Establishment and support of a children's hospital – the community as champion

Twice in 50 years the community and public have played a leading role in the establishment and the survival of the Red Cross War Memorial Children's Hospital.

The first instance is the leading role played by the Children's Hospital Campaign Committee, spearheaded by the Red Cross Society of the Western Cape.[1]

Although the urgent need for a children's hospital had been highlighted in 1941, when the Cape Provincial Administration announced its 10-year hospital building scheme in 1945, it did not include plans for a children's hospital. Fortunately by this stage the drive for a children's hospital as a living memorial to the ex-servicemen who died in World War II had been taken up by the Red Cross Society and had widespread public and community support.

The strength of the public support for this appeal was so great and persistent that planning for a children's hospital was reinstated as a partnership between the public drive and the Government of the Cape Province. The initial plans were for 400 beds at a cost of £400 000. The Children's Hospital War Memorial Appeal Committee set a target of £200 000 to be matched by the government's commitment. The long delays in implementation raised the cost to £700 000 and reduced the beds to 176. In the end the Appeal Committee raised R238 000 with the Province making up the balance and providing an additional £100 000 for equipment.

This partnership was even more remarkable in that the Administration of the Cape Province asked the Cape Red Cross Society to assume responsibility for both planning and construction, as they did not have the capacity to undertake this in the post-war period.

In 1956 the Red Cross Society handed over the hospital to the Cape Provincial Administration, with this final injunction: 'The Red Cross War Memorial Children's Hospital has been established by the Cape Region of the South African Red Cross Society as an enduring memorial to the sacrifice, suffering and service for our people in World War II 1939 - 1945. It is hoped that future generations, in their thankfulness for the benefits of this hospital, may be mindful of those in whose memory it has been erected.'

With that the Red Cross Society and the community appeal committees across the country wrapped up their business and left the hospital and its owners, the Province, to their own devices.

The initial infrastructure was soon inadequate. Bed numbers were increased to 283 by crowding more patients into wards, and prefabricated short-stay wards were added on. The outpatient clinic area was particularly inadequate and further 'temporary' prefabricated extensions were added on in the 1970s and 80s. Because of the severe overcrowding, planning to upgrade facilities and to expand the size to 400 beds began in 1989 with the announcement of a R30 million commitment by the Province to the project. This was not to be, and rumour has it that the over-expenditure on the new Groote Schuur Hospital had consumed the funds. There were also fears that primary and secondary health services were being neglected at the expense of tertiary-level expansion. The suggested solution – neglecting the special needs of children and the way that a children's hospital provides them – was to cram the children's hospital into the new GSH, large areas of which could not be commissioned, staffed and occupied.

The battle for survival for Red Cross War Memorial Children's Hospital was now on. On the one side were passionate and dedicated staff supported by an increasingly strong public voice led by the news media and ordinary citizens – on the other, a province running out of money and facing increasing and competing demands from primary and secondary health care facilities.

This was the stage that led to the second highly successful partnership in the hospital's life.

Through the initiative of hospital staff and the hospital board, and supported by a group of representatives from community organisations, the professions and business, an Independent Trust to support the hospital was formed. The principles that still guide the Trust's functions were established from the beginning. The hospital must decide on its priorities for fundraising. The Trust must retain independence to be able to operate, and in dealing with the public must be fully accountable, totally transparent, and operate efficiently and effectively. Since its first day every cent donated by the public has gone to the appeal target. Operating costs were initially met by a grant from the hospital board, and prudent investment of funds has allowed the Trustees to meet ongoing costs without touching donor money. Tax exemption for donors under Section 18A was a major incentive for individuals and business to donate.

When the Trust was registered in 1994 a partnership developed in the same way as in 1945. By agreement with the Province the Trust raises the money for an approved building project, manages the design and construction in consultation with the Province, and hands the project over to the hospital on completion. The only condition set by the Trust is that the facilities will be used for the benefit of sick children and that the province will maintain them in good order.

In total the community has contributed R238 million over the

last 12 years. The Provincial Government of the Western Cape has also made a significant contribution, paying consultant fees for the initial projects, providing funds for the upgrading of Ward E1 and extension to the ward size by the façade extensions, and undertaking many other basic maintenance and redevelopment projects in the hospital.

The similarities between the campaigns of 1945 - 1956 and 1994 - 2006 are striking: management and initiation of the campaigns by an independent voluntary organisation, strong community involvement and support, and effective partnership with the Government so as to achieve a common goal – a hospital that is focused on providing the best possible specialist care for children in need. In doing this the Children's Hospital Trust is ably supported and works closely with the hospital's Facilities Board and the Friends of the Children's Hospital, who provide additional support for patients and their families and manage a large number of community volunteers who work in the hospital with the children.

In 1956 the partnership between the community and the Government was dismantled. In retrospect this was a tremendous mistake, as it took more than 35 years for it to be re-established. The Children's Hospital Trust has no intention of allowing this to happen again.

By continuing its fundraising role, the Trust will endeavour to assist the hospital to build on and grow its reputation as a centre of excellence for the specialist care of children.

In the future it will also assist the hospital and the university in expanding their role in teaching and training, and engaging in research into the most pressing diseases affecting Africa's children.

Most importantly it will do all that it can to maintain a strong partnership between the community and the State.

David Beatty

Professor of Paediatrics and Child Health
Red Cross War Memorial Children's Hospital
Rondebosch
Cape Town

Corresponding author: *D Beatty (dbeatty@ich.uct.ac.za)*

1. Heese H de V. The history of a War Memorial Children's Hospital in Cape Town. *S Afr Med J* 2006, **96:** 854-860 (this issue).

The rise and fall of children's hospitals in South Africa

In ancient cultures, medicine and religion were linked, and 'hospitals' developed as pious foundations for religious orders providing care and hospitality for the indigent, elderly, handicapped and infirm with particular devotion to the sick. During the ensuing centuries hospitals gradually developed to provide facilities for the ill and by the Middle Ages hospitals with medical and nursing staff were well established. However, medical science developed rapidly so that during the early 1800s hospitals gradually developed from being primarily a site of charity, care and convalescence to the institutions as we know them today.[1]

Driven by need, specialist hospitals were created to provide health care for specific groups. Hospitals exclusively designed for children were erected in Paris (1802), Vienna (1826), Berlin (1830), St. Petersburg (1834), Vienna (1837) and London – Great Ormond Street (1852).

From about the 1860s few children were admitted to hospitals, mainly because of the fear of cross-infections; mothers were regarded as the best nurses and mother-child separation was not advocated. While these ideas could be regarded as limitations, they were also progressive in that unnecessary separation between children and their caregivers was avoided. Hospitals in Victorian times had a very homely atmosphere; they were light, airy and cheerfully messy with young children, their nurses, their mothers and their toys in happy disarray around the wards – a place like home.

At the turn of the century this pattern had completely changed. Children were usually separated from their families, sometimes for weeks on end. Order was the keyword – mothers were only allowed to breast-feed and dying children were left in the care of men of the cloth. This unhappy state of affairs prevailed for many years and concerns culminated in the famous Platt Report 1959,[2,3] and others which made detailed recommendations about the non-medical aspects of the care of children in hospital.

The most important of these were unrestricted visiting to all children, mothers should remain with their children, and training of medical and nursing students should emphasise the emotional and social needs of children and their families. Few hospitals accepted these important recommendations and established patterns of care did not change. Reasons for this were plentiful: the distress of children in hospital was accepted as inevitable; children's memories were considered short – hospitalisation was seen to have no lasting emotional or psycho-social ill effect on children; children apparently rapidly adapted to hospitalisation; there was fear of cross-infection; mothers were often considered 'difficult' and disturbed routine; there was also a lack of space. But perhaps most importantly, mothers at those times had not asked for changes and either did not have the knowledge or the public power to do so.

In South Africa, public awareness regarding the need for a special approach to children was awakened by the human tragedy and suffering that followed in the wake of World War I.[4] The driving forces behind establishing children's hospitals in South Africa were mainly socially conscious women and returning soldiers from World War I and World War II. These early pioneers of children's hospitals had to overcome much prejudice from provincial authorities and from those accustomed only to the needs of adult institutions. By succeeding in their efforts, they also underscored the rightful place of paediatrics as a major discipline in the teaching and practice of medicine.

The options of accommodation available for sick children include: a freestanding children's hospital, a freestanding speciality and rehabilitation hospital, or a children's ward in a general hospital – the least desirable of the three options.[5] These facilities are committed to providing active, quality, cost-effective, primary, preventive and specialised care to children in need. Children need extra time, extra monitoring, specialised medicine and caregivers with special skills and compassion to communicate with and care for them. Facilities such as these also serve as regional centres and engage in cutting-edge research in children's health.

In South Africa three children's hospitals were built as freestanding and independent centres and one was recently promulgated as a children's pavilion. Sadly, two of these children's hospitals, which became centres of innovation and excellence in child health, died a slow, painful and irreversible death. This came about because of the ravages of time, administrative lack of interest and official policy, fiscal considerations and a lack of understanding of the specific role that a children's hospital can play in child health.

Transvaal Memorial Hospital for Children (1923 - 1978)

This hospital was established as a children's hospital in 1923 in thankful remembrance of the successful termination of World War I and to commemorate those who had died in service during this time. Four energetic women from the Transvaal branch of the National Council of Women initiated this process in 1919. Eight acres were allocated by the municipality in Milner Park and money was donated from the SA Red Cross, the municipality, the mines, industry and private initiatives. The hospital was initially a 100-bed facility for children under the age of 14 years and was the first of its kind in South Africa. Over the years, this hospital grew from strength to strength. It became a cradle of excellence in child health and was one

of the main reasons that paediatrics became an independent speciality in the 1920s, to the great advancement of child health in this country. However with the development of the new all-inclusive Johannesburg Hospital the days of the Children's Hospital were numbered and it was eventually incorporated into the new hospital in 1978. Part of this once proud hospital building has become an Institute of Child Health and the other provides ambulant paediatric medical and dental care to the community.[4]

Transvaal Memorial Children's Hospital (circa 1930s).

Children's Memorial Hospital, Durban (1931 - 1990s)

This beautiful old hospital was erected as a lasting memorial to the fallen in World War I. Councillor Mary Siedle played a prominent role in the initiation of the scheme in 1923 to develop the children's hospital and in the collection of funds, and with her unselfish efforts and enthusiasm brought the project to its successful conclusion in February 1931. The basic aim of this hospital was to provide an institution where ailing children could receive individual attention. The Durban Corporation granted a site of 3.5 acres and the Natal Provincial Council undertook the administration and maintenance of the hospital. Funds were received from the Corporation and many friends of children who contributed amounts, large and small, towards this commemorable effort. It was a beautifully constructed child-friendly hospital on the beachfront. Service groups and women's guilds created the memorial and commemorative wards and decorated them with stained glass windows, nursery rhymes and other architectural features – a home from home for children. During the turbulent years of

Statuette dated 1920 in atrium of the Durban Children's Hospital with inscription.

The Children's Hospital, Durban (circa 1935).

Figurine decorating the walls in the children's ward.

World War II and the period that followed, the hospital served the needs of sick children with great efficiency and pride. An outpatients building was added in 1948.

The infrastructure and old-fashioned operation theatres could not accommodate the increased demand for services over the years and the hospital was allowed to deteriorate slowly. The imminent closure of the hospital was fiercely resisted by medical staff and the public and sufficient funds were collected to restore the hospital to its previous glory and functionality – to no avail. During the early 1980s, all children were transferred to the adjacent New Addington Hospital. In this new environment children had no special place and disappeared from prominence. Thereafter the hospital mainly functioned as an outpatient clinic and finally closed its doors in the early 1990s. All that is left is a day centre and the remaining structure has become a derelict remnant of this once proud and efficient hospital (R Mickel, B Winship – personal communications).

Pretoria Children's Hospital (1960s - 1970s)

The foundation stone for the new Pretoria General Hospital was laid in 1932 and children were accommodated in this new hospital. In 1947 paediatric patients were moved to two pre-fabricated wards at the Beatrix Street Complex, which was converted into a medical facility for children. Surgical patients always remained within the main hospital. These wards were originally designed for World War II convalescing soldiers. The hospital then functioned as an independent children's unit, mostly for medical patients, until it was incorporated in 1987 into the main hospital complex.

Proactive thinking men and women however lobbied fiercely for the establishment of an independent children's hospital in Pretoria during the 1960s. This concept never materialised because of indifference from the Transvaal Provincial Administration, which was not in favour of independent specialised hospitals but rather for centralised hospital planning, as early as 1952. Furthermore, they were against duplication of services, arguing that there was not sufficient expertise and that nurses could not be only paediatric-trained despite the fact that plans were so far advanced that the Andrew McColm Hospital was earmarked as a potential children's hospital and that a substantial amount of money had already been collected to build a children's hospital. This decision undoubtedly had a negative influence on paediatric care in Pretoria. Instead of amalgamating paediatric services, the children were spread out throughout the main hospital complex.

