Medicine at the Extreme

by

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The Chairman of the meeting was Ms. Pauline Shiff.

I would like to start my lecture on "Medicine at the Extreme" by looking at the third world extreme. I will then move to the diametrically opposed extreme: first world neurosurgery which really takes us to the cutting edge of medical practice today. I will speak about what neurosurgery will be like in the third millennium and some of the problems that are being created for us as medical practitioners and presumably for you as lawyers.

The Australian Defence Force of which I've been a member since 1984 is able to transport a medical facility wrapped up in containers in a single Hercules aircraft anywhere in the world. A field hospital can be set up on the ground from these containers within a few hours to become a functioning operating theatre, reception facility, resuscitation element and ward. This is one of the attractions of working in the Australian Defence Force (ADF) as a medical practitioner. We are able to provide remote care to individuals be they military personnel or civilians. For example we set up a hospital on Bathurst Island in the Northern Territory. Portable anaesthetic apparatus can be placed in one of these facilities. The surgery was performed within a tent and the ward was also in a tent. This Aboriginal health support was in fact by someone in our audience tonight, Colonel David Kings. This endeavour was supported by the Northern Territory government to enable these aborigines to receive eye and ear surgery in their own remote home environment. They much prefer to have this surgery done on Bathurst Island than travel to Darwin. They also prefer to be in open-air tents as wards than to be in the fixed buildings of the Darwin Hospital. They much prefer to be without the encumbrances of the first world in Darwin and much prefer to have their surgery in their own setting. Many patients had their sight saved and their deafness cured by Australian military surgeons.

There were also primary health activities which involved general practice, health surveys and correction of basic health problems. In this way, the ADF builds strong trusting relationships with the indigenous people of Australia. The Australian Defence Force also must operate in a very unfriendly environment. Following the genocide in Rwanda in 1994, there was total disruption, dislocation, disorder, anarchy and destruction of the society. This genocide was not on the same scale as occurred in Nazi Germany but nonetheless was a horrific and evil event.

The Australian Defence Force deployed to Rwanda with 5,500 UN personnel and the Australian contingent provided the health support for

the mission. There were about 300 Australian personnel deployed to Rwanda. 2 million people were displaced out of the country, half to a million people were murdered and a half to one and a half million remained in refugee camps in Rwanda and about 4 million remained where they originally had been residing. You can see a total dislocation of the population of this very small country, which is about the size of Tasmania Prior to the genocide, Rwanda was one of the best developed and most beautiful countries in Africa. It had one of the best developed education, legal and health systems of any country in Africa. So you may well ask the question, how could a country like that descend into such levels of depravity? Just as you could ask the same question of Germany during the Second World War - how could it happen and how can we prevent it happening again?

What were the conditions on arrival? When the Australians first arrived in Kigali, the capital of Rwanda, and set up their hospital in the Kigali General Hospital there was a major security problem. It was a very hostile environment against UN personnel and any foreigners. There was civil war with Tutsis killing Hutus and vice versa. Infectious disease was rife and epidemics were breaking out. This scenario sounds very familiar because it is like what is happening in Afghanistan right now.

There were no civil authorities; no justice system; no police; no civil service; corruption was rife. There was population flux, community crime and unexploded ordnance. There were mines within the ground that people were treading on and losing limbs and lives.

The hospital itself was filled with filth and litter. There were scattered corpses throughout the hospital building. Looting of hospital equipment had occurred. When I was there this equipment was appearing in the local market up for sale. There was physical damage to the hospital buildings resulting in a leaking roof which was a major problem with patients in the hospital. There was no power, no sewerage, no clean running water and no refrigeration. There were no medical supplies. There was a gross shortage of national doctors and nurses because they'd been murdered. They were from the educated class, the Tutsis, who were murdered by the Hutus. There was a gross over-demand for medical services and HIV and other infectious diseases were running at extraordinary levels. You are now able to see why only a military operation under the control of the United Nations can restore this sort of situation to some semblance of order and peace. There were 5,500 personnel in Rwanda from mainly African countries but also Canada,

Australia and England and to a small extent, the United States.

