Trauma: A Social and Medical Challenge

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I must confess that, initially, when I received the invitation to present the Scudder Oration at this event, I was quite surprised. Although, on one hand, I felt extremely honored, on the other, I cannot hesitate to say that I was apprehensive about meeting your expectations. I gave extensive thought to what would be the most appropriate manner in which to approach this talk and, having a choice between a highly technical theme versus a more conceptually based one, I opted for the latter. Mine will be a very personal view of a very complex subject and for which I will, at times, avail myself of experiences lived through in Brazil. Inevitably, I will also allude to established concepts and ideas, offering opinions and interpretations slightly different from those that you may be used to hearing. For this reason, I ask that my words be heard with patience and tolerance and that they be interpreted as an effort to contribute to minimizing the impact of this condition that has affected humanity since primordial times, as an integral part of the history of *Homo sapiens* and of the natural selection process. As a matter of fact, the history of trauma is intertwined with the history of *Homo sapiens*. Although it has been responsible for deaths, mutilations, sequelae, and suffering, trauma has, nonetheless, played an important role in the slow but inevitable change in the human genome. It is not by chance that, over the millennia, man has acquired the skills necessary to react coherently and effectively to aggression through a series of adaptation mechanisms.

My intent is not to offer miraculous solutions, because these do not exist, but to emphasize our responsibility in the search for solutions that are not only relevant for developed countries, but that are relevant worldwide. I will begin with a few words on the modern history of trauma care. Then I will present and discuss some basic principles of epidemiology to emphasize its importance in primary prevention. Finally, I will offer some thoughts on a very complex subject: trauma management.

Currently, traumatic injuries are responsible for more than 4 million deaths annually, and affect predominantly young people, leading to the loss of an extremely high number of potential life years and causing more than 10 million definitive sequelae. In addition, their direct and indirect costs are extremely high. Among the nonintentional causes, those from road traffic incidents are to be emphasized. Intentional causes are responsible for approximately one-third of the total deaths. Intentional traumas are mostly from suicides, although homicides and wars account for a significant number of deaths and sequelae.

The last decades have witnessed substantial change in the history of trauma and trauma care. First, there has been an exponential increase in the number of traumatic injuries. Second, the perception of what trauma is, per se, and how to treat it, was strongly influenced by the US National Academy of Sciences, which, in the 1960s, defined trauma as the "neglected disease of modern society." Since that time, trauma has no longer been viewed as a consequence of "accidents," and the general approach toward trauma has been significantly modified. In fact, what is most relevant about the definition proposed by the National Academy of Sciences is precisely the concept of trauma as a disease and, as such, deserving an interpretation and an approach similar to that given to other diseases. I am referring to primary prevention (elimination of trauma), to secondary prevention (or a treatment that offers a holistic approach), and to tertiary prevention (or patient rehabilitation). Of these, the most relevant and effective, when possible, is primary prevention. The reality is that prevention is a concept that is easy to understand but difficult to implement; in particular, in the case of a disease such as trauma, in which we find nonintentional etiologic mechanisms that are relatively simple to control, existing side by side with those that are intentional and extremely complicated to control. Similarly, definitive treatment and rehabilitation also depend to a great extent on the nature of the trauma and of the patient's profile and injuries. For these reasons, I will start by analyzing some important aspects of the epidemiology and etiology of the disease that is trauma. I remind you that the perspective presented will be that of a surgeon, not that of an epidemiologist.

If we analyze the global impact of trauma, 2002 World Health Organization (WHO) data clearly demonstrate that "external causes" rank fourth in worldwide causes of death, after cardiovascular diseases, infectious diseases, and cancer. External causes are responsible for approximately 10% of the yearly death toll in the world. If we take a closer

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look at the causes of death in the five great regions of the planet, Africa, the Americas, Europe, the Eastern Mediterranean region, and Southeast Asia and the West Pacific rim, it is interesting to note that this percentage remains approximately the same, about 10%, even if the diseases that precede the external causes may modify its prevalence from region to region. On the other hand, if we analyze the etiology of factors responsible for mortality resulting from external causes, we will note that, worldwide, the primary causes of death are vehicle-related fatalities and injuries, followed by suicide, intentional violence, and many others. These data are not necessarily surprising, possibly with the exception of the high rate of suicide.