What happened to the finances already committed to the project, especially from the University of Pretoria's Rag activities, remains a mystery. It is a real tragedy that an independent children's hospital was never built in Pretoria (J H J Becker, A C Haasbroek – personal communications).[6]

Red Cross War Memorial Children's Hospital (1956 to date)

The first children's hospital in Cape Town, the Denis Buxton Memorial Hospital for Children, was erected in 1920. The foundation stone for a new Children's Hospital was laid in 1953 and this hospital was officially opened on 18 June 1956 as a living war memorial to the sacrifice, suffering and service of South Africans who fought and died in World War II. This institution's growth has been and continues to be phenomenal; the amount of work accomplished is commendable. The work ethos is goal-directed to the total needs of sick children and their families. It has all specialist and sub-specialist medical services for children, as well as nurses and health practitioners in allied paediatric disciplines. The hospital annually admits 19 000 children, attends to 214 000 outpatients and 39 800 emergencies. Sixty-seven per cent of children are less than 5 years of age, 8% of beds are allocated to the paediatric intensive care unit and 48% to high care. Bed occupancy is in the order of 80 - 110% on a regular basis and in-hospital stay is approximately 4.5 days per patient. These factors attest to the precarious health status and needs of the most vulnerable in our society.

Its exceptional value to paediatric medicine in South Africa is further demonstrated by the large number of medical, nursing and allied medical practitioners who have been trained at this facility over 5 decades, i.e. paediatric surgeons – 82, paediatricians – 226, Doctors of Medicine – 42, Masters of Medicine – 53, Masters of Philosophy in Maternal and Child Health – 35, child psychiatrists – 7, paediatric pathologists – 3, paediatric anaesthetists – 4 annually.

Red Cross War Memorial Children's Hospital (circa 1996).

Red Cross Children's Hospital, although a national asset, was considered for closure in the mid 1990s.[7] Luckily sanity prevailed and the hospital is now firmly established as the leading children's hospital in sub-Saharan Africa providing primary, secondary, and outreach services and it functions as a local, regional and national tertiary referral hospital. The success of this hospital also depended on the personal efforts of men and women who had a great love for children, combined with a sense of responsibility and a unique devotion to the child requiring care.

Tygerberg Children's Hospital (2001 to date)

Although several attempts were made to establish a children's hospital during the 1970s, they were mothballed and never materialised. The need to consolidate children's services however remained and the Tygerberg Children's Hospital was eventually promulgated in 2001 with 300 beds as a specialised children's hospital for neonates and children up to the age of 12 years.

All children's services are now congregated in a single geographical area and the hospital became a functional pavillion within the main hospital complex during 2005. All ancillary services are shared with their adult conterparts, including administration and finances. (B van der Merwe and S W Moore – personal communication).

Threats to independent children's hospitals

Ideally, each province in South Africa should have an independent children's hospital but this dream may be impractical. At least, a fully staffed and equipped children's unit or pavilion in a general hospital should be the minimal requirements. In practice these units should be administratively and financially independent from their adult counterparts and have an open-door policy for acute, chronic and emergency admissions.

There are numerous problems with small or fragmented paediatric departments in that they have split-site working conditions and insufficient experienced junior medical staff to provide the level of cover required. In addition they may not have the facilities for ambulatory or day services and there may be deficiencies in specialist and sub-specialist structures. Furthermore, accreditation of services may be difficult to achieve and career pathways may be limited.[8]

Children's hospitals are often not regarded as unique institutions and struggle financially, partly owing to changes in health care policies. These restraints threaten the remaining resources that children's hospitals or pavilions have and the ability to maintain them. This is manifest by the demise of two of the prominent children's hospitals in South Africa with Red Cross Hospital as the only surviving children's hospital in sub-Saharan Africa. The value of this hospital is self-evident.

H Rode
M R Q Davies
A Berg

Departments of Paediatric Surgery and Child Psychiatry
Red Cross War Memorial Children's Hospital
Rondebosch
Cape Town

Corresponding author: *H Rode (hrode_staff_ich_rxh_uct@mail.uct.ac.za)*

1. Porter R, ed. *Cambridge Illustrated History, Medicine*. Cambridge: Press Syndicate, University of Cambridge, 1996.
2. Platt Sir H. *The Welfare of Children in Hospital*. Report of the committee. Ministry of Health, Central Health Services Council. London: Her Majesty's Stationery Office, 1959.
3. Chalmers B. Annotation: care of children in hospital. *Child Care, Health and Development* 1993; **19:** 119-126.
4. Heymann S. The Transvaal Memorial Hospital for Children 1923 - 1973. *S Afr Med J* 1973; **47:** 1827-1833.
5. Burger JG. Hospitalisasie van kinders. *S Afr Med J* 1956; **30:** 294-296.
6. Mieny CJ. *UP Geneeskunde 50*. Pretoria: Gutenberg Boekdrukkers, 1993: **46,** 58.
7. Beatty DW, Henley L. Red Cross Children's Hospital – a valuable national resource. *S Afr Med J* 1997; **87:** 978-979.
8. Dodd KL. Children First – the Audit Commission study of hospital services. *Arch Dis Child* 1993; **69:** 173-180.

'The Red Cross Children's Hospital is helping to provide that foundation of health to many children. We all pray that our children will never need the services of such a hospital, but whether it is our child, our neighbour's child or a child in a neighbouring country – somebody's child needs the Red Cross Children's Hospital every day. We can help to ensure that when that need arises, skills, technology, medicines and care are readily available.'

Graca Machel

HISTORY

The history of a War Memorial Children's Hospital in Cape Town

H de V Heese, A Steenkamp

We celebrate the inception half a century ago of the Red Cross War Memorial Children's Hospital. Two proposed living memorials to members of the then Union Defence Force (UDF), now the South African National Defence Force (SANDF), who were wounded or killed on active service during World War II originated among soldiers on active service in Italy during 1944 - 1945.

There is a general belief that the concept of the Red Cross War Memorial Children's Hospital, as well as the subsequent collection of funds for building a children's hospital in Cape Town, was proposed by members of the Regiment 'Westelike Provinsie' who were serving in the 6th South African Division at the time. It was felt that the South African Red Cross Society, rather than the authorities, should be entrusted to hold the funds collected. A significant amount was reportedly collected in this way, although no records are available (personal communications – K Elkin, M Matthew, C Schulz).

Another group of soldiers attending an educational course in Florence, Italy, conceived the idea of establishing a nationwide health foundation as a living memorial.

Both groups believed that the memorial should be of social import, particularly to the benefit of South Africans of colour. The courage and dedication of the UDF's coloured and black troops had been markedly evident during the Abyssinian, Western Desert and Italian campaigns, in which they had served as sappers, anti-aircraft artillerymen, transport troops, stretcher-bearers and in various other capacities. The courage of the stretcher-bearers in desperate actions such as that at Sidi Rezegh in the Western Desert had made a deep impression on their white compatriots.

It appears that at some stage those who favoured a children's hospital in Cape Town had to give way to the idea of founding a nationwide health service for all members of the community, beginning with the needs of people of colour.

Division of Paediatric Medicine, School of Child and Adolescent Health, University of Cape Town and Red Cross War Memorial Children's Hospital, Rondebosch, Cape Town

H de V Heese, BSc, MB ChB, MD, FRCP (Edin), DCH, RCP&S (Eng)

Freelance researcher, Cape Town

A Steenkamp

Corresponding author: *H de V Heese (heese@xsinet.co.za)*

Early planning

The planning of a children's hospital in 1945 as a living memorial to the World War II fallen by the Cape Region of the South African Red Cross Society (Cape Red Cross) and the Cape Provincial Administration (CPA) is documented. Their efforts had the support of the Medical Association of South Africa (MASA), civic associations and the public. Locally resident veterans of the Abyssinian, Middle East and Italian campaigns probably played individual roles in promoting and assisting with the project, and Messrs Mansergh and Lightfoot, two of the architects of the hospital, had both been prisoners of war.

A children's hospital as a living Red Cross war memorial was first suggested at the annual general meeting of the Cape Red Cross in May 1945 under the chairmanship of Sir Richard Goode. Their Regional Council approved it as a worthy memorial to the sacrifice, suffering and service of South African soldiers during World War II, and one with which the Cape Red Cross would be proud to have been directly associated. They launched an appeal for funds, with a target figure of £200 000 – starting with a £10 000 donation from its own funds.

A planning committee was appointed consisting of Messrs V U T Watson (convener), G Ackerman, A F Corbett and L B Goldschmidt and Professor M R Drennan. Their first task was to resolve whether a children's hospital in the Cape Peninsula was included in a large hospital programme the CPA had announced at an estimated cost of £8 million over 10 years. The Administrator, Major G B van Zyl (subsequently Governor General of the Union of South Africa), advised that any possibility of a children's hospital being built in the Peninsula for many years to come was precluded by the crying need for hospitals in many parts of the Cape Province where none existed. The Cape Red Cross project was accordingly welcomed by the Administration, which agreed to a £-for-£ subsidy.

The drive to raise £200 000 for the proposed hospital was opened by a broadcast appeal from the Cape Town radio studios by the next Administrator, Mr P A Myburgh. He stressed the need for hospital beds for children, citing 400 children's deaths due to diarrhoea and enteritis between July 1944 and June 1945 because of the lack of hospital facilities ('Child Hospital as Memorial. Cape Drive to Raise £200,000', *Cape Times* 20 March 1946).

Problems arose between the National War Memorial Health Scheme (NWMS) Interim Committee and the Cape Red Cross during the latter half of 1945. The Interim Committee opposed the existence of two organisations competing for funds to establish 'living memorials'. They wanted the Cape Red Cross to join them and abandon the idea of a War Memorial Children's Hospital.

The government of the day favoured a National War Memorial Health Foundation, and the Minister of Health, Colonel H Gluckman, arranged a meeting to discuss the situation. An unsigned aide-mémoire, probably written by Mr W U T Watson, recorded those attending; a Cape Red Cross deputation consisting of Messrs W U T Watson, G Ackerman and J H Tandy, Dr L B Goldschmidt and Professor M R Drennan, and the Minister's group which consisted of Drs P Alan and G W Gale, Mrs M Ballinger (MP), Dr Freedman (MP), Lt. Col. C H S Runge, Maj. Gen. F Theron, Messrs Roscoe and Knoetze, and three other unnamed persons.

Arguments were raised to convince the Cape Red Cross deputation to join the NWMS. Lt. Col. C H S Runge made the point that the NWMS would be larger than a children's hospital, would satisfy the needs of others and be both living and lasting. Gen. F Theron indicated that the Cape 6th Division Thanksgiving Fund had collected about £12 000. However, the Cape Red Cross deputation stood its ground and made it clear that it wanted a children's hospital in Cape Town. Col. H Gluckman said that he would communicate this decision to the new Administrator of the Cape, Mr J G Carinus, and inform the Cape Red Cross about the outcome. The Minister, in a letter of 7 February 1946, confirmed that he had had a meeting with the Administrator, who had informed him that the CPA Executive Committee had resolved on 19 November 1945 that the Cape Hospital Board (CHB) be granted £200 000 towards the cost of a children's hospital, provided that the South African Red Cross Society contributed a similar amount. The minister added that the CPA would not be willing to fund the whole amount for a children's hospital. He also noted that 'the evidence submitted to the National Health Services Commission by the representatives of the Medical Association of South Africa (Cape Western Branch) and other local interests convinced me of the urgency which exists here for a children's hospital. Nevertheless I am bound to express regret that your organisation should have decided to sponsor as a war memorial a scheme which is a normal responsibility of the local population of the Cape Peninsula apart from the war … you will appreciate therefore that it would be impossible for me to support any projects which are likely to interfere with the national appeal. I suggest therefore that you consider whether funds for this much-needed hospital could not be obtained without identifying the project with the war memorial movement.'

Sir Richard Goode thanked the Minister, in a reply dated 9 February 1946 and placed the letter before the society's Branch Council. The minutes of a meeting of the fund-raising committee which was held on 8 February 1946 states: 'After discussing the letter of the 7th February 1946, addressed by the Minister of Health to the Branch Chairman, it was unanimously decided to recommend that the appeal in regard to the Red Cross War Memorial Children's Hospital should be proceeded with as originally approved by the Branch Council.'

The building of a children's hospital was not referred to at the inaugural meeting of the War Memorial Health Foundation in 1946 and is also not evident in *The Story of Your Hospital* by Mr V U T Watson, which must be regarded as highly significant of the wide division and complete break between the two groups.