The nature of peacekeeping itself is of interest to us all. It involves protection of innocent victims, prevention of further conflict, reaching consensus with the warring parties, being impartial, using minimal force to achieve the peaceful objectives, adhering to strict rules of engagement which vary according to the operation and liaising with local authorities to try and restore peace and order.

The military task in this situation is to protect the relief operation. Trucks going into Afghanistan now are not protected and we read recently where the drivers of those trucks have been attacked by Afghanis to steal their cargo or extort money. This is one of the prime tasks of the military operation, to protect the relief getting through, protect human rights, control movement and provide general assistance to the UN missions. The military mission in Rwanda was to provide security and to assist and coordinate the humanitarian support of participating countries, organisations to facilitate a rapid and effective end to the crisis in Rwanda. The execution of the mission in Rwanda was to concentrate the force operations on creating secure conditions to facilitate the delivery of humanitarian assistance and the return refugees and displaced persons to their homes.

The Australians set up the hospital in the pre-existing Kigali General Hospital. The operating theatre had Australian equipment and we were able to do many types of surgery that could be done in Australia. The intensive care unit (ICU) could offer most of the treatments that ICU could do in Australia but with very limited resources. The main ward in the hospital was a typical developing world scene: beds very crowded, often two patients to a bed, one facing one way and the other in the reverse direction, often the relatives sleeping near the bed. No food was provided by the hospital. Relatives had to fend for themselves to bring the food to their loved ones in the hospital and many of these patients in the medical wards were dying of HIV. A horrendous situation, I'm sure you will agree, but not unusual throughout the developing world, particularly in Africa, and not even in the war-torn situation Rwanda was in. One finds that sort of ward situation in many developing world countries.

The challenges we faced as medical practitioners in Rwanda were a broad range of conditions including paediatrics and obstetrics. Medical personnel in the Australian Defence Force are not necessarily used to dealing with young children or women in labour which may be complicated. The general surgeons have to cope with a situation where

one might have to do an emergency Caesarean section, as I've done several times, or operate on a young child with an acute problem that may be life-saving. The surgery required ranges from basic surgery to advanced surgery. There is pressure on the ADF to provide this surgery to the local people who may not otherwise be treated. This often prevents deformity, pain, suffering or death. The equipment in this situation is inadequate when you compare it to the advanced equipment we have in Australia and must adapt to limited resources being able to use essential items.

Re-supply becomes an issue in this situation and in this case we were being supplied by the United Nations which can be a very inefficient organization, and supplies don't necessarily get through to where they're supposed to get through in a timely fashion.

There is a lack of investigative facilities. There is a personal risk of contracting infectious disease. There may be a mass casualty potential. One may be forced in this situation to reject some of those patients for treatment because the resources are not available to treat them or because their chance of survival is so remote that you have to concentrate your resources on those who do have a reasonable chance of survival. This concept of negative triage is foreign to our first world practice. Family separation is also an issue. It's a very strange environment. There are peculiar medical politics. There is the personal threat of mine injury and assaults on the street. All Australian personnel in these environments may be armed for personal protection. The absence from one's medical practice obviously creates problems.

I would like to discuss landmines because it's become one of my crusades to help solve the landmine problem. Obviously, it is going to take many, many decades to reduce landmine numbers significantly but it is something that can be done and we should all be working towards that goal. Landmines are a scourge and create enormous damage to people's lower limbs, but also arms and hands. Landmines are causing tremendous damage to innocent victims, in many cases children and women. Breadwinners in these developing countries are desperately needed in their families to do the work on the farms to create an income for the family. If the breadwinner is lost, what happens to the family? If children are killed or maimed the future earning capacity of the family is destroyed. Not only that, but the psyche of these poor victims is ruined for life just by having these sort of horrific injuries. I think you can see this by the visage of this young child, the look of total devastation on his face. A child should be smiling at his age but this

poor child has lost both his legs and is totally ruined for life. All of this is quite preventable.

There is a wonderful organisation called "Handicap International" which is based in France and helps the victims of war. I came across them in Rwanda. They set up a limb-making factory in a developing country using local materials, local manpower to create prosthetic limbs for these unfortunate landmine amputees so that they can at least walk around. These prostheses are not attractive limbs but they are effective. Landmine education is of vital importance and often large posters are displayed to try and teach the local population what to do to avoid being injured or killed by landmines. Land mine clearance is possible. The estimate of a total of 130 million mines to clear at a cost of $33 billion is probably an over-estimate. It costs between $US3 and $US30 to manufacture a mine and between $200 and $1,000 to clear it. It requires about 80 days for a prodder to clear one hectare of mine-sewn land.