If we repeat the etiologic analysis for each of the regions worldwide, we realize that this profile changes substantially from region to region. In this manner, motor vehicle accidents represent the primary external cause of death worldwide, with the exception of Europe. Intentional external causes, such as homicides and, remarkably, wars, prevail above other causes in Africa. In the Americas, homicides are the primary external cause of death. In the Eastern Mediterranean region, motor vehicle accidents dominate as the primary cause, with the percentage of remaining causes more or less equally distributed. In Europe, in Southeast Asia, and in particular, in the Western Pacific rim, suicides are the dominant external cause. It is interesting to note also that falls, an age-related etiologic factor, represent an important cause of death in at least three regions of the world: the Americas, Europe, and the West Pacific, which may reflect the demographic profile of the population of these regions.

As we will see, similar figures result from mortality rate analysis of the main regions of the Americas, published in 2006 by the Pan American Health Organization. But it is also important to remember that the data to be presented are not 100% accurate given that, in many countries, there is a high rate of under-reporting, up to 20% in some cases. Additionally, other factors contribute to the difficulty in conducting data analysis in the Americas. Given these exceptions, I would like to emphasize that the most interesting aspects noted are that vehicle-related accidents and suicides in North America, and homicides in Brazil and in the Andean region, are responsible for a high percentage of deaths by external causes, and that in the southern part of the South American continent, this mortality coefficient is low, and the etiologic mechanisms are equally distributed among the different external causes of death.

Interestingly, a similar analogy can be made within the same country. When one considers the geographic regions of a large country such as Brazil, the significant diversity in terms of global indicators, and causes, becomes evident. This clear diversity between countries and regions reflects the impact of a set of demographic, cultural, social, political, and geographic factors that should, most certainly, be taken into consideration in planning primary prevention. I could go so far as to suggest that trauma-associated mortality rates, and the cause of traumatic lesions, could be used as indicators to classify the developmental stage of a country or a region or the demographic characteristics of a population. The conclusion is that the planning of effective preventive and therapeutic strategies becomes an extremely arduous task given that what could be considered an effective action in one region would not necessarily be so in another. To make matters even more difficult, another important aspect that must be taken into serious consideration is the impact of globalization. According to the *World Report on Violence and Health* of the World Health Organization , ". . . globalization has led to increased inequalities in income and helped destroy factors such as social cohesion that had protected against interpersonal violence. Societies with already high levels of inequalities. . ., are likely to witness an increase in interpersonal violence." To summarize, although trauma is already a significant public health problem, these data lead us to predict that it will most likely worsen in coming years, even in the developed world.

The American College of Surgeons (ACS) trauma prevention program states, with due cause, that "prevention is the vaccine for the disease of injury." So there is a critical need to identify viable primary prevention methods. Generally speaking, primary prevention of mortality or morbidity as a result of nonintentional causes is relatively simple. It depends, essentially, on obvious measures such as education, development, and implementation of reasonable legislation and its enforcement and investments in order to create safe and healthy environments. As a whole, such initiatives have been well implemented, and I will not further address this subject.

The greatest challenge, however, is associated with intentional trauma, in particular, homicides, which are witnessing an increase in frequency and result from extremely complex phenomena. In fact, analysis of available data clearly suggests that there is a strong relationship between various contextual causes, such as high birth and fertility rates, urbanization, poverty and illiteracy rates, and the prevalence of homicides. I will briefly exemplify these facts using data from the Americas. The Andean area and Brazil are regions that have high birth rates, illiteracy, poverty, and urbanization rates. External causes, as a whole, and homicide, in particular, display average levels in these regions that are higher than those for the other American regions. Similar analysis of various regions of Brazil demonstrates