Strong support for the fund-raising campaign was expressed in a leader of the *Cape Times*, entitled 'Hospital for children', on 20 March 1946. The medical profession stressed the acute shortage of accommodation for sick children in the existing hospitals in the Cape Peninsula. The lack of a hospital devoted solely to children was emphasised in a leader in the *SAMJ*. MASA pleaded for support of the efforts of the Cape Red Cross to raise funds for a children's hospital in Cape Town. (The subject was also referred to in a circular sent to members by Drs Karl Bremer (MP) and Louis Bosman (MP), requesting full support for the fund-raising campaign by the Cape Red Cross Society.) They stated *inter alia* that the medical profession and MASA had originally urged the need for a children's hospital in Cape Town in 1941.

Mr J G Carinus requested the Cape Red Cross to assume the primary responsibility for planning and building the hospital. When completed, the hospital would be handed over to the CPA. Mr J G Carinus became president and Mr G Ackerman chairman of the appeal committee. The response to the appeal for funds was satisfactory. By September 1947 the Duke of Edinburgh's Own Rifles had raised £700 for beds, and the Red Cross Society had Christmas cards for sale at sixpence each towards the end of 1947.

The CHB under the chairmanship of Capt. N Hare from 1945 until 1951 was responsible for the provision and maintenance of hospitals in the Cape Province. In a review of the work of the CHB it is stated that the Cape Red Cross had a project to build a children's hospital as a war memorial, supported by the military forces who had returned from the North at the close of World War II.

Finding a site

The hospitals sub-committee of the CHB, including Cape Red Cross representation, chaired by Mr A A Balsillie (MPC), commenced its quest for a suitable site. Advantages of establishing the children's hospital as near as possible to Groote Schuur Hospital were stressed, but this proved unsuccessful. Sites subsequently documented included a site in Pinelands near Conradie Hospital, Maynardville,

Hawthorndene (the property of Princess Labia), the government vaccine station in Rosebank, and the municipal recreational grounds in Rondebosch. The last two sites were favoured. The central government and the Cape Town City Council were approached to obtain a site without cost.

Information was received that the authorities were considering moving part of the vaccine station at Rosebank and a portion of this ground, which was satisfactory as regards accessibility for a children's hospital, would be available. Progress during 1948 - 1949 concerning this site and planning the 400-bed hospital was disappointing as a serious obstacle was encountered. Test boreholes sunk on the site for the guidance of the constructional engineers disclosed porous clay to a considerable depth, which would necessitate additional expenditure of approximately £100 000 for piers for the foundations. The final blow fell in December 1949 when, because of delays in decisions of a technical nature, the Rosebank site could not be expected to be vacated for at least a further 2 years. Efforts were renewed to find an alternative site.

A deputation met the Mayor of Cape Town, Councillor C O Booth, to ask for help in solving the problem. They indicated that the municipal ground bordering the Rondebosch Common and Klipfontein Road, which had been leased by the municipality to the Municipal Employees' Sports Association for some years but had not been used, would be a satisfactory site in exchange for the vaccine station site. Subsequent negotiations proved successful, and the central government's approval was obtained.

Architectural progress and financial setbacks

The initial planning required that the hospital should provide for future expansion to a capacity of at least 600 beds. A non-resident patients' department was to be built. The intention was that outpatients should attend only by appointment and after being referred for specialist attention. A lecture hall and other teaching facilities were planned to meet the requirements of medical students and postgraduate students. Architects in consultation with the Children's Hospital Committee of the Cape Red Cross, a special technical sub-committee of the CHB, and the Cape Western Branch of MASA planned a hospital according to the most modern standards. Medical, nursing and technical experts were involved. The architects were assisted by Dr Wolf Rabkin, Head of the Department of Paediatrics at Groote Schuur Hospital and the University of Cape Town, and advised by Professor Moncrieff of the Great Ormond Street Children's Hospital in London. A preliminary sketch of the south front of the proposed hospital appeared in *The Argus* of 20 April 1948.

The approximate cost was now well over £1 million and Mr J G Carinus halted the expansive planning as it was impossible to proceed with the money available. Dr J Ware, the Medical Inspector of Hospitals of the CPA Hospitals Department, was asked to draw up a balanced plan of realistic cost, to the same standard but with reduced accommodation and provision for reasonable expansion. His 'outline' scheme was considered by all concerned at the meetings under the chairmanship of Dr J Hendrikz, the Director of Hospital Services. Actively involved in the discussions were Mr A A Bassilie, Dr A I Goldberg, Dr L N Mirvish, Mr V U T Watson, Dr J Ware, Dr J Luckoff, Mr A F Corbett, and Dr L B Goldschmidt. The MASA sub-committee dealing with the Red Cross War Memorial Children's Hospital, Drs J van Selm and Wolf Rabkin, expressed concern about many aspects of the planning and the inadequate outpatient department facilities. However, the scheme was eventually accepted with minor amendments. Although the CPA could now commence, they stated that, because of the large volume of building work on their hands and staff limitations, it would be impossible for the building to be undertaken for at least 2 years.

The situation was depressing, and a deputation discussed the problem with Mr Carinus. He enquired whether the Cape Red Cross would be prepared to assume the responsibility for building the hospital, and on completion hand it over to the CPA. With trepidation the Council of the Cape Red Cross accepted the Administration's offer. At this stage it was estimated that the hospital, when completed and fully equipped, would cost £700 000, considerably in excess of the £400 000 target adopted by the Cape Red Cross and the CPA. However, by the end of March 1951, the Cape Red Cross had received £190 878 and by March 1952, £219 583. The CPA agreed to increase its contribution and to be responsible for a further £100 000 to equip the hospital, while the Cape Red Cross undertook further financial responsibility. Fund-raising by the Cape Red Cross closed on 13 December 1954, when the sum collected reached £238 000 and donors were informed that the target had been reached. Contributions had come in pennies from the poor, thousands of pounds given by wealthy persons or companies, and in large and small amounts raised at street collections, fêtes and balls in town and country. Detailed information on the organisation of the appeal under Mr G Ackerman, Chairman of the Appeal Committee, is in the Archives of the Cape Red Cross.

Building and completion

A special Red Cross Children's Hospital Building Committee chaired by Mr Watson was appointed to proceed with the project. The architects, Mr Brian Mansergh, in association with Messrs Lightfoot, Twentyman-Jones and Kent, commissioned by the CPA and the Cape Red Cross, were briefed that the hospital was to accommodate 176 children and 10 mothers, and have a treatment block for outpatients, with the potential to expand to nearly double this capacity. A nurses' block and

a lecture hall and other teaching facilities were to be included to meet the requirements of nurses, and both under- and postgraduate medical students.

Continually rising costs made it imperative to commence building operations as soon as possible in 1952. A start was made on the nurses' quarters, which were completed in 1953, since the planning for the main hospital was more complex. The Governor General, Dr E G Jansen laid the foundation stone on 7 October 1953, and reports and photographs of the ceremony appeared in the *Cape Times* on 8 October 1953. Uniformed Red Cross members of all races lined the route to the dais where the ceremony took place. The hospital was handed over to Mr P J Olivier, the Administrator of the Cape, on 29 February 1956. The cost of the fully equipped hospital at completion was £700 000, of which the Red Cross had contributed £238 000. The *Cape Argus* of 28 February 1956 gave the completed hospital extensive coverage, the headline reading '£700 000 hospital is a community effort' and a report of the ceremony appeared in the *SAMJ* of 31 March 1956.

Mr V U T Watson presented the Administrator with a document formally handing over the hospital to the CPA and containing a description of its purpose and evolution. The Deed of Handing Over the Red Cross War Memorial Children's Hospital in English and Afrikaans by The South African Red Cross Society (Cape Region) contains information that should be honoured in perpetuity: 'In handing over The Red Cross War Memorial Hospital to the Provincial Administration of the Cape of Good Hope, to be run as a hospital for specialised treatment of children, Red Cross desires to record that the Hospital has been established by the Cape Region of Red Cross of South Africa as an enduring memorial of the sacrifice, suffering and service of our people in World War II, 1939 - 1945.' The following statement also appears in bold in the deed: 'Red Cross earnestly requests that this record shall be suitably preserved in the Hospital, so that future generations, in their thankfulness for the relief of the suffering of their young ones, may be mindful of those in whose memory this Hospital has been established.'

The Administrator, in officially taking over the hospital from the Cape Red Cross on behalf of the CPA, spoke on the theme 'on the ruins of the past do we build the future'.

The hospital was opened at 8.45 am on Monday, 18 June 1956 at a dedication service attended by the staff and led by the Rev. C K Storey of the Methodist Church and the Rev. A J van Wyk of the Dutch Reformed Church. The *Cape Times* of Friday, 15 June 1956 reported that the first patients admitted on 15 June 1956 were 15 convalescent children with poliomyelitis and from 18 June medical cases would be admitted. Surgical cases would have to wait till 16 July, when the four surgical theatres, the outpatients department and the casualty department would be opened.

Conclusion

Has the hospital remained as a worthy memorial to the sacrifice, suffering and service of South African soldiers during World War II? Has it benefited children of South Africans of colour and has the lot of all children suffering from illness been alleviated? The answer is an unequivocal 'yes'. By January 1957 outpatient attendances were 3 000 a month and by 1961 88 836. Of these, 90% were persons of colour; over 90% did not pay hospital fees and over 70% attended the medical department. The last figure increased to over 80% by 1970. The doors of the outpatient department remained open 24 hours a day 7 days a week. Approximately 80% of the beds were allocated to patients of colour. The percentage of medical and surgical in-patients remained at approximately 50% each.

The Red Cross War Memorial Children's Hospital, in the 61st year since it was conceived by the Red Cross Society of South Africa (Cape Region), and 50 years after the admission of its first patients, has remained a vibrant and living memorial to members of the South African forces who were wounded or killed during World War II.

Mr Sadiq Keraan of the Institute of Child Health library and Ms Jean Rissien of the Health Sciences Library of the University of Cape Town provided editions of the *South African Medical Journal*. Thanks to: Ms Diana Ross, Public Relations Officer of the Red Cross War Memorial Children's Hospital, who referred ex-servicemen who visited the hospital to Professor Heese; Mrs Clem Robertson (daughter of Mr V U T Watson) for making available newspaper articles and reports; and Mrs Dalmari Steward for access to South African Red Cross Society archival material. Mr Willem Steenkamp provided expertise and advice in the preparation of the manuscript and Ms Jayne Coetzee assisted with its typing.

Sources of information

Cape Town newspapers from 1945 to 1956 lodged with the National Library of South Africa.
Cape Hospital Board Report, Retrospect, p. 25. Groote Schuur Hospital Archives.
Mr V U T Watson: personal records and annual reports of the South African Red Cross Society (Cape Region) for the years 1949, 1950, 1951 and 1952.
Mr V U T Watson. *The Story of Your Hospital*. Cape Town: South African Red Cross Society, 1956. Published for the handing over ceremony of the Red Cross War Memorial Children's Hospital to the Cape of Good Hope on 29 February 1956. Division of Paediatric Medicine Archives.
South African Medical Journal editions: 1940 to 1957.
South African Red Cross Society (Cape Region): Archives.
The First 10 Years: an illustrated brochure. Division of Paediatric Medicine Archives.
Louw J H. The first two decades of the Red Cross War Memorial Children's Hospital. *S Afr Med J* 1976; **50:** 1037-1047.

LANDMARK DISCOVERIES

Undernutrition, brain growth and intellectual development

R D Griesel, L M Richter

'Twenty of the most grossly undernourished Cape Coloured infants who could be found, were collected over the period 1955 - 1960. They were matched for age and sex with a control group of 11 boys and 9 girls … The birthweights of the undernourished group were said to be normal, ... First seen between the ages of 10 and 16 months … all of them fell well below the 2.5 percentile of the average weight of Cape Coloured children of their age. The average weight of the control group at one year of age …fell at the 10th percentile of the average weight for Cape Coloured children of this age.' Thus was the stage set for remarkable reports on an 11- and later 20-year follow-up study that were to appear from the pen of Stoch, Smythe and their colleagues from 1967 onwards.

The rationale underlying the selection of such a young group of underweight children for study was that 'previous investigators had stressed that the brain is spared during undernutrition but all the studies had been in individuals over 2 years of age, by which time growth of the brain is almost complete'. The children were examined at yearly intervals for height, weight and head circumference and biannually on psychological measures. Cognisant of the need to document intellectual growth on the basis of appropriate psychometric instruments, a variety of 'tests' was applied, where possible having been developed or adapted for the South African population and age-group-specific. In a further attempt to provide objective data on brain growth electroencephalographic (EEG) recordings were carried out. The latter were painstakingly analysed by detailed hand measurement of frequency and voltage characteristics.

In terms of growth the undernourished group had consistently smaller mean head circumference than the control or an American reference group, up to about 13 years of age; their mean heights and weights were similarly significantly below those of the controls. The clinical EEGs revealed two undernourished children with nonspecific abnormalities and the group as a whole revealed a lot of instability on provocation. Eight of the undernourished children showed slow activity and a lack of alpha patterns suggestive of maturational delay.