The International Campaign to Ban Landmines of which I am a proud member is involved in mine clearance, assistance for victims, monitoring the implementation of the Ottawa Treaty, which I will shortly describe, and works with non-state actors such as guerrillas who are often the predators and the culprits involved in laying landmines. The ICBL also lobbies for the universalisation of the treaty. The Ottawa Treaty was developed by the ICBL in conjunction with the UN and the fortieth country to ratify the treaty was Burkina Faso in 1998. The convention then entered into international law in March 1999. Australia signed the treaty in December 1998. Interestingly, USA, China and Russia still have not signed the treaty. Adherence to the Ottawa Treaty means no use, no production, no stockpiling, the destruction of any landmines that the country possesses and no transfer of landmines or assistance with other nations who do not comply. Unfortunately, the worst offenders are the countries who are not signing the treaty, both in terms of production of landmines and in terms of the countries that are faced with the landmine disaster on their own doorstep.

We can increase cooperation with the Ottawa Treaty gently by dialogue, education, declarations, unilateral agreements, particularly with rebels and the non-state actors and identifying the mine-free zones and building peace in the longer term. The Australian Government has done a great deal in this area and the Minister for Foreign Affairs Mr. Alexander Downer should be congratulated for his efforts in this regard. It has been a priority of Australian foreign policy to build a solution to

this problem. There has been an appointment of an Australian special representative on de-mining. The Australian Defence Force is actively providing specialist personnel to international mine clearance efforts, as are many other non-government aid organisations. Australia will allocate $100 million for de-mining and related problems by 2005 and is participating in the conference on disarmament.

There is a wide range of medical problems on a peacekeeping operation. The main problems are trauma and infection, for example, fractures, stab wounds and osteomyelitis. Tetanus occurs because there is no immunisation. Tetanus is a fatal disease in most cases. Parasitic infestations are also common. Unusual problems such as chronic infection developing in a child's eye following a traumatic perforation required the removal of the eye. Complicated obstetrics is also common and challenging. One also encounters horrific examples of what war does to children. In Rwanda there was a girl who had been burnt severely in an explosion and has a grotesque fixed deformity of the neck and would go through life with that deformity unless something was done to correct it. I was able to excise the scars and perform a split skin graft to the area and bring her neck back to a more normal position.

The Australian Defence Force has also been involved in Bougainville. About 100,000 people were murdered during this civil war, and the multi-national Peace Monitoring Group - was formed to restore and maintain peace. The copper mine close to Arawak, the capital of Bougainville was shut down by the civil war. A tent city of Australian, New Zealand, Vanuatuan and Fijian personnel providing logistic and health support to the people of Bougainville was set up in the aluminium storage facility. The PMG is shortly to wind down as peace treaties have recently been signed between the PNG government and the Bougainville people.

Timor is a tropical third world country with many small villages. East Timor was one of the poorest provinces of Indonesia. There was a disastrous civil war, conflagration, destruction, rape, pillage, murder and destruction of a society. The buildings of East Timor were burnt to a cinder. The infrastructure was destroyed and many people were murdered. INTERFET was the peacekeeping operation set up by the United Nations initially, with the permission of Indonesia. Twenty nations including Australia deployed to East Timor to restore the peace. Australia, New Zealand and the other contributing nations commanded by General Peter Cosgrove deserve credit for the success of the mission.

The Australian Government has been previously embarrassed by relationships with Indonesia and East Timor. Indonesia has run a clandestine campaign in East Timor over many years to maintain a submissive population and suppress the movement for self-determination. However, since the referendum in East Timor, Australia has certainly done its part in restoring peace to this troubled nation. I had the great privilege of meeting Mr. Xanana Gusmau only a few days ago when he was in Melbourne at a United Nations function to receive a peace award which was very well deserved.