comparable data. To clearly establish the correlation between intentional violence and precarious subsistence levels, one needs only to mention a work that was presented a few years ago. Research analyzed the impact of legalized abortion on crime rates in the United States and concluded that . . ." The evidence. . . is consistent with legalized abortion reducing crime rates with a twenty year lag . . . we estimate that crime was almost 15% to 25% lower . . ." Needless to say this is a very polemic topic. But it is precisely because of the critical impacts the trauma epidemic has on this planet that it must de discussed, in particular, with relevance to final comments made by the authors of the study: ". . .equivalent reductions in crime could, in principle, be obtained through alternatives for abortion, such as more effective birth control, or providing better environments for those children at greatest risk for future crime."

In summary, there is no universal answer for the primary prevention of trauma. If I were asked to choose the tools best suited, I would respond in two words: education and justice, education for nonintentional external causes and justice for the intentional ones. Taking into consideration that, regardless of the investments made, there are no primary prevention methods that could have global effects, the need to minimize the consequences of trauma through an effective and quick treatment response becomes obvious. This is what is meant by "secondary prevention." I will now discuss secondary prevention and the extremely complex challenges that we will need to meet to make it feasible. My words are the result of personal interpretations and must be considered as encouragement to search for solutions.

Until the middle of the last century, trauma patient care was performed in a rather rudimentary way. Trauma patients were rescued without great care, were transported in absolutely inadequate vehicles, were cared for in overcrowded general emergency services and, what was more critical, were cared for by completely unprepared professionals. Keeping in mind the meaning of trauma as a disease, in countries with more resources, a real operation of war occurred 50 years ago, and care was modified, according to a definite strategy. In 1976, the Committee on Trauma (COT) of the American College of Surgeons (ACS) published the first version of *Resources for the Optimal Care of the Injured Patient*, a document that became a historical landmark in the treatment of trauma. Care, both prehospital and hospital, was restructured by trauma systems created according to well-defined criteria, and care responsibility was delegated to adequately trained surgeons whose dedication to trauma victims care then was a priority. With time, the original guidelines suffered subtle modifications, but remained true to the initial established principles. The emphasis given to "optimal hospital resources" was changed to "optimal care, given available resources," as a reflection of a basic principle: that the need to assist trauma victims should be undertaken in a universal manner, not solely in trauma centers, but also in other institutions, in high-income countries and in low- and middle-income countries.

In the United States and elsewhere, as a consequence of the implantation of trauma centers and the valorization of patient care, an attractive field of work was opened for surgeons interested in dedicating their time to this activity. This was a period of great development for trauma surgery and resulted in innumerable studies, in clinical and experimental research, in definition of management and guidelines, and in publication of several high-quality books that brought an explosive dissemination of knowledge in the area. As years passed, however, this panorama slowly was modified. As a result of several factors, among which are the change in patient profile, the increasing adoption of nonsurgical management, the increasing participation of professionals of other specialties, low salaries, and negative implications for the lifestyle of surgeons dedicated to trauma, the interest in the specialty decreased. Older surgeons widened their field of care and young surgeons opted for other areas in which to practice. This is what we are also witnessing in countries such as Brazil and several other Latin American countries. As a consequence, in the last decades, profound modifications occurred in the profile of the professionals responsible for trauma patient care, as can be witnessed by innumerable publications on the subject and the several proposals that have been made. In the last 10 to 15 years, there have been growing numbers of published studies attesting to the flight of trauma surgeons to other specialties and the difficulties encountered in the attempt to motivate professionals to enter or remain in the field. An excellent review on this theme may be found in the study by Esposito and coworkers, published in 2005 and available in the EAST site.