Child, Youth, Family and Social Development Programme, Human Sciences Research Council and University of KwaZulu-Natal, Durban

R D Griesel, MA, PhD
L M Richter, PhD

Corresponding author: *R D Griesel (prd3@mweb.co.za)*

The psychometric measures revealed a statistically significantly poorer performance by the undernourished in comparison with the control group on two-thirds of the measures, though even the control group itself did not meet the standard set by population norms. In particular, non-verbal test scores were poorer among the undernourished group. No significant correlation was seen between the physical and psychometric measures. Classroom educational placement of the undernourished group was similarly very low compared with the population norm.

The authors concluded that 'there is cumulative and impressive evidence that severe undernutrition during the first two years of life, when brain growth is most active, has resulted in permanent reduction of brain size and defective intellectual development'.

The import of this paper can be found at several levels. The most evident is that the Stoch and Smythe paper has frequently been referred to as one of the best-controlled investigations in which the long-term effects of undernutrition have been documented. The advantages of longitudinal as opposed to cross-sectional experimental design in this context are self-evident, but these authors had the faith and courage to engage in the long-term commitment such a design implies.

This study has been the springboard of many attempts, not only in South Africa but across the world, to come to grips with the problems that beset research in this field, including, for instance, the definition of undernutrition and malnutrition in meaningful terms. The identification of adequate control groups against which to assess growth and behaviour is a complex problem. Even Stoch and Smythe did not really account for their control selection except to refer to local population growth norms, and subsequent research has still not come to grips with appropriate control groups, given the multidimensional nature of the problem. These early researchers in this field also pointed the way to the need for using relevant and culturally appropriate assessment tools with acceptable normative information for their psychometric assessments.

The value of the study can also be assessed from the point of view of one of the methods used to assess brain function. The EEG was not only used to check on clinical abnormalities, as most earlier EEG research had done. Stoch and Smythe engaged in tedious manual measurement of the detail of the EEG needed to document the changing patterns of frequency and amplitude in the maturing brain. Only later

did normative data become available on this measure, once the automation of computer measurement had been perfected for the EEG. Subsequent EEG studies were able to confirm the maturational delay reported by these authors in regard to brain development.[1]

Though not many empirical data were presented in the paper with regard to social and emotional functioning, the authors did report on their impressions. It is noticeable that in both their own later publications and the work of other researchers confirmation of disturbed emotional and psychological factors, other than intellectual functioning, was found among individuals with a history of early undernutrition.

This paper is an example of pioneering research in the field of undernutrition and its effects on growth and behaviour. Reviewing it does however allow for speculation on issues that the authors may, given the state-of-the-art research today, wish the current generation of researchers would address. Three examples come to mind. The relatively recent identification of several points where spurts in growth as well as 'pruning' take place in the developmental trajectory of children raises the question of repeated vulnerability once the all-important period of growth reported on by Stoch and Smythe has been weathered. What would improved techniques of monitoring of brain function reveal in a repeat of this classic study? Functional assessments of both metabolic and EEG indicators of the brain in action are now possible, allowing great resolution in both measurement and identification of maturing function in specific areas of the brain. What of a closer monitoring of social and emotional development over the early lifespan? Stoch and Smythe challenge us!

Reference

1. Griesel RD, Richter LM, Belciug M. Electroencephalography and performance in a poorly nourished South African population. *S Afr Med J* 1990; **78:** 539-543.

Bibliography

Stoch M, Smythe P. Does undernutrition during infancy inhibit brain growth and subsequent intellectual development? *Arch Dis Child* 1963; **38:** 546-552.

Stoch MB, Smythe PM. The effect of undernutrition during infancy on subsequent brain growth. *S Afr Med J* 1967; **41:** 28.

Stoch M, Smythe P, Moodie A, Bradshaw D. Psychosocial outcome and CT findings after gross undernourishment in infancy: a 20-year developmental study. *Dev Med Child Neurol* 1982; **24:** 419-436.

Observations on the origin of congenital intestinal atresia

Lewis Spitz

The article by Louw and Barnard entitled 'Congenital intestinal atresia – observations on its origin' published in *The Lancet* in 1995[1] was a landmark paper that elucidated the pathogenesis of intestinal atresia and radically altered the surgical treatment of the condition.

As a result of a review of cases of intestinal atresia at Great Ormond Street Hospital, Louw postulated that at least some atresias might have been due to interference with the blood supply to that portion of the fetal gut. This study was published in the *South African Journal of Clinical Science* in 1952.

Louw and Barnard proposed that 'strangulation of foetal bowel may end in disappearance of the infracted portion, with, at most, a complicating meconium peritonitis'. This sequence of events was possible only because of the sterile environment of the fetal intestine in *utero*.

Barnard embarked on a series of experiments involving interfering with the blood supply to a segment of bowel in the fetal pup. Barnard stated triumphantly in this article that 'after many disappointments due to anaesthetic and technical difficulties, death of the foetus, premature labour and cannibalism, success has now been achieved in two animals'. This was a remarkable achievement at the time and a testament to Barnard's persistence and technical skills.

The outcome of the experiments together with the clinical findings at surgery supported the theory of a 'vascular accident' as the cause of intestinal atresia. From a practical point of view, the authors made the assumption that if the vascular origin of atresia was accepted, it was likely that the blood supply to portions of the bowel adjacent to the atretic segment would be compromised, not sufficiently to cause necrosis but sufficiently to cause a functional problem with resultant defective peristalsis.

Their recommendation was that the blind bulbous end of the proximal intestine should always be resected before an anastomosis is performed. The immediate result of this policy was a reduction in the mortality for intestinal atresia at Great Ormond Street Hospital from 69% to 33%. The advice was rapidly adopted universally and became standard in the management of intestinal atresia. A truly remarkable achievement.

Institute of Child Health, University College London

Lewis Spitz, Emeritus Nuffield Professor of Paediatric Surgery

1. Louw JH, Barnard N. Congenital intestinal atresia: Observations on its origin. *Lancet* 1995; 19 Nov: 1065-1066.

PRACTICE REVIEW

Appendicitis – pitfalls and medicolegal implications

J S Karpelowsky, S Bickler, H Rode

Appendicitis, despite being the most common acute surgical condition of the abdomen in children, remains a diagnostic challenge.[1-6] It is estimated that up to 20% of children who present with acute abdominal pain will eventually be diagnosed with appendicitis.[7] Missed or delayed diagnosis of appendicitis is also among the top five most frequent malpractice claims against emergency department physicians.[1] Initial misdiagnosis by the first-contact physician approximates 30% in children 14 years or younger.[8] This fact is well described in the international literature and is due directly to the nonspecific symptoms and signs of early appendicitis. There is also no good accurate defining diagnostic test for early appendicitis and diagnosis based on physical examination is often impossible.[5] Furthermore delayed diagnosis caused by parents, physicians and surgeons further compromises the timely management of the disease.

The fundamental aspects of diagnosis in appendicitis in children are described below, with emphasis on how variations in anatomy and clinical presentation can make this difficult. Common causes of misdiagnosis are identified, and a strategy for reducing the rate of misdiagnosis is outlined in an attempt to expedite diagnosis and thereby improve outcomes and reduce reasons for litigation.

Red Cross Children's Hospital review

A recent review (2005) of 136 consecutive children with appendicitis at Red Cross War Memorial Children's Hospital has highlighted many of the difficulties involved in diagnosing appendicitis that may have clinical and medicolegal implications: (*i*) the peak incidence of appendicitis in prepubertal children occurred at 9 - 12 years of age with 3% < 3 years; (*ii*) symptoms of appendicitis had been present on average 2 - 3 days prior to admission (range 0 - 13); (*iii*) these findings were similar for both perforated and non-perforated appendicitis – whether this indicates that in fact there are two types of appendicitis, one that perforates and one that does not, is still a source of some debate; (*iv*) after a child was admitted to hospital with abdominal pain it could take surgical staff up to 67 hours to confirm the diagnosis for perforated and non-perforated appendicitis; and (*v*) life-threatening complications can result as a consequence of both delayed presentation and under-resuscitation. The overall complication rate was 10%.

Types of complications

Complicated appendicitis had a significantly longer hospital stay, 3 days for non-perforated compared with 5 days for the perforated group. The perforated group had, in some instances, stays for 3 - 8 weeks due to complications, with a significant increase in the number of operations needed to remedy the consequences of complications. These included enterocutaneous fistulas, severe iatrogenic ischaemic limb damage secondary to hypotension, multiple intra-abdominal abscesses, renal failure and prolonged intensive care stays.

The mortality rate was 0.7%. Although the disease can be far advanced and children admitted in extremis, death is unusual (0 - 2.4%).[1] During a reviewed 20-year period 6 children admitted to hospital with a subsequent clinical diagnosis of appendicitis died from the following causes: moribund on admission – 3; appendix stump leak following an appendectomy done for abdominal pain – 1; appendicectomy done in error in a child with acute rheumatic fever – 1; post-operative stress ulceration with fatal gastric haemorrhage – 1.

Medicolegal claims reviewed in the records of the Medical Protection Society (time unspecified) revealed 86 cases against doctors. Of these 50% related to postoperative complications, 20% to misdiagnosis and 7% to intra-operative mishap.

The postoperative complications were primarily due to retained collections, sepsis and bowel obstruction (63%). The next most common problems were systemic complications relating to cardiovascular compromise, e.g. pneumonia and in adults deep-vein thrombosis (21%). Lastly, retained instruments and foreign bodies such as needles, swabs and drains caused complications in 16%. Many of these relate to the late presentation of appendicitis and possible delay through patient or physician error.

Delayed diagnosis formed the basis of a significant proportion of claims laid against physicians; these included incorrect diagnosis, perforation, systemic sepsis and death. The difficulties and reasons for delay in diagnosis in paediatric cases are elucidated below.

Only a small percentage of complaints related to intra-operative mishap, most to difficult identification of the correct anatomy, e.g. removal of the ureter or incomplete removal

Department of Paediatric Surgery, Red Cross War Memorial Children's Hospital, Rondebosch, Cape Town

J S Karpelowsky, MB BCh, FCS (SA), Cert Paed Surg SA
S Bickler, MD, FACS
H Rode, MB ChB, MMed (Surg), FCS (SA), FRCS (Edin)

Corresponding author: *J S Karpelowsky (jkarpel@ich.uct.ac.za)*

of the appendix. Again complications were associated with advanced disease.

Anatomical considerations

Morphologically the appendix is the underdeveloped distal end of the caecum and is a long diverticulum projecting from the caecum at the confluence of the three taenia.[9]

The appendix can assume various anatomical positions, i.e. retrocaecal 74%, pelvic 21%, paracaecal 2%, subcaecal 1.5%, pre-ileal 1%, postileal 0.5%. In children, as opposed to adults, the caecum and the appendix assume a more abdominal than pelvic position. This diversity of position and relatively elevated position lead to varied presentations. The underdeveloped greater omentum is an important additional factor contributing to the difficulty in localising the inflammatory process to the right iliac fossa (RIF). As a consequence, young children are more likely to progress to generalised peritonitis. The pathological process from onset of appendicitis to perforation in adolescents and adults usually occurs within 24 - 36 hours. In young children this can be as little as 8 - 24 hours.[10]

Clinical presentation

The clinical presentation of appendicitis is related to the position of the appendix, the stage and progression of the disease, and the degree of peritoneal irritation. The natural clinical history can be divided into three phases. The first phase is largely nausea and vague abdominal pain without physical findings. Mild constitutional symptoms may be present. The next stage is progression to constant, localised pain in the RIF with systemic evidence of inflammation. The third phase is characterised by the inflammatory process progressing to perforation, abscess formation and peritonitis with concomitant worsening of abdominal signs, i.e. guarding preceding rigidity, marked abdominal distension and tenderness.

Variations to the typical scenario

The inflamed appendix is in a 'hidden position' unable to be detected by the palpating hand in 15% of patients with simple appendicitis and in 30 - 68% of patients with gangrenous or perforated appendicitis (pelvic, retrocolic, retro-ileo-colic), thereby changing the clinical manifestations of appendicitis.[3,11] When the appendix is in a 'hidden position', patients will present with less abdominal pain, less local tenderness in the RIF and a longer duration of symptoms before the diagnosis is established. A higher perforation and sepsis rate occurs and the differential diagnosis is more varied. This atypical presentation with relatively unimpressive physical findings may cause the patient to delay seeking medical attention and may dissuade a physician from considering appendicitis as the cause of the patient's symptoms.

An inflamed appendix touching the rectum or in the retro-ileal position may mimic diarrhoea, which can be substantial in watery volume and mimic gastroenteritis closely.[12] This symptom is common enough to potentially confuse the definitive diagnosis. In the retrocolic position it may cause renal angle tenderness and in the pelvis on the bladder wall, dysuria and even leucocytes in the urine.