The Australian Defence Force continues to contribute to the peacekeeping operation in East Timor. The Forward Surgical Troop (FST) is a field hospital which has been set up in the old museum of Dili. Within tents and air-conditioned connexes, are medical and dental facilities from which health support is provided to the United Nations personnel. Humanitarian support is also provided to the local population using spare capacity. A major component of the work done in this operation and on previous peacekeeping operations is humanitarian support.

Inside the operating theatre you could imagine that you were back in Australia although it is somewhat cramped. The ward is set up in tents and the patients are kept beneath mosquito nets so that there is no cross-infection of malaria or dengue fever which are endemic mosquito borne diseases in East Timor. The Australian Defence Force is active in trying to prevent mosquito proliferation in stagnant water to reduce the risk of malaria and dengue fever. Dengue fever produces a rash very much like measles. It presents very much like glandular fever. It causes an intense tiredness and lethargy which may last many months. It can be a very debilitating serious condition which has no definitive treatment because it is caused by a virus. You have to just stop the mosquitos biting if you wish to prevent it.

The first night we arrived in Dili we were faced with the situation of a bus crash in which twenty Timorese victims were thrown out of the bus and injured. This is a mass casualty scenario that one must be prepared for in a military environment. One of the women had bleeding in the chest and abdomen. She would have died without the support of the FST. She made a good recovery and walked out of the hospital within a week.

I want to conclude this component of the talk by discussing developing world medicine in general because I am interested in delivering humanitarian support, or more specifically tertiary health

services, to the developing world. It is assumed by many that the health needs of the developing world reside almost solely with prevention and primary health care of infectious diseases such as gastro-enteritis, pneumonia, measles, HIV and tuberculosis and trauma and other common problems in the third world. And very simple measures can be undertaken to try and reduce the incidence of these problems and to treat them using primary health care resources. However, what has been neglected over many years is money being spent on tertiary health services. The developing world has poor resources, deficient equipment, and a shortage of trained personnel and there is often poor morale in those who are working. There are Florence Nightingale-style wards at the Port Moresby General Hospital which are vastly improved over what the wards prior to this. The new wards were built using Japanese foreign aid to PNG. Japanese foreign aid has produced quite a nice building but still a very crowded environment and resources are in very short supply. The failure of the electricity or water supply is common and there is an epidemic of suburban crime in Port Moresby. Recently a priest was murdered in his home. Who would want to go to PNG and do any work there? It is still possible to work in this environment and to do a lot of good and that's what I try and do.

Vietnam is a developing country. It has about 80 million people. It has about 100 neurosurgeons. The Cho Ray Hospital in Ho Chi Minh City is the biggest public hospital in Vietnam. Within their operating theatre there is basic surgical and anaesthetic equipment. I'm sure Dr. Dick Sutcliffe, a consultant anaesthetist in the audience, would comment on this and say this equipment dates from the 1930s. The equipment in the intensive care unit is primitive compared with what we are using in Australia. The diathermy machine looked to me like one of the original machines from the 1920s but they are still using it. It still works but it's a far cry from what we would need to do modern surgery. But the Vietnamese struggle along with this apparatus and these lack of resources, as do many other peoples of the developing world.

This is one of the reasons why I wrote "Neurosurgery in the Tropics" with the former Professor of Surgery at the University of PNG, David Watters. We wrote this book for the generalist to assist the management of neurosurgical patients in the developing world. It is another fallacy in the developing world, that neurosurgical problems are esoteric, few in number, expensive to deal with, with poor outcomes and that we shouldn't be concerned with neurosurgery in the developing world, that it's in the "too hard" basket, and that there are too many other priorities

of health needs in these countries. However, neurosurgery includes a lot of conditions that can be treated very simply with minimal resources by generalists, or by neurosurgeons. That is what we are showing on the front cover of the book. A brain abscess which is quite treatable and curable in a child, a man with tuberculosis of the spine who was becoming paraplegic, a man who broke his neck in an accident and a young child with hydrocephalus who has excess fluid in the brain. All very common problems in the developing world: infection, including tuberculosis, trauma and hydrocephalus. All are eminently treatable.