At the moment, there is a discussion on which is the most adequate profile for the professional who cares for trauma victims. Although there is no consensus, there are various opinions suggesting creation of a new specialist, the emergency surgeon, along with others that propose that trauma care should be assumed, again, by the general surgeon. In my opinion, the most adequate alternative is that proposed by the American Association for the Surgery of Trauma (AAST) in 2005: ". . .trauma and general surgery should together create a specialist that has a broad training in elective and emergency surgery, trauma surgery and surgical critical care." In Brazil, and probably in other Latin

American countries, the significant improvements in trauma care which occurred in the United States brought an increasing interest on the subject. However, the actual impacts on routine management of trauma victims were more limited and were concentrated in few centers localized in some big cities.

In general, trauma care continues to be dispensed by general surgeons in the initial phases of their careers. Often the first care is dispensed by surgeons of other specialties, if not by clinicians. In addition, most of the professionals responsible for trauma care, even the surgeons, have limited trauma education, so the adopted protocols are usually those proposed by centers in more developed countries, without accounting for the fact that the available resources are completely different.

It is important to emphasize the linear relationship between trauma mortality rates and financial resources of a country. For example, if we analyze patients with life-threatening but salvageable lesions, the mortality rate jumps from 6% in the US to 36% in Ghana. Although these data may be interpreted in a variety of ways, nonetheless, they deserve careful attention. In Brazil, official data show that the per capita annual public expenditure on health is less than $300 US. These data are worrisome if we compare them with those from other countries and with the average hospital costs for treatment of trauma victims. As seen from this perspective, the definition of what should or should not be done in the treatment of trauma becomes even more difficult. In fact, the notion of treating trauma by following the guidelines established by trauma centers in the developed world becomes absolutely unviable. Indeed, the proposed guidelines are frequently based on limited information that reflects the experience of centers endowed with human and material resources usually unavailable in a global, universal form. Repeating what has already been stated: we must offer "optimal care, given available resources." In other words, algorithms and guidelines are useless when they do not offer alternatives compatible with existing resources.

This disparity is aggravated by the fact that, at least in Brazil, few medical schools have disciplines directed to trauma care and it is not uncommon for surgery residents to have a limited experience in trauma care. To further complicate the panorama, most of the trauma victims are cared for in public hospitals, frequently short of resources. In addition, the professionals responsible for the initial care usually work under an on-duty schedule, without an adequate tertiary survey, and receive nonstimulating salaries. What should then be done? Although it is extremely difficult to foresee what will happen from now on in countries with an economic and cultural profile different from that in North America, some previews may be perceived, at least in Brazil and probably in other Latin American countries.

From my point of view, the ingredients that should establish the profile of trauma care in Brazil in the coming years are the following:

1. Although general surgery continues to represent a necessity in terms of assistance to rural areas and for most of the small and medium-sized cities, its future is uncertain.
2. Everything indicates that, with time, general surgery will suffer a devaluation process in the labor market, resulting in a progressive fragmentation, a fact already occurring in great centers.
3. Surgery tends, more and more, to return to be what it was some decades ago: A specialty characterized by the execution of procedures. In other words, the surgeon is increasingly becoming an operating physician.
4. Trauma patient care will continue to be preferentially dispensed in public hospitals, by hired professionals under a weekly on-duty schedule and with low salaries.
5. Even if more slowly, nonsurgical care will be increasingly adopted, although penetrating wounds continue to represent the etiologic mechanism of a significant proportion of trauma.
6. Medical schools (largely private), and residency programs will continue to privilege other areas, obeying the incentives offered by the labor market. It is important to point out that approximately 25% of medical graduates do not have access to residency programs.
7. The presence of several specialists caring for trauma patients already is an established fact. Among them are orthopaedists, neurosurgeons, plastic surgeons, vascular surgeons, intensivists, radiologists, and others.
8. Even if there were surgeons specifically directed to trauma care, the participation of some surgical specialists is unavoidable, eg, neurosurgeons, orthopaedists, and plastic surgeons.
9. The possibility that, with time, orientation and complete supervision of the care of the trauma patient will be dispensed by an intensivist and that surgical care will be given by specialists in the different areas is not excluded.
10. In any case, considering personal and professional implications inherent to trauma care, to imagine the existence of a significant number of professionals who will choose trauma surgery as a life option is highly improbable.