Diagnosis

Despite technological advances, the key to successful diagnosis of appendicitis is a careful history, a thorough satisfactorily carried out, and if indicated serial, physical examination, a high index of suspicion and supporting selected laboratory studies. If more than one of these aspects indicate appendicitis, further evaluation is usually unnecessary. Only in confusing cases or atypical presentations, should further diagnostic studies be ordered.

A rectal examination to aid the diagnosis is rarely done in children. In a large study with 100 consecutive children with appendicitis, rectal examination only contributed to the diagnosis in 3% of cases.[13] It is a very distressing and traumatising event for children and not encouraged at Red Cross Children's Hospital.

Ancillary diagnostic studies done in elucidation of the cause of acute abdominal pain in children are used to supplement clinical evaluation, but they do not appreciably reduce the frequency of missed appendicitis or negative appendectomy.[6,14] A moderate polymorphocyte leucocytosis is normally present, but the count may be normal in cases with perforated appendicitis and can also be raised with other causes of abdominal pain. Use of the leucocyte count alone may result in missed diagnosis or unnecessary surgery.

Plain abdominal radiographs usually contribute little to the diagnosis of appendicitis and are not routinely recommended. However, if they are ordered, certain findings may be found such as the presence of a faecalith, abnormal and atypical lower quadrant gas patterns, localised ileus, lumbar scoliosis and obliteration of the psoas shadow. Plain radiographs are more useful in identifying other causes than confirming the diagnosis of appendicitis. Chest radiographs may be particularly helpful[15] to exclude an occult pneumonic process which may mimic appendicitis.

In experienced hands ultrasound may be helpful (accuracy 85%), but this is not universally available.[15] Ultrasound, however, can provide a non-invasive method to review the entire abdomen and pelvic cavities.

Focused computed tomography (CT) with bowel contrast to diagnose appendicitis has a positive yield of 95%.[16] However, it exposes patients to significant radiation and has not reduced the negative appendectomy rate, again emphasising the fact that history and physical examination by an experienced physician is as accurate as CT in diagnosing appendicitis.[17]

In an effort to improve diagnosis, laparoscopy both for evaluation and treatment can be an important adjunct, especially in peri-pubertal girls and children with equivocal findings. It is, however, an invasive procedure requiring general anaesthesia. The role of laparoscopic appendicectomy is still under debate with some trials showing an improved outcome[18] while others show no benefit.[19] The era of laparoscopy has, however, caused a dramatic increase in the number of medicolegal complications; how this will affect the diagnosis and management of appendicitis has yet to be elucidated.

Surgical consultation is necessary for children in whom appendicitis is suspected. There are no standard guidelines laid down for surgical referral by first-contact physicians when appendicitis is suspected, or when its classic features are absent. However, it is common practice to observe patients with acute abdominal pain of uncertain cause to allow the pathology to declare itself, thereby avoiding an unnecessary laparotomy. The intention is to resuscitate if needed, repeat abdominal examinations, and do further diagnostic studies. When used in this setting, observation should not lead to a higher rate of complicated appendicitis.

Differential diagnosis

Differential diagnosis of acute appendicitis varies depending on the age and sex of the patient and is particularly difficult in the young non-verbal child. In paediatric populations, the diseases most commonly mistaken for appendicitis are acute nonspecific abdominal pain of unknown origin, gastroenteritis, urinary tract infections, viral enterocolitis, intestinal parasitosis, primary peritonitis, dysfunctional voiding, pneumonia and uncommonly Meckel's diverticulitis.

Factors contributing to delays in diagnosing appendicitis

A variety of factors have been cited as causing delays in the diagnosis of appendicitis.[6,15,20,21] The ability to diagnose appendicitis is related to the patient's age, the history obtained and the diligence with which the physical examination is performed. In children under 3 years of age, appendicitis is virtually never diagnosed before perforation and should be considered in children presenting with a triad of abdominal pain, tenderness and vomiting.[2] Early diagnosis is further compromised by the child's inability to verbalise symptoms and endure physical examination, concern among caretakers about other more possible diagnoses, especially gastroenteritis or small-bowel obstruction, and failure by one or more physicians (67%) to diagnose appendicitis early.[5]

In a study to identify differences between correctly diagnosed appendicitis and misdiagnosed cases that resulted in litigation between 1982 and 1989, missed cases appeared less acutely ill, had fewer complaints of right lower quadrant pain, required significant analgesia for undiagnosed abdominal pain or symptoms and, more often, received an emergency room discharge diagnosis of gastroenteritis (50%) or nonspecific abdominal or urinary tract infection. Most of the patients were incorrectly sent home without counselling or instruction. After inappropriate discharge, the average time to correct diagnosis was 39 hours. Delayed diagnosis was associated with a 91% incidence of ruptured appendicitis, and required more surgery with more postoperative complications. In addition, the complication rate was higher in patients who did not receive appropriate discharge or follow-up instructions and in those whose parents did not return for repeat visits.

Diagnosis is often delayed if there is pre-admission uncertainty regarding the diagnosis or when patients/parents and physicians consider an alternative diagnosis.

In several studies[5,22] information regarding patient and physician delay was available in 93% of cases. Patient delay ranged from half a day to 45 days with a prolonged delay period of more than 3 days, more frequently seen in the misdiagnosed group. Physician-related delay ranged from 2 to 430 hours, and of interest to note, the mean physician delay was similar in acute uncomplicated appendicitis and advanced cases.[11] Another study records that 45% of their patients with ruptured appendices had previously been seen by their family physician who failed to make the correct diagnosis.[23]

Removing a 'lily white' appendix

Removing a 'lily white' appendix is primarily due to the uncertainty of diagnosing appendicitis. A normal appendix is removed in between 6% and 18% of patients. The current rate of negative appendectomies in the USA is approximately 20%.[1,21] Consensus is that this rate should be < 10%.[24] Morbidity associated with the removal of a non-infected appendix is in the order of 6 - 17%, which is significant.

Conclusions

Mistakes in diagnosis do occur and shortening the interval from symptom onset to surgery is definitely desirable. There are, however, common and universal factors/reasons for the diagnostic dilemma in acute appendicitis. All these factors are well described.

1. The typical signs and symptoms of acute appendicitis are nonspecific early on and may be varied, i.e. atypical presentation. These symptoms and signs are often under-valued and ignored.

2. It is often impossible to diagnose appendicitis on the basis of a single physical examination: indeed most errors occur after only a single examination. Repeated abdominal examination is crucial even if the child has to be admitted for observation.

3. Absence of the classic signs and/or symptoms of acute appendicitis, pain but no nausea or vomiting, can confuse the physician.

4. Administration of narcotic pain medication followed by discharge can mask symptoms, and if required should warrant admission or further investigation.

5. Patient and parents are often sent home with only a vague understanding of signs to look for or inadequate instructions to follow.

6. Parental factors include delay in contacting health professionals, not recognising the symptoms as being significant and failure to follow instructions. When parents were encouraged to observe their sick child at home, a higher incidence of perforation occurred (65%).[4]

7. Misdiagnosis is common with treatment of a different diagnosis, i.e. urinary tract infections, gastroenteritis, pneumonia.

8. Obvious signs and symptoms are overlooked.

9. Children with appendicitis will have a higher incidence of vomiting, diarrhoea, dysuria and respiratory symptoms contributing to misdiagnosis of the condition.

10. Although appendicitis under the age of 3 years is infrequent, every effort should be made to diagnose the disease early, to reduce complications if perforation has occurred. The rate of perforation in this age group is high.

11. Red Cross Children's Hospital experience has shown that because of uncertainty about the diagnosis or symptoms mimicking other conditions, the final diagnosis and surgery were often delayed before the correct diagnosis was established. These findings again indicate the difficulty in making a diagnosis even if children have been admitted to a teaching hospital. Delay in diagnosis does not necessarily result in perforation.

Recommendations

To improve the diagnosis of acute appendicitis, shorten the clinical pre-appendectomy period, reduce associated morbidity and decrease medicolegal implications, we would like to put forward the following recommendations.

1. Always suspect the possibility of acute appendicitis in a child with acute onset of abdominal pain even if the symptoms and clinical findings are atypical. Always ask: is this, or is this not, appendicitis?

2. When in doubt, it is advisable to submit the child to active observation by repeated planned examinations[25] or to give specific discharge instructions to the family/guardian regarding their return if the condition does not improve. Earlier follow-up should also be arranged.

3. A patient who presents with acute abdominal pain migrating to the RIF and with local signs, falls into a group that has a diagnostic accuracy of 95% for acute appendicitis. Only when the clinical presentation is equivocal or a mass is present in the RIF, should imaging modalities be utilised to establish the diagnosis.

4. We believe that this strategy would reduce time delay and lead to timely surgical intervention.

References

1. Chung CH, Ng CP, Lai KK. Delays by patients, emergency physicians, and surgeons in the management of acute appendicitis: retrospective study. *Hong Kong Med J* 2000; **6:** 254-259.
2. Alloo J, Gerstle T, Shilyansky J, Ein SH. Appendicitis in children less than 3 years of age: a 28-year review. *Pediatr Surg Int* 2004; **19:** 777-779. Epub 2004 Jan 16.
3. Hardin DM Jr. Acute appendicitis: review and update. *Am Fam Physician* 1999; **60:** 2027-2034.
4. Brender JD, Marcuse EK, Koepsell TD, Hatch EI. Childhood appendicitis: factors associated with perforation. *Pediatrics* 1985; **76:** 301-306.
5. Rusnak RA, Borer JM, Fastow JS. Misdiagnosis of acute appendicitis: common features discovered in cases after litigation. *Am J Emerg Med* 1994; **12:** 397-402.
6. Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. *N Engl J Med* 2003; **348:** 236-242.
7. Wagner JM, McKinney WP, Carpenter JL. Does this patient have appendicitis? *JAMA* 1996; **276:** 1589-1594.
8. Blab E, Kohlhuber U, Tillawi S, *et al*. Advancements in the diagnosis of acute appendicitis in children and adolescents. *Eur J Pediatr Surg* 2004; **14:** 404-409.
9. Buschard K, Kjaeldgaard A. Investigation and analysis of the position, fixation, length and embryology of the vermiform appendix. *Acta Chir Scand* 1973; **139:** 293-298.
10. Rappaport WD, Peterson M, Stanton C. Factors responsible for the high perforation rate seen in early childhood appendicitis. *Am Surg* 1989; **55:** 602-605.
11. Guidry SP, Poole GV. The anatomy of appendicitis. *Am Surg* 1994; **60:** 68-71.
12. Horwitz JR, Gursoy M, Jaksic T, Lally KP. Importance of diarrhea as a presenting symptom of appendicitis in very young children. *Am J Surg* 1997; **173:** 80-82.
13. Dunning PG, Goldman MD. The incidence and value of rectal examination in children with suspected appendicitis. *Ann R Coll Surg Engl* 1991; **73:** 233-234.
14. Flum DR, Morris A, Koepsell T, Dellinger EP. Has misdiagnosis of appendicitis decreased over time? A population-based analysis. *JAMA* 2001; **286:** 1748-1753.
15. Rothrock SG, Pagane J. Acute appendicitis in children: emergency department diagnosis and management. *Ann Emerg Med* 2000; **36:** 39-51.
16. in't Hof KH, van Lankeren W, Krestin GP, et al. Surgical validation of unenhanced helical computed tomography in acute appendicitis. *Br J Surg* 2004; **91:** 1641-1645.
17. Partrick DA, Janik JE, Janik JS, Bensard DD, Karrer FM. Increased CT scan utilization does not improve the diagnostic accuracy of appendicitis in children. *J Pediatr Surg* 2003; **38:** 659-662.
18. Li P, Xu Q, Ji Z, *et al*. Comparison of surgical stress between laparoscopic and open appendectomy in children. *J Pediatr Surg* 2005; **40:** 1279-1283.
19. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. *Ann Surg* 2005; **242:** 439-448; discussion 448-4750.
20. Williams NM, Johnstone JM, Everson NW. The diagnostic value of symptoms and signs in childhood abdominal pain. *J R Coll Surg Edinb* 1998; **43:** 390-392.
21. Koloske AM, Love CL, Rohrer JE, Goldthorn JF, Lacey SR. Diagnosing appendicitis in children: it comes down to the physical examination *Gastroenterology* 2004; **127:** 675-677.
22. Eldar S, Nash E, Sabo E, *et al*. Delay of surgery in acute appendicitis. *Am J Surg* 1997; **173:** 194-198.
23. Savrin RA, Clatworthy HW jr. Appendiceal rupture: a continuing diagnostic problem. *Pediatrics* 1979; **63:** 36-43.
24. Rao PM, Rhea JT, Novelline RA, Mostafavi AA, McCabe CJ. Effect of computed tomography of the appendix on treatment of patients and use of hospital resources. *N Engl J Med* 1998; **338:** 141-146.
25. O'Donnell B. *Abdominal Pain in Children*. 1st ed. Oxford: Blackwell Scientific Publications, 1985: **17**-19.