Now we move to the opposite extreme of medical practice. I think I am a very fortunate person to be able to work at these extremes of medicine. Most people in medicine are working somewhere in the middle. It is just the way I've developed in medicine, that I've been able to move towards each end of the extreme and have been able to function at those ends of the extreme. That's quite difficult to do, as you can imagine, from being a neurosurgeon doing delicate neurosurgery to doing much more general surgery in the developing world. I suppose I'm one of the old guard that's been trained in a very general sense and become very sub-specialised in what I do now, so I'm still able to bridge both worlds. But there are not many people left who can do that.

Where is neurosurgery taking us in the third millenium? Neurosurgery in the past has been really quite gross and has involved quite gross manoeuvres within the cranial cavity with retraction of the brain, exposing the deep structures. It was not necessarily destructive but quite invasive. Neurosurgeons have been practising that sort of neurosurgery even until the last decade. Neurosurgery now has become much more refined, precise and minimally invasive. One example is an eyebrow incision which enables us to enter the skull through a very small opening to achieve much the same aims as we achieve with a much larger exposure. We can do very delicate vascular neurosurgery, clipping aneurysms through these small windows. We create small corridors through the brain or under the brain to reach a selected target.

It's interesting that military technology and space technology have impacted on neurosurgical practice. Developments in imaging, electronics and computer technology from the space program have impacted on the imaging of the brain in the operating room. The jet fighter pilots use heads-up display with crosshatches in their goggles so that they can aim their laser-guided missiles. We have crosshatches in

our microscope eyepieces that lead us to a target in the brain which is exactly the same target as we would be seeing in the patient's own brain images on the screen beside the patient undergoing the operation. This is frameless stereotaxy which allow us to do very precise, minimally invasive surgery on the head and the spine.

We can also place fine telescopes (or endoscopes) into the brain to examine the very deepest recesses of the brain through the ventricles which are the fluid-filled spaces within the brain. We are able to perform minimally invasive surgery through these endoscopes. There is a television camera attached to this scope and we can view the patient's brain remotely on the television monitor using this apparatus. We can see inside the ventricle, as we approach the foramen of Monro, which enables us to enter the third ventricle. We can then create a window through the floor of that ventricle to allow the escape of cerebrospinal fluid.

Another trend in neurosurgery is minimally invasive spine surgery where through very small openings quite sophisticated constructs of metal and screws and bone grafts can be placed in the spine. It can even be done using endoscopes. Aneurysms in the brain can be treated by passing snakelike coils of metal through the femoral artery in the groin and into the aneurysm. The head doesn't even have to be opened to treat these aneurysms.

The use of magnetic resonance imaging in the operating room is a new use of the technique. A small magnetic resonance scanner which is much smaller than the ones you would have seen can be placed in the operating room and lifted up beside the patient's head during the procedure to obtain images while the operation is underway. The reason this is done is to verify that the tumour has been removed.

I think in the future we will be seeing the use of prosthetic devices to restore damage in the nervous system such as vision. There will be electronic grids placed on the visual cortex of the brain which will connect with glasses so that light images in the glasses will be converted into electric impulses which will be then fed back into the brain so that the brain will see what the electronics is seeing. That can already be done with hearing and Professor Clarke in Melbourne has been at the forefront of the development of the bionic ear, but we're going to see the bionic vision coming in the next decade.

There are many challenges in neurosurgery. For instance, the head injury. A large blood clot pressing on the brain after a motor vehicle accident or in a second case, a very swollen brain with smaller

haemorrhages renders both patients deeply unconscious. There is tremendous structural damage to the brain caused by a high-speed motor vehicle accident. This type of injury can lead to permanent disability such as personality change, chronic headaches, visual loss, memory problems, etc. We don't have a cure for these problems. We can ameliorate them to some degree but we don't yet have a cure for the primary brain injury where nerve cells have been torn asunder. There are still too many patients ending up with severe brain damage after severe head injury. We need to do something about that. One of the things that we are doing at the Alfred Hospital is to do more invasive monitoring of the brain which involves measuring oxygen directly in the brain or measuring brain temperature. This allows us to get a better appreciation of the deranged physiology within the brain to try and restore it to a greater degree of normality.