In view of this panorama, to imagine what will happen is extremely difficult. In the longterm, the situation should be reexamined in the search for acceptable solutions. In the meantime and while a solution is being defined for this con-

fusing situation, it is reasonable to imagine possible investments in two areas: infrastructure and education. The alternative of investing fundamentally in infrastructure is clearly debatable. Although a minimum of resources is indispensable, massive investments in ambulances, hospitals, sophisticated diagnostic resources, etc, are a mistaken approach because it is the most expensive and least efficient method of providing medical care. Of course, it would not be sensible on my part to underestimate the importance of advanced technology currently available for the diagnosis and treatment of trauma victims. But in order for resources to be effective, the presence of qualified professionals who can properly implement such technology and interpret its impact, is a must. An unprepared doctor depends on advanced technology, even if its use is unnecessary, and frequently interprets findings incorrectly, adopting unnecessary or even prejudicial therapeutic measures. In other words, the combination of an untrained doctor and easily accessible technology will serve only to complicate assistance and to exacerbate costs without resulting in adequate treatment. For these reasons, the need to create consensual educational instruments becomes clear, allowing, in an efficient and compact form and at reasonable costs, the guarantee of constant updating, apart from medical schools and equivalent formal educational institutions.

There are intensive courses designed to offer the essential or basic knowledge necessary to guarantee good patient care. Such educational programs should follow some fundamental characteristics, including transmission of up-to-date essential information; objectivity; short duration; low costs; feasibility in environments with few resources; and possibility of transmission at a distance or reproduction using accessible and cheap instruments. In other words, in the short-term, we must invest to create didactic instruments able to deal with the multiple variables involved in trauma care in different contexts.

The best example is the Advanced Trauma Life Support (ATLS) course. The ATLS program has had a tremendous impact worldwide and has contributed substantially to the improvement of trauma care. It is understandable why it has been responsible for the training of more than half a million doctors in approximately 50 countries. Since its implementation in Brazil in the late 1980s, to the present, the ATLS program has trained more that 28,000 doctors, that is, slightly less than 10% of all Brazilian doctors, and 900 instructors. It is important to note that the license that was given to us by the ACS to translate the complete program into Portuguese had a determinant impact. But ATLS has some restrictions. One of them is its costs which, even though they are relatively low, may be beyond the budget of physicians who live in more precarious conditions and who are, exactly, those who need it most. The second is a tendency toward increasing sophistication, introducing state-of-the-art technology that is not always available in countries and places with fewer resources. A greater restriction, however, is the fact that ATLS essentially focuses on initial care. Surgical care, the treatment of the visceral injuries, when indicated, is not approached by the program. In other words, global and definitive patient care are not addressed. For this reason, an analysis of the impact of its implementation in terms of the reduction of trauma-associated mortality and morbidity becomes problematic or at least, is made more difficult. An initiative to overcome this limitation of ATLS may be offered by the Advanced Trauma Operative Management course, which was recently introduced. The course was designed to teach students how to diagnose and treat penetrating injuries of the abdomen and chest. The course is both compact and extremely well planned. Practical activities are developed using swine and students receive a CD/video and documents that contain information about procedures to be followed. But the number of students that can be trained is small, and its implementation is limited by logistical and financial difficulties. Also, the fact that the course focuses on diagnosis and treatment of penetrating trauma confines its range and may challenge the universal scope of the course.

For these reasons, I ask myself whether or not it would be interesting to complement the ATLS through a more holistic training program that also takes into consideration the availability of local resources and that could be offered at a reasonable cost. An analysis of the current literature allows us to identify various such initiatives, clearly demonstrating the interest and need for an efficient instrument for the training of human resources and that has the previously mentioned characteristics. Among the available educational instruments, I found the training program proposed by the World Health Organization (WHO) in collaboration with the International Association for Trauma Surgery and Surgical Intensive Care (IATSIC) and the International Society of Surgery (ISS), entitled *Guidelines for Essential Trauma Care,* to be the most comprehensive. Although this program is still in its development phase, it is an interesting initiative because it proposes an approach for complete trauma care, which is compact, easily assimilated, and applicable to low- or intermediate-income countries. The goal is to promote low-cost improvements through standards that could be made available to almost every injured person in the world. But it limits itself to conceptual proposals and does not include practical activities.