Accepted 27 June 2006.

PRACTICE REVIEW

The history of paediatric trauma care in Cape Town

A B (Sebastian) van As, Heinz Rode

Trauma is a leading cause of morbidity, mortality and disability in childhood. In most developed countries where 18% of the population are in the age group 0 - 15 years, injury exceeds all other causes of childhood mortality. In the developing countries of Africa, however, children aged 0 - 15 years constitute 43% of the population and trauma has an even bigger impact on child health.[1]

There is an erroneous perception that trauma is not a major health problem in Africa, derived from undue emphasis on mortality statistics alone. Yet, the impact of trauma ought to be measured not only in terms of death, but also the tremendous morbidity and disability caused by injuries, and their socio-economic consequences.[2]

History of emergency care

Until the late 60s and early 70s of the last century, medical trauma care received very little attention in most communities or from health care providers. Emergency medical care became a focus of widespread and continuing attention following publication in 1966 of the landmark report of the National Academy of Sciences (NAS) and the National Research Council (NRC): *Accidental Death and Disability: The Neglected Disease of Modern Society.* Morticians provided up to 50% of prehospital transport before that time, perhaps largely because hearses were the only available vehicles to accommodate stretchers.[3] The need for and success of emergency trauma care was firmly established by military surgeons on the battlefields of Korea and Vietnam.

Emergency care of children in Africa

The burden of trauma weighs heavily among all other diseases in modern times and although the industrialisation of Africa lags behind other continents, the most deadly transport vehicle, the motor car, continues to wreak havoc among our young population. There are reports that motor cars in Africa are responsible for more than 200 times more accidents, injuries and deaths than motor cars in the developed world. Motor vehicle accidents continue to be the leading cause of trauma in children in most reports, and are responsible for 26 - 40% of all trauma-related childhood deaths in Africa.[4]

In South Africa more than one-third (39.5%) of infant transport-related deaths and more than half (56.4%) of child transport-related deaths were the result of pedestrian injuries. Among children, the 5 - 9-year age category was the most at risk for passenger injuries.[5] Of all the non-natural deaths occurring in South Africa, at least 10% are persons under the age of 18 years.[5]

Trauma care at Red Cross War Memorial Children's Hospital

Although it is now widely recognised that systematisation of trauma care reduces mortality and improves outcome in Africa, especially sub-Saharan Africa, trauma systems hardly exist. The development of such systems is urgently needed and involve several levels of planning. This was first recognised by Professor S Cywes, the head of Paediatric Surgery from 1975 to 1997. As a result of his vision, a Child Safety Centre was established at Red Cross Hospital in 1978, according to international standards, with the initial aid of a R1 000 grant from the Urban Foundation.[6] It has played a pioneering role concerning safety issues for children in Africa, and its staff became actively involved in improving the care of injured children, with a particular focus on preventive care.

Plans to develop a trauma unit, specifically dedicated to children, were also developed, and a previous administrative corridor on the ground floor of the B wing of the hospital was transformed to house the unit, comprised of a treatment and resuscitation room, a fully fledged radiodiagnostic imaging room, two operating theatres and a paediatric high-care ward with 10 beds. The unit was officially opened on 24 April 1984 and a new paediatric trauma surgeon appointed, together with a paediatrician. The specialised paediatric trauma unit proved to be an immediate success and in the first 5-year period 57 468 patients were treated (Table I).

During the course of 1997 a new system of health care referrals was introduced in the Western Cape, leading to a rather acute decrease in the number of patients presenting to our Unit. This decline continued until 2000; since then, however, the numbers have been rising gradually. Although the absolute numbers declined after 1997, the number of major trauma cases (resuscitations) actually increased, probably as a result of the increasing population of Cape Town.

Trauma Unit, Department of Paediatric Surgery, University of Cape Town and Red Cross War Memorial Children's Hospital, Rondebosch, Cape Town

A B (Sebastian) van As, MB ChB, MBA, FCS (SA), PhD

Heinz Rode, MB ChB, MMed (Surg), FCS (Surg), FRCS (Edin)

Corresponding author: *A B van As (abvanas@ich.uct.ac.za)*

Table I. Patients treated and operated upon at the Red Cross Trauma Unit (1984 - 2004)

Year	Patients treated	Operations
1984	11 178	507
1985	12 052	1 201
1986	12 860	1 064
1987	12 857	969
1988	12 923	921
1989	12 375	1 022
1990	14 892	912
1991	13 209	897
1992	12 461	778
1993	13 136	907
1994	14 780	1 397
1995	15 569	1 220
1996	13 473	951
1997	9 228	1 000
1998	8 752	1 013
1999	8 214	953
2000	6 923	861
2001	7 193	869
2002	8 050	829
2003	8 517	895
2004	8 798	892

Of all patients, 17.1% required admission. The majority of children presented to the trauma unit after a fall (43%), while other most common causes were bumps and blows (15%), transport-related injuries (11%) and burns (11%).[7]

In 2001, we performed a 10-year review, analysing the major causes of admission. Results are shown in Fig. 1. A total of 88 822 children were treated at the trauma unit in the period from 1991 to 2000. The most common injuries were falls (*N* = 32 766) (21%), transport-related injuries (*N* = 11 915) (13%), burns (*N* = 7 241) (8%), struck by or against an object (*N* = 9 064) (10%), foreign bodies (*N* = 3 677) (4%), sharp instruments (*N* = 3 601) (4%) and non-accidental injuries (*N* = 3 302) (3%).[8]

One of the strengths of close co-operation between the trauma unit and the Child Safety Centre was the opportunity to enter all paediatric trauma patients' details in the database at the Child Safety Centre. This made it possible to extensively study and analyse paediatric trauma, with the particular aim of designing effective accident-prevention programmes.

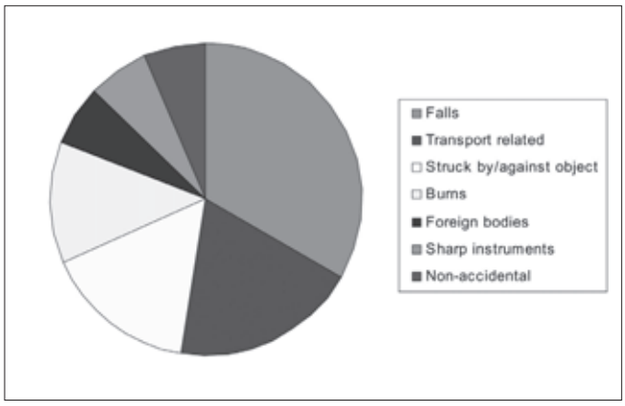


Fig. 1. Most common mechanisms of injury of patients admitted to the trauma unit (N = 88 822).

The new trauma unit at Red Cross Hospital

During the late 90s it was recognised that the transformed administrative corridor was not the ideal geographical location to have a busy trauma unit. In accordance with the international trend to have a single unit dealing with emergency medical care as well as trauma, plans were designed to develop a new trauma unit with direct access to the medical emergency unit. This has several advantages. There is no patient confusion. All emergency patients enter the same door, with both the medical and surgical resuscitation rooms in close proximity of the emergency entrance. Another advantage is closer co-operation between medical emergency staff and surgeons. Also, in case of a mass disaster the units can become seamless and overflow into each other.

With great help from the Red Cross Hospital Trust R17 million was fundraised within a record time, and the unit was opened in October 2004. The new unit consists of a vastly modernised resuscitation room, including digital radiological equipment, two state-of-the-art modern operating theatres

Fig. 2. The new Trauma Unit at Red Cross Children's Hospital.

Fig. 3. The digital whole-body imaging device (Lodox StatScan) in the resuscitation room.

and a trauma admission ward, double the size of the old unit. The surface area of the unit has increased by 100%, enabling treatment and resuscitations to be more effective. In the old trauma unit the distance between the specially manufactured paediatric cots was only 60 cm, while in the new unit the international standard of 1.8 metres was achieved. This provides the nursing staff with ample space to conduct their duties without being hindered by other patients or visitors. The new unit is also designed to be naturally lit by daylight rather than artificial light, providing the children with a pleasant environment in which to recuperate (Fig. 2).

Another valuable asset to the new unit is a digital whole-body scanner, the Lodox StatScan. This imaging device, located in the resuscitation room, is able to perform a whole-body radiological scan within minutes after arrival of the child in the Trauma Unit, at significantly lower levels of radiation as compared with conventional radiological imaging. This is of particular advantage when dealing with large numbers of paediatric polytrauma patients. It also highlights subtle fractures that may be clinically missed initially (Fig. 3).

Conclusion

Paediatric trauma care at our hospital has come a long way over the last 25 years, from practically being non-existent to an excellent, dedicated paediatric tertiary trauma centre, with a specialised surgeon present 24 hours a day. We can only hope that the care in other parts of the country will catch up soon.

References

1. Population Reference Bureau: 2002 World Population Data Sheet. Available at: **http://www.prb.org/pdf06/YouthInAGlobalWorld.pdf**. Accessed on 7 August 2006.
2. Nwomeh BC, Ameh EA. Pediatric trauma in Africa. *African Journal of Trauma* 2004; **1:** 7-13.
3. **www.aap.org/sections/pem/10M%Emergency%20Carr%20FOR%20children%20(272pp).pdf**
4. Adesunkanmi AR, Oginni LM, Oyelami AO, Badru OS. Epidemiology of childhood injury. *J Trauma* 1998; **44**: 506-511.
5. Bowman WB, Donson H, Harris C, *et al*. *A Profile of Fatal Injuries in South Africa*. Third Annual Report of the National Injury Mortality Surveillance System. Medical Research Council, University of South Africa, December 2002.
6. Cywes S. The neglected disease of modern society and the Child Accident Prevention Foundation of Southern Africa. *S Afr Med J* 1990; **78**: 381-382.
7. Kibel SM, Bass DH, Cywes S. Five years' experience of injured children. *S Afr Med J* 1990; **78**: 387-391.
8. Van As AB, du Toit N, Wallis L, Stool D, Chen X, Rode H. The South African experience with ingestion injury in children. *Int J Pediatr Otorhinolaryngol* 2003; **67**: S1, S175-178.

Accepted 4 July 2006.

PRACTICE REVIEW

Fifty years of paediatric anaesthesia – new approaches to an old technique

A T Bosenberg, R J Ing, J M Thomas

The safety of paediatric anaesthesia has improved since Red Cross Children's Hospital opened its doors 50 years ago. At that time routine surgical procedures were considered life-threatening. To avoid the dangers of general anaesthesia some surgery was performed under local infiltration. However significant advances in virtually all aspects of paediatric anaesthesia have occurred over the past five decades. The peri-operative well-being of all children has become an expectation. Economic pressures may have modified practice so that children after minor and some major surgical procedures can be discharged the same day.

Peri-operative well-being is paramount. Improved outcome in children of all ages has become the focus of the modern paediatric anaesthesiologist. This has taken place in the face of improved surgical techniques and advances in neonatal care. More and more complex surgery, even in premature babies, who were not previously expected to survive, is being performed with good outcomes. Without the advances in anaesthesia, many of the surgical procedures performed at Red Cross Children's Hospital could not be done.

Computers and information technology have become an integral part of our lives. Evolution of this technology has influenced the way we conduct modern anaesthesia. Anaesthetic machines are self-calibrating with built-in safety checks to ensure safe delivery, fluid therapy and the infusion of intravenous agents can be tightly controlled and fine tuned, and ventilators and monitoring equipment have become highly sophisticated computer-controlled apparatus. Even anaesthetic record keeping can be automated.

Some of the more important advances considered to have had the greatest impact on the safety of anaesthesia and the well-being of children undergoing surgery are highlighted.

Improved safety

Digby Leigh and Kathleen Belton wrote the first paediatric anaesthesia textbook[1] before the foundations to Red Cross Children's Hospital were even laid. Jackson Rees wrote his seminal paper on neonatal anaesthesia in 1952.[2] In South Africa peri-operative mortality in the general population was 89 per 10 000. Anaesthesia mortality, defined as mortality partially or totally related to anaesthesia, was in the order of 3.3:10 000.[3]

By the mid-eighties the frequency had fallen below 1:10 000 and was comparable to rates in developed countries. In children the decrease in peri-operative mortality has followed similar trends with the most significant decrease occurring over the past three decades. Mortality has decreased from 1.8:1 0000 in 1954 - 1966[4] to < 1:10 000 in developed countries,[5,6] even in high-risk children less than 1 year of age. The National Confidential Enquiry into Perioperative Deaths (NCEPOD) in the UK, established to evaluate the number of deaths in children under 10 years, recorded that only 5 of the 417 deaths were attributable to anaesthesia. Most recent figures from Australasia record deaths attributable to anaesthesia as low as 1 in 68 000.[7]

Surgery-associated mortality in the neonate has declined from more than 60% to less than 10% over the past 35 years. Red Cross Children's Hospital surgeons under Professor Louw could boast a lower neonatal mortality (1.8%), considerably better than any reported in the mid-70s.[8] This progress is attributable, almost entirely, to a better understanding of the pathophysiological changes that can occur during the perioperative period. It became increasingly apparent that the acute metabolic response to injury plays a central role in determining the clinical outcome of the critically ill infant. Unfortunately the impact of the HIV epidemic has had a significant impact on surgical outcome over the past decade.