Parkinson's disease is another area that I have been interested in for many years. We place fine electrodes in the brain which stimulate deep structures in the brain to correct many of the features of Parkinson's disease. Parkinson's disease causes tremor, stiffness and rigidity. Balance is disturbed and there is poverty of movement as the disease progresses. Surgery can alleviate many of the ill effects of Parkinson's disease. The electrodes are implanted in the brain under local anaesthetic so that we can test the patient during the procedure to obtain the best result. The permanent electrode is connected to a battery-operated pacemaker which delivers a gentle continuous low current to the brain to relieve the tremor. The pacemaker is placed beneath the skin of the chest wall.

Neural transplantation has also been used to treat Parkinson's disease. Here is an example of the media going to extremes of misrepresentation and hyperbole about a very limited technique which is still highly experimental.

"A leading transplant surgeon has been given the brain of a monkey in an amazing 14 hour operation. British born professor, Callan McDonough underwent the pioneering surgery after his own brain was severely damaged in a car crash. Now the 33-year-old professor is well on the way to complete physical recovery but there are mental problems. He has not regained full power of speech and can only repeat single words like "banana."

There are of course many examples of responsible journalism as well. "Cures from the Womb" is a headline referring to the use of foetal cells to treat many different diseases in humans including Parkinson's

disease but it does give us some glimpse of the future. But there are going to be major problems in harvesting foetal nerve cells, and President George W. Bush has been grappling with this issue. Australian medical ethicists, legal experts and politicians are also considering the issues surrounding the use of foetal tissue and stem cells.

Foetal neural transplantation has improved the outcome of some patients with Parkinson's disease, but there have been some recent reports of the procedure causing serious side effects. You may recall reading in the newspapers that there have been some patients who have had these transplants who have developed dyskenesia (abnormal movement) that they didn't have prior to the surgery. This has occurred because the transplants are producing high levels of dopamine which aggravates their movement disorder. There are also great problems in collecting the tissue.

We can also obtain foetal cells from stem cell populations which are derived from embryonic cells and which keep replicating. We could also obtain them from other animal species, like the pig. In the USA, pig brain tissue has been transplanted into human brain to correct Parkinson's disease. The results were not impressive. And before too long there will be ways of reducing the immune response to xenografts, which are grafts from other species. I predict that within a decade it will be possible to transplant porcine tissue without it being rejected.

We can also obtain these cloned cells from the individual themselves. For instance, in the mouse we can take the mouse egg from the ovary and fuse it to the cells from other parts of another mouse's body, a mature mouse, join it to the embryonic egg cell so that it becomes an embryonic stem cell, but it has the machinery in it to make the same cells as in the adult individual, the same genetic components. And now people are trying to do that with human cells. You may have read reports where bone marrow cells have been harvested and can be transmuted into other cell types. These are stem cells from the bone marrow of adult individuals that can be transformed into other cell types, e.g. nerve cells or blood cells. It is also possible to identify stem cells in the mature brain, a feat that was thought impossible until only a few years ago. Dr. Perry Bartlett, Head of Neurobiology, and his team at the Walter & Eliza Hall Institute of Medical Research have been able to identify these stem cells in the mouse brain. The adult mouse brain has these primitive stem cells within it. These cells could be cultured so their numbers multiply and you could theoretically transplant these cells back into the damaged brain of that individual. Scientists are

trying to replicate this work in the adult human brain, although no one has been successful to this time. It would seem that the number of stem cells in the human brain are far fewer more delicate and more difficult to culture than they are from the mouse brain. What is the potential use of the stem cells? Neuro-degenerative diseases, stroke, motor neurone disease, spinal cord injury and even head injury. A lot of biological development still needs to take place but I think stem cells have a very bright future and not necessarily embryonic stem cells but stem cells derived from the adult individual.

Epilepsy surgery has come a long way even in the last decade. The magnetic resonance (MR) scan can detect subtle abnormalities of the cortical architecture. Abnormal groups of nerve cells called cortical dysplasia may cause intractable severe epilepsy. It is possible to identify this pathology using MR imaging and then do other tests to look at brain function, such as the SPECT scan, and to even implant electrodes in the brain to identify abnormal electrical impulses and the source of the epilepsy. We can stimulate the brain through these electrodes to map speech and motor areas of the brain in the awake patient. We actually did that in a 15-year-old boy at the Royal Children's Hospital only a year ago, probably one of the youngest patients to have this done.

