 1995; **274:** 1043-1048.

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