Induction

The aim of modern paediatric practice has been to reduce the impact of hospitalisation. Anaesthetists have played their role in this regard. Intramuscular injections are no longer used for premedication or analgesia unless specifically indicated. Children, and some parents, do not understand the need for preoperative starvation. Fortunately attitudes have changed and research has shown that the old maxim 'starve from midnight' is inappropriate. Children may be given clear sweet fluids up to 2 hours before elective surgery without additional risk.

The whole anaesthetic induction process is more 'child-friendly' in an attempt to make it a more congenial experience for children of all ages.[9] Rapid-onset, short-acting sedatives (midazolam) are popular in day-case surgery. Despite early resistance,[8] parents are allowed to accompany their child to the operating theatre until they are 'asleep.' (Fig. 1). Favourite

Department of Anaesthesia, University of Cape Town and Red Cross War Memorial Children's Hospital, Rondebosch, Cape Town

A T Bosenberg, MB ChB, FFA (SA)
R J Ing, MB ChB, FCA (SA)
J M Thomas, BSc (Ed), MB ChB, FFA (SA)

Corresponding author: *A T Bosenberg (bosie@cormack.uct.ac.za)*

toys or other 'security blankets' are welcomed. Pungent odours of some anaesthetic vapours can be disguised by flavoured facemasks that are now produced in a variety of colours. Sevoflurane, even in high concentrations, is more pleasant, faster acting and has an odour that is more easily disguised than halothane or ether.

Fig. 1. Parental presence at induction, previously considered impossible, is now common practice in many institutions. Innovative methods can reduce anxiety at induction.

The inherent fear of needles has swayed anaesthetists to use of inhalation inductions rather than intravenous inductions in children. The advent of EMLA (eutectic mixture of local anaesthetics), a topical local anaesthetic cream that allows painless needle insertion, has changed the practice in some institutions. Unfortunately the onset time for adequate anaesthesia is approximately 1 hour, limiting its use in a busy environment. Other agents (amethocaine, lidocaine iontophoresis) with slightly shorter onset times have also proved impractical.

Pain management

Less than 30 years ago pain management was not considered a priority for children undergoing surgery. 'Children seldom needed medication for the relief of pain after general surgery. They tolerate discomfort well.'[1] Attitudes changed in the early eighties with the realisation that better pain management and suppression of the stress response improved surgical outcome.[10] Inadequately treated pain in the newborn may also contribute to an increased sensitivity to pain in childhood.[11]

A multimodal approach to pain management is considered optimal.[12] The pharmacokinetics of paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) has been researched in children over the past decade. Much larger doses are required for analgesia and paracetamol has significant 'morphine-sparing' effects. An intravenous form of paracetamol has recently become available. Furthermore, with a better understanding of the pharmacokinetics of morphine and other opiates, continuous infusions of these agents are used routinely.

Continuous opiate infusions dictate adequate monitoring. Children old enough to understand – about 5 - 6 years and older – can use patient-controlled analgesia (PCA). PCA gives children autonomy, something they were not granted in the past. Lower doses are required to provide satisfactory analgesia when using PCA.

Proponents of regional anaesthesia argue the benefits of continuous epidural infusions and more recently continuous peripheral nerve blockade. Regional anaesthesia fell out of vogue with the introduction of inhalational anaesthesia in the early part of the 20th century. Regional anaesthesia became popular when it was re-introduced in the mid-80s as the benefits of pain relief were realised and the increased survival of premature infants challenged the anaesthesiologist. The use of regional anaesthetic techniques has gathered momentum as equipment more appropriate for use in children has become available. It is now possible to perform epidural anaesthesia even in extremely low-birth-weight babies.[13]

Pharmacokinetic studies,[14,15] some performed at Red Cross Children's Hospital, have demonstrated the safety of continuous epidural infusions even in neonates.[15] The benefits include profound analgesia without opiate-induced respiratory depression, less need for postoperative ventilatory support, reduced nausea and vomiting, and no problems on withdrawal. Drug dosages, previously extrapolated from adults, have now been determined for children of all ages. Recent prospective studies[16] show that the major complications of regional anaesthesia in children are transient, easily treated and occur while the anaesthetist is still in attendance.

Evaluation of the efficacy of any treatment modality requires a validated pain scoring system. Many have been used and validated for children of different ages. All require education, time, understanding and a sufficient level of trained personnel. The BOPAS (Burn Observational Pain and Anxiety Scale) scoring systems,[17] developed and validated at Red Cross, have become an integral part of the management of children with burns.[18]

Monitoring

Early monitoring was rudimentary; at times the anaesthetist 'barely knew whether the paediatric patient was alive or dead' (Tom Voss – personal communication). In this computer age the level of sophistication reached today would be the envy of our predecessors. Monitoring and maintenance of physiological function is an essential component of any anaesthetic. The more parameters monitored, the more information obtained and, provided the anaesthetist responds to the changes in the correct manner, the better the outcome will be. Gone are the days of a 'finger on the pulse' and prioritising the only available ECG machine, which was usually seized by the 'alpha' anaesthetist, to the highest risk patient. Automated non-

invasive blood pressure monitors with appropriate-sized cuffs are far more accurate than a baumanometer reading with an inappropriately large cuff. Fine-gauge arterial cannulas have replaced the 'needle in radial or brachial artery' (Tom Voss – personal communication).

Perhaps the most significant single development in modern anaesthesia has been pulse oximetry. Anaesthetists soon learnt to their horror that bradycardia was not an early sign of hypoxia. To wait for SpO_2 of 40% before triggering a response courted disaster. Further technological advances have led to cerebral oximetry using near-infrared spectrometry (NIRS). The FDA has recently approved the INVOS 5100 (Somanetics, Troy, MI, USA) cerebral oxygenation monitor. The INVOS employs an infra-red light source and two sensors applied over the skin of the left and right frontal cortical region. Each sensor transmits two beams of infra-red light. One sensor detects reflected infra-red light predominantly from skin and bone, and the other sensor analyses reflected light returning from brain tissue at a depth of 2.5 cm.[19] The monitor displays a regional saturation index (rSO_2) of the mixed venous blood in the cerebral cortex that in return reflects the adequacy of regional cerebral perfusion.

There is some evidence that neurological outcome is improved with this type of monitoring, provided cerebral oxygenation is maintained, particularly during cardiopulmonary bypass (CPB) surgery.[20] Other monitors of cerebral function have been introduced but are not universally used in children. These include the Bispectral Index (BIS) monitor and Auditory Evoked Potential (AEP) monitors. The BIS, developed using integrated electroencephalograms (EEG) of adults, has only recently been validated using values obtained from anaesthetised or sedated children.

Automated self-calibrating machines that measure virtually every physiological parameter are the allies of the modern day anaesthetist. Inspired and expired gas measurement (oxygen, carbon dioxide and anaesthetic agent) give vital information that was not available to our predecessors. Blood gas analysis, serum electrolytes and clotting status can be determined within minutes. These are taken for granted today but were not even considered possible as little as 30 years ago.

Management

Pharmacological advances, an improved understanding of neonatal physiology and goal-directed intensive care have all contributed to improved outcome. Long-term ventilation of newborns with tetanus was first performed at Red Cross.[21] No paediatric, let alone neonatal, ventilators were available at the time and innovative modifications of adult ventilators were made to reduce deadspace[22] and to reduce complications (e.g. barotrauma). This innovative work by Tom Voss proved to be a forerunner of ventilatory support and respiratory care that altered the expectations of surgeons, paediatricians and parents of children requiring major surgery forever.

Ventilatory support together with drugs that modify cardiopulmonary physiology have significantly improved the outcome of critically ill infants. Modes of ventilation have come a long way since modifications were made to 'adult' ventilators.[22] Perhaps the most advanced mode of ventilation in regular use today is high-frequency oscillatory ventilation (HFOV) which is essentially used to maintain oxygenation at low airway pressures in 'stiff lungs' to reduce barotrauma. CPB is no longer confined to cardiac surgery. CPB is used in some intensive care units to support infants with life-threatening pulmonary pathology, e.g. meconium aspiration or pulmonary hypoplasia associated with congenital diaphragmatic hernia.

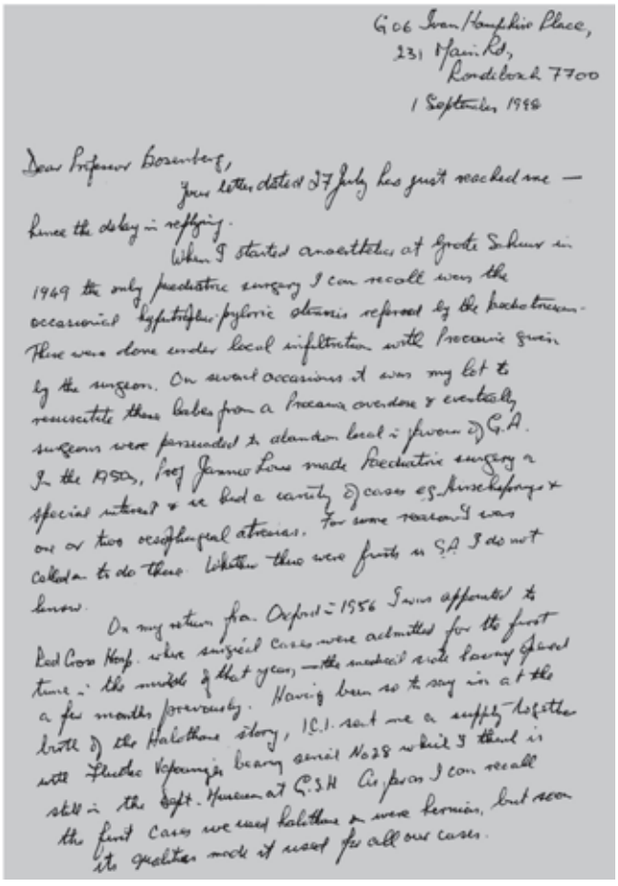
Pharmacological advances have been a major factor in improving outcome and are likely to continue as the secrets of cellular and genetic function at the molecular level are revealed. Prostaglandin E infusions are now used routinely to maintain the patency of the ductus arteriosus in cyanosed newborns with duct-dependent pulmonary perfusion. Surfactant has proved life-saving for many preterm infants, not only improving their chances of survival but also reducing the severity of pulmonary barotrauma and bronchopulmonary dysplasia. Inhaled nitric oxide, a potent evanescent pulmonary vasodilator, may be used to improve pulmonary perfusion in certain reversible pulmonary hypertensive conditions.

Drugs that support or augment myocardial function have also played a major role. For example, milrinone, an inodilator, increases cAMP independent of adrenergic receptor stimulation. In children, milrinone decreases systemic vascular resistance by 37% and pulmonary vascular resistance by 27%[23] and thus decreases right and left heart-filling pressures. The inodilator effects of milrinone are greater than dobutamine and nitroprusside and it has played a major role in decreasing the risk of low cardiac output syndrome after congenital heart surgery, particularly following single ventricle repair.[24]

Anaesthetic agents

Halothane was introduced into clinical practice in 1956. Arthur Bull was one of the first to use halothane anaesthesia in children when surgery began at Red Cross[8] (Fig. 2). Halothane has remained popular for use in children but is slowly being replaced by sevoflurane, a rapidly acting less pungent agent with less cardiovascular depression. Other agents (isoflurane, desflurane) are also less myocardial depressant. These agents are used for maintenance rather than induction of anaesthesia because they are too irritant for the paediatric airway.