We can remove dysplastic areas to treat focal epilepsy. We also can remove larger areas of brain, like the temporal lobe of the brain in the very common temporal lobe epilepsy. A recent randomised trial, published in the New England Journal of Medicine, showed this technique to be of significant benefit compared with medical therapy alone. This is a well-tried technique which has been around since the 1930s but it has been refined over the years. The most extreme example of brain resection for severe epilepsy is the hemispherectomy. I present the example of a child with intractable severe epilepsy, already paralysed down the opposite side of the body, where we can remove almost half the brain to stop the epilepsy, which indeed it does in most cases, and usually also improves the weakness.

I would like to say a few words about the operation that I've become particularly involved in. In fact I'm proud to say that our team at the Royal Children's Hospital has now done the largest number of these patients in the world and we are attracting patients from all over the world for this operation. The reason is because the parents of these children communicate on the Internet. There is a website for children with hypothalamic haematoma which is a condition of an abnormal

arrangement of nerve cells in a lump deep within the brain in the hypothalamus which is an area that up until recently neurosurgeons have been reluctant to operate on because it's such a delicate area and it controls so many vital functions.

We decided that the only way to cure these seizures was to remove these lesions completely and we have achieved excellent results with a low rate of complications. These children may be having up to 100 seizures a day and their life is totally destroyed by that epilepsy. They have no chance of making a go of it in life. They may end up retarded, autistic and totally disabled. They often have behavioural disorders. They may have precocious puberty and they may get secondary generalised epilepsy. The so-called 'gelastic' seizures involve pathological laughter. It is halfway between a laugh and a cry, and is part of the seizure. The hypothalamic hamartomas. Vary in size from 0.5 to several centimetres in diameter. We can remove these lesions completely from above, coming down between the hemispheres of the brain through a narrow corridor of access to the hamartoma and remove it. There has been excellent control of the seizures in most cases. We have now done 23 of these cases. At the stage we had only done 17 patients, 14 of them were seizure free and the other five of them were more than 90 per cent seizure free and two of them had less than a 90 per cent reduction. There are very good results compared with what had been recorded previously what was often an untreatable condition. There have been other benefits of this surgery, particularly in terms of behavioural improvement. The children have been much more able to concentrate with much better speech output and social interaction. The post-op electro-encephalogram (EEG) has shown a marked reduction in epileptic activity in the brain.

Where do we go from here? Well, I think the human genome, genetic engineering and proteomics will be major components of medicine in the 21st Century. Proteomics involves the discovery and development of proteins from genes which might act as therapeutic agents rather than the standard drugs we use today. We will be using much more complex protein molecules to correct disorders and that will include brain disorders. Neurosurgery will probably be doing molecular surgery which will involve injecting genes and proteins into the brain to correct various disorders.

We will be using nanotechnology and miniature devices. We will be using robots. Robots are already being used to do remote general surgery, neurosurgery and cardiac surgery. You probably read in the

newspaper recently where they were doing minimally invasive coronary artery grafts using robots. Of course the surgeon was directing the robot but the robot was able to do very precise movements in a very confined space. However, there are still conditions in neurosurgery that are untreatable. We don't have an effective treatment for this young woman with a very large vascular malformation in the brain which has a potential to rupture, causing severe haemorrhage and death. It cannot be removed because it is in such a delicate location.

This is a child with a brain stem tumour, a highly malignant tumour. We can treat it with chemotherapy and radiotherapy but that child's lifespan is measured in terms of six to twelve months. Can you imagine a young child of five developing progressive weakness of the face, difficulty swallowing, trouble walking, limping and the parents finding out that the poor child has an incurable brain tumour like this? Imagine what the parents and the child must face. A horrific situation for which we still have no answer.

I would like to finally reflect on some of the challenges that we as neurosurgeons and other medical practitioners will face in the future. I think many neurosurgeons are overworked. We need to spend more time with our families and look after ourselves as well as our patients. Neurosurgeons are becoming increasingly super-specialised which may reduce our general perspective. We face a high medico-legal threat. It is likely to increase. There are ways to reduce it, and that's the subject of probably another full address by someone. I understand that neurosurgeons in New South Wales are likely to be paying up to $200,000 for medico-legal insurance next year if the system keeps going in the direction that it's going in. A totally impossible figure for any neurosurgeon to comply with and remain in practice.