Another new and interesting perspective seems to be the Definitive Surgical Trauma Care course, a registered trademark of the International Association for Trauma Surgery and Intensive Care (IATSIC). The course consists of a core curriculum, and incorporates lectures, cadaver sessions,

surgical procedures in animals, and case presentations. According to the authors, "the course is designed to prepare the relatively fully trained surgeon to manage difficult- . . .injuries. . . The course fulfills the educational, cognitive and psychomotor needs for mature surgeons, surgical trainees and military surgeons, all of whom need to be comfortable in dealing with life-threatening penetrating and blunt injuries. . . ." All these programs follow certain basic characteristics and should be directed to populations of professionals eventually involved in the care of trauma victims. I understand that the populations to be reached should be basically the following: professionals dedicated to the planning and organization of trauma care services; professionals in any specialty who assume initial resuscitation of victims in prehospital settings or in the emergency room; and surgeons in any specialty who dispense initial definitive surgical care to the victims.

Now I will briefly present an educational program developing in collaboration with the Discipline of Informatics of the University of São Paulo Medical School, which aims to offer a compact teaching instrument of easy access, based on the integration of four components: a brief text; images obtained during care of victims in the emergency service; images acquired through dissection of cadavers; and three-dimensional images created using the "Virtual Man." This educational instrument, if properly developed, may complement theoretical programs, rendering them more effective as teaching and updating instruments. In addition, if made available through the Internet, it can make the access easy for those interested, at any time and at low cost. Once it is adequately developed, the program potentially covered by the "Virtual Man Project" may contribute both to the courses directed to initial resuscitation and those directed to definitive treatment of the victims. It should be emphasized that it may constitute an educational instrument of great value in transmitting the way to execute complex surgical maneuvers eventually needed for the care of victims, even if performed only sporadically.

Summing up, what can be done in the short-term, and with acceptable difficulty levels, might be the following:

1. Integrate national and international medical societies in order to construct a single front, capable of identifying practical solutions that would be valid both for high-income countries and countries in which sophisticated resources are not available and which also do not rely on specialized professionals.
2. Invest in the development of low-cost, high-efficiency educational instruments, such as those mentioned earlier, particularly among professionals who work under precarious conditions, and promote the rapid dissemination of knowledge to distant geographic areas, through the use of telemedicine.
3. Motivate medical schools to offer basic knowledge to medical students and training to surgery residents on trauma care.

I repeat that many of these considerations are the result of personal interpretations, and I ask you not to interpret my words as criticisms, but just as incentives to the debate and search for alternatives. I will end by emphasizing the significance of having been the first Brazilian surgeon to be invited to this most honorable task. In my case, in particular, this invitation is of special significance. Within a few weeks, and in accordance with Brazilian legislation, I will reach the compulsory retirement age. I will be able, without a shadow of a doubt, to affirm that the door of my academic career will be closed with a golden key, so to speak. Many well-known great names in North American and world surgery have preceded me in this tribute. I would like to mention and publicly thank each one for their contribution to the care of trauma victims. I prefer, however, to pay homage to them through a symbolic figure who played a determining role in my life, and in the lives of countless young surgeons. I refer to Dr Francis D Moore, who, through his example and words, motivated me to follow an academic career. I would also like to thank my many colleagues and friends from Brazil, from different Latin American countries, and from the United States, who are part of my academic and professional life and offered me help and support in countless ways. Finally, I could not refrain from mentioning a very important person in my life, who motivated and supported me throughout my professional career and who carried the heavy load of helping me to maintain my emotional tranquility and to care for our children during my long and repeated absences, my wife, Marilda.

SUGGESTED READING

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