The trend in modern anaesthesia is to develop rapid-onset, short-acting agents with rapid offset of action and fewer side-effects. Thiopentone has, until recently, been the mainstay of intravenous induction. Althesin and propanidid were popular for a while but were withdrawn because of the high incidence of anaphylactoid reactions to the cremophor vehicle. Propofol, a rapidly metabolised agent, has made a huge impact and has virtually replaced thiopentone. Propofol is much more forgiving on the paediatric airway. Many anaesthetists now



G 06 Ivan Humphris Place,
231 Main Rd,
Rondebosch 7700
1 September 1988

Dear Professor Rosenberg,
Your letter dated 27 July has just reached me — hence the delay in replying.
When I started anaesthetics at Groote Schuur in 1949 the only paediatric surgery I can recall was the occasional hypertrophic pyloric stenosis referred by the paediatricians. These were done under local infiltration with Procaine given by the surgeon. On several occasions it was my lot to resuscitate these babies from a Procaine overdose & eventually surgeons were persuaded to abandon local in favour of G.A.
In the 1950s, Prof James Law made paediatric surgery a special interest & we had a variety of cases eg. Atresia oesophagus & one or two oesophageal stenoses. For some reason I was called in to do these (whether there were fistula in G.A. I do not know).
On my return fm. Oxford in 1956 I was appointed to Red Cross Hosp. where surgical cases were admitted for the first time in the middle of that year, the medical side having been a few months previously. Having been so to say in at the birth of the Halothane story, I.C.I. sent me a supply together with Fluothane Vaporizer bearing serial No 28 which I think is still in the Dept. Museum at G.S.H. As far as I can recall the first cases we used halothane in were hernias, but soon its greater use was used for all our cases.

Fig. 2. The first page of a letter written by the late Professor Arthur Bull describing the start of anaesthesia at Red Cross Children's Hospital 50 years ago. Prof. Bull was the first to use halothane anaesthesia in children. Coincidentally the recipient had the honour of being examined by Prof. Bull for his DA in 1977.

facilitate intubation using propofol anaesthesia rather than suxamethonium. Pain on injection needs to be addressed.

More potent synthetic opiates (fentanyl, sufentanil, alfentanil and remifentanil) have threatened morphine's role as the gold standard.[25] These opiates have a different duration of action with fewer cardiovascular effects. Remifentanil is proving most popular for continuous infusions because of its short duration of action, rapid metabolism, easy titratability and predictable offset of action. In combination with propofol, total intravenous anaesthesia can easily be provided.

Cocaine, chloroprocaine and lignocaine were the only local anaesthetic agents available in the 1950s. Despite the fact that chloroprocaine is considered the safest agent for use in neonates, it proved a problem before the maximum safe dose had been established. 'My lot was to resuscitate these babies from procaine overdose while having a pyloromyotomy' (Arthur Bull, personal communication; Fig. 2, second paragraph). Lignocaine and chloroprocaine are too short-acting for practical use unless given by continuous infusion.

Bupivacaine, a longer-acting local anaesthetic agent, was introduced into clinical practice in 1963. With the re-introduction of the use of regional anaesthesia, bupivacaine became the most widely used local anaesthetic agent worldwide. Concerns about cardiotoxicity and the inability to resuscitate patients who had been exposed to a toxic dose stimulated research into less cardiotoxic agents. Ropivacaine, originally used as an anti-arrhythmic agent in the 1950s, and chirocaine (the pure laevo enantiomer of bupivacaine) were introduced in an attempt to overcome the problem in the late 1990s. Safe practice of regional anaesthesia remains dependent on the correct placement of the local anaesthetic agent in safe doses and careful monitoring irrespective of the agent used.

The alpha$_2$-adrenoreceptor agonists have found a new and ever-increasing role in modern anaesthesia because they have analgesic, anaesthetic and sympatholytic properties.[26] Clonidine, used for over 20 years to treat hypertension, is a mixed alpha$_2$/alpha$_1$-adrenoreceptor agonist. It modulates the nociceptive pathways at a number of sites and significantly reduces anaesthetic requirements. Clonidine is now regarded by some as the ideal premedicant[27] as well as an ideal adjuvant for both intravenous and neuraxial analgesia. It has been used for sedation in intensive care not only for its intrinsic sedative properties but also because it potentiates the sedative-hypnotic effects of other agents and blunts the sympathetic response thereby minimising fluctuations in blood pressure and heart rate. Dexmedetomidine, a relatively new, more highly selective and shorter-acting central alpha$_2$-adrenoreceptor agonist, is gaining in popularity.[28]

Airway

Establishment and maintenance of a secure and patent airway is vital to safe anaesthesia. The Schimmelbusch mask and black rubber masks of yesteryear have been replaced by transparent malleable cushioned facemasks – some even scented with fruit flavours. These are far more user-friendly both for the provider and the consumer. Perhaps the biggest single advance in airway management since the endotracheal tube has been the laryngeal mask airway (LMA). This supraglottic airway device, designed by Archie Brain, has all but replaced the endotracheal tube in some institutions. Other supraglottic devices have not made the same impact.

Red rubber latex endotracheal tubes were the bane of both children's and anaesthetists' lives. Airway occlusion by a herniated cuff, post-extubation stridor and laryngeal damage were common. Newer softer latex-free materials have allowed ventilatory support for longer periods with fewer complications. Low-profile cuffed endotracheal tubes, previously considered the realm of adult anaesthetists, are widely used in paediatric practice nowadays. This was initiated in the intensive care setting for children who were difficult to ventilate but has been used with increasing frequency in theatre to reduce pollution and to make the use of low-flow anaesthesia more economical.

Fibre-optic laryngoscopes and bronchoscopes, with or without video assistance, have revolutionised our ability to

visualise the dynamics of the normal and abnormal airways and to facilitate intubation in difficult situations. Once skill in the use of fibre-optics has been mastered, the only limitation to the ability to intubate a patient is size, i.e. the size of equipment relative to the patient airway.

Future

Computer and information technology, including telemetry, will continue to have a major influence on the development of all aspects of medicine. The development of new surgical techniques has, and will, mandate further advances in anaesthesia. Laparoscopic and minimally invasive surgery (cardiac, neurosurgery) have not only improved outcome but have presented new anaesthetic challenges, albeit a test of the anaesthetist's endurance in some situations. Further advances will dictate further change. Robotic surgery is already on the horizon.

However, economic constraints limit the pace of progress in less developed countries. The availability of sophisticated equipment and expensive drugs is limited, particularly in the public domain. This not only applies to anaesthesia but to all aspects of surgery and medicine. In anaesthesia advances in technology, for example, have allowed precise cannulation of central or peripheral vessels under ultrasound guidance, thereby reducing the risk of complications of these procedures. Ultrasound-guided peripheral and central nerve blocks[29] using smaller doses of local anaesthetic[30] can be performed with improved safety.

But the portable ultrasound machines and cerebral function monitors described earlier are expensive and are not likely to be freely available in the foreseeable future. Can safety and outcome be further improved within these budgetary constraints? This remains a challenge and an ethical dilemma.

Conclusion

Our predecessors have shown that violation of the fundamentals of good anaesthesia quickly produces a far graver condition of the patient. Attention to detail is essential if neonates, infants and children are to benefit from modern anaesthesia. An unresolved issue, particularly in the South African context where resources are relatively limited, is the relationship between anaesthetic-related morbidity and mortality and the competency of anaesthetists who care for children. Proper training and experience have been shown to have a positive impact on reducing both morbidity and mortality.[7]

While mortality remains a major outcome parameter, the rate at which this can be further reduced is very small. The focus of modern paediatric anaesthesia is to improve other harmful outcomes.[31] Effective pain management outside of the operating theatre remains a priority. The cause of awareness, previously not considered a problem but recently described in children, needs to be clarified. Other causes of anxiety and stress that have an impact on postoperative behaviour need to be addressed.

The Internet has made access to information easy, not only for ourselves but also for the parents, and sometimes even our patients. Parents have a better understanding of their child's problem and their expectations are raised. This presents a different challenge for the modern paediatric anaesthetist. Discerning questions must be answered with empathy. The aim should be to stay one step ahead in order to enhance the overall quality of paediatric anaesthesia.

The authors wish to thank Tom Voss and Roger Thornington for their input with regard to the earlier days at Red Cross, and Sarah Johnston for interviewing Tom Voss in his home in Sydney, Australia.

References

1. Leigh MD, Belton MK, eds. *Pediatric Anesthesia.* Macmillan Company, 1949.
2. Rees GJ. Anaesthesia in the newborn. *BMJ* 1950; 4694: 1419-1422.
3. Harrison GG. Deaths due to general anaesthesia at Groot Schuur Hospital, Cape Town (1956-1987): Part 1. Incidence. *S Afr Med J* 1990; **77**: 412.
4. Holzman RS. Morbidity and mortality in pediatric anesthesia. *Pediatr Clin North Am* 1994; **41**: 239.
5. Murat I. Mortality, morbidity and outcome. In: Bissonette B, Dalens BJ, eds. *Pediatric Anesthesia: Principles and Practice.* New York: McGraw-Hill, 2002.
6. Morray JP, Geiduschek JM, Haberkern C, *et al*. Anesthesia related cardiac arrest in children. *Anesthesiology* 2000; **93**: 6-14.
7. Van der Walt JH. Searching for the Holy Grail: measuring risk in paediatric anaesthesia. *Paediatr Anaesth* 2001; **11**: 637-641.
8. Louw JH. The first two decades of Red Cross Children's Hospital. *S Afr Med J* 1976; **50**: 1037-1047.
9. Bösenberg AT, Williams GD, Reddy D. Attitudes towards parental presence at induction of anaesthesia. *S Afr Med J* 1996; **86**: 664-667.
10. Anand KS. Relationships between stress responses and clinical outcome in newborns, infants, and children. *Crit Care Med* 1993; **21**(9 Suppl): S358-9.
11. Taddio A, Katz J, Ilersich J, *et al*. Effect of neonatal circumcision on pain response during subsequent routine vaccination. *Lancet* 1997; **349**: 559-603.
12. Lonnqvist PA, Morton PA. Postoperative analgesia in infants and children. *Br J Anaesth* 2005; **95**: 59-68.
13. Bosenberg AT. Epidural analgesia for major neonatal surgery. *Paediatr Anaesth* 1998: **8**(6); 479-483.
14. Bosenberg A, Thomas J, Cronje L, *et al*. Pharmacokinetics and efficacy of ropivacaine for continuous epidural ropivacaine infusion in neonates and infants. *Pediatr Anesth* 2005; **15**: 739-749.
15. Bosenberg A, Thomas J, Lopez T, *et al*. Plasma concentrations of ropivacaine following a single shot caudal of 1, 2 or 3mg.kg in children. *Acta Anaesth Scand* 2001; **45**: 1276-1280.
16. Giaufre E, Dalens B, Gombert A. Epidemiology and morbidity of regional anaesthesia in children: a one year prospective survey of the French language Society of Pediatric Anesthesiologists. *Anesth Analg* 1996; **83**: 904-912.
17. Albertyn R. The measurement of procedural pain and anxiety in paediatric burns: the new BOPAS method. PhD thesis, UCT, 2002.
18. Thomas JM, Rode H. *A Practical Guide to Paediatric Burns*. Cape Town: SAMA Health and Medical Publishing Group, 2006.
19. Hoffman GM, Ghanayem NS, Tweddell JS. Noninvasive assessment of cardiac output. *Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu* 2005; 12-21. Elsevier, 2005: 12-21.
20. Austin EH, Edmonds HL, Auden SM, *et al*. Benefit of neurophysiological monitoring for pediatric cardiac surgery. *J Thorac Cardiovasc Surg* 1997; 114: 707-717.
21. Smythe PM, Bull A. Treatment of tetanus neonatorum with intermittent positive-pressure respiration. *BMJ* 1959; **2:** 107-113.
22. Voss TJ. The adaptation of ventilators for anaesthesia, with particular reference to paediatric anaesthesia. *S Afr Med J* 1967; **41:** 1079-1082.
23. Chang AC, Atz AM, Wernovsky G, Burke RP, Wessel DL. Milrinone: systemic and pulmonary hemodynamic effects in neonates after cardiac surgery. *Crit Care Med* 1995; **23:** 1907-1914.
24. Hoffman TM, Wernovsky G, Atz AM, *et al*. Efficacy and safety of milrinone in preventing low cardiac output syndrome in infants and children after corrective surgery for congenital heart disease. *Circulation* 2003; **107:** 996-1002
25. Lloyd-Thomas AR. Modern concepts of paediatric analgesia. *Pharmacol Ther* 1999; **83:** 1-20.
26. Sanderson PM, Elringham R. The role of clonidine in anaesthesia. *Hosp Med* 1998; **59:** 221-223.
27. Lonnqvist PA, Habre W. Midazolam as premedication: Is the emperor naked or just half-dressed? *Pediatr Anesth* 2005; **15:** 263-265.
28. Coursin DB, Maccioli GA. Dexmedetomidine. *Curr Opin Crit Care* 2001; **7:** 221-226.
29. Willschke H, Marhofer P, Bosenberg A, *et al*. The use of ultrasonography for ilioinguinal/iliohypogastric nerve blocks in children. *Br J Anaesth* 2005; **95:** 226-230.
30. Willschke H, Bosenberg A, Marhofer P, *et al*. Ultrasonographic-guided ilioinguinal/iliohypogastric nerve block in pediatric anesthesia: what is the optimal volume? *Anesth Analg* 2006; **102:** 1680-1684.
31. Thomas J. Brute force or gentle persuasion? *Paediatr Anaesth* 2005; **15:** 355-357.

Accepted 25 July 2006.