The administrative load of leaders and managers in the public hospital system is becoming excessive. Even for those in private practice, the administrative load, the form filling, the bureaucratic interaction is becoming burdensome. Patient expectations are becoming impossibly high. I have patients coming to me who already have a thick inventory of data from the Internet. They print it off, they will 'doctor-shop' until they find someone they think is suitable. Maybe that's a good thing but it creates a lot of stress for the doctors who provide the advice and deliver the care. We have to allow time for research and teaching. It's very important for us as medical practitioners to pass our knowledge on to those succeeding us.

There is a lot of competition for the health dollar and, unfortunately, neurosurgery being at the extreme end of practice, is probably also at the most expensive end of practice. Neurosurgery is arguably the most resource hungry specialty in terms of the equipment that it requires and the bed days used by the patients. It remains a challenge to adequately fund neurosurgery departments in this environment. How do we maintain first world medicine in an ever-diminishing health resource environment?

The essence of medical and legal practice will still involve the individual doctor to patient relationship or lawyer to client relationship, I'm sure you'll all agree with that. And that relationship principally involves compassion, caring, interest, concern, good communication but, above all else, love for one's fellow man.

QUESTION: DR ARCHER. Can I ask if there's anything on the horizon along the lines of the Parkinson's surgery with dopamine to treatment of depression with serotonin?

PROFESSOR ROSENFELD. I think that with Professor Burrows in the audience it's going to be difficult for me to answer that question with any authority. But let me say that it's interesting that the treatments for psychiatric disease are becoming much more biological as time goes on. There are functional, psychodynamic and family issues which weigh heavily into the causation of mental illness, but medical science is discovering new things about the biology, the neurophysiology and the biochemistry of the brain every day and I believe that the biochemistry of depression is becoming very well understood. It is interesting that there is a new neurosurgical treatment for depression although it's very controversial. There is a device called the vagal nerve stimulator, which is used to treat epilepsy, where a pacemaker is placed under the skin of the chest wall and a device is connected to the vagus nerve in the neck. An electric current goes up the vagus nerve into the brain and it somehow modulates and alters the neurotransmitters in the brain and in some cases relieves depression. Unfortunately, it hasn't been evaluated in a controlled trial and I'm not advocating it. I'm just informing you that neuroscientists are thinking about new ways of treating mental illness. Of course, it is highly controversial and it gets on to the psychosurgery topic, but I think psychosurgery is a field that probably will expand in the future. There will likely be biological therapies for mental illness which may involve neurosurgical procedures. It may not however be in the next five years. I hope that goes some way towards

answering your question. It would be interesting to hear what Professor Burrows has to say about that as well.

QUESTION: PROFESSOR BURROWS. As a member of the Psychosurgery Review Board I am interested to expand on that a little. At the World Federation of Biological Psychiatrists meeting in Berlin just recently there was data produced on the stimulator that you talked about in the treatment of depressive disorders, so I think I would also say that it has a future.

QUESTION: MR FRANCIS. Kendall Francis. Why do the United States, Russia and China not fall into line in getting rid of landmines? It seems incredible.

PROFESSOR ROSENFELD. Because the military advise their governments not to sign and the reason is that they still feel that landmines are a legitimate weapon that they can use to deflect the enemy if they're used a 'legitimate' way, which means placing the landmine in very restricted zones which are marked. But, of course, we know that the countries which are using them don't do it that way; they use them in a totally indiscriminate way and drop them from aircraft and lay them anywhere. The Americans are, of course, frightened that if they stop landmine production that a country like Russia or China would still be using them, so it's a game of one-upmanship. If the Russians or Chinese have them, the Americans have to have them too. They all have to maintain their military might. The Australian military has been very sympathetic to the landmine issue and has actually destroyed their stockpile. They exploded them all. They still use the Claymore mine, which is not really a mine as such; it's an anti-tank weapon. It is not triggered by people walking on it. Australians have essentially got rid of landmines.