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## SURGICAL CHALLENGES IN LIMPOPO PROVINCE, SOUTH AFRICA

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***Cover image.*** *Located just outside of Polokwane, the Polokwane Game Reserve is one of the largest municipal game reserves in the country. It conserves the Pietersburg Plateau false grassland, comprising open savannah and themeda grass with acacia trees. The reserve is home to more than 21 species of wildlife, with frequent sightings of ostrich, impala, wildebeest, zebra, nyala, sable antelope, eland and giraffe.*

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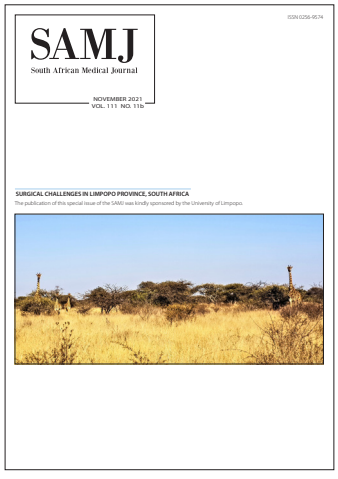
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# Surgical challenges in Limpopo

Surgical challenges in rural areas are very well documented. The vast geographic area covered by the province of Limpopo is no exception. What is different in Limpopo is that the provincial administration has demonstrated a great interest in and commitment to developing excellent healthcare for all its citizens, albeit from a rather low base.

Recently it has supported the growth and diversification of the various surgical services in the province. New surgical departments are being established, while existing departments are undergoing significant growth.

One of the key components of raising the bar for surgical specialties is close collaboration with the University of Limpopo to advance this academic project.

The Medical School of Limpopo is the latest established and newest of the nine medical schools in South Africa (SA). Needless to say, tremendous challenges had to be overcome in establishing such a medical school. In spite of humble beginnings, the medical school currently graduates ~100 medical doctors annually. About half of these are 'homegrown' MB ChBs; the other half are graduates from the Nelson Mandela – Fidel Castro Medical Collaboration Programme. The latter group undertake their first four - six undergraduate study years in Cuba (and in the Spanish language!), after which they come to Limpopo in order to be introduced to and acquainted with SA clinical medicine. The University of Limpopo is very proud of the progress made over the last decade, the Health Professions Council of South Africa having recently (August 2021) finalised their five-yearly visitation to the University of Limpopo and accredited the Limpopo medical undergraduate training programmes.

In the light of these developments, we judged it timely and appropriate to document a number of achievements of the Department of General Surgery at the University of Limpopo. This special edition of the *SAMJ* consists of three parts:

The *first part* provides a brief historical overview of the Medical School and the Department of Surgery in Limpopo.[1]

The *second part* consists of four research reports, recently undertaken in the Department of General Surgery in Polokwane and Mankweng, and all pertaining to the growth of the academic project at the University of Limpopo. The first two articles review the number of theatre procedures performed in Limpopo Province during 2019 and the number of patients admitted to the surgical specialties during April 2021.[2,3] This is followed by a two-year review of patients seen at the Pietersburg and Mankweng hospitals breast cancer clinic and a review of the profile of molecular subtyping of breast cancer and clinicopathological features.[4,5]

Finally, the *third part* consists of a number of interesting surgical case reports, to provide an indication of the length and depth of surgical challenges in Limpopo Province. The first three case reports pertain to special cases of breast cancer.[6-8] These are followed by two unusual cases: a large retrosternally extended thyroid[9] and a case of a missed diaphragmatic hernia.[10] The last five cases are all interesting trauma cases, including two cases of paediatric trauma.[11]

We hope and trust these will enlighten the reader about this exciting and fast-growing surgical department in rural South Africa!

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# A brief overview of the past, present, and future of the Department of General Surgery at Pietersburg and Mankweng hospitals in Limpopo Province, South Africa

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## Past

It is no secret that there has been a paucity of medical care facilities in rural areas. In 1978, the Medical University of South Africa (Medunsa) was established to alleviate this situation by training black doctors, dentists, and other health professionals – at that time over 90% of medical personnel were white.[1]

Ga-Rankuwa Hospital (currently the Dr George Mukhari Hospital) was established in 1973 but was converted to an academic centre and the university's first teaching hospital in 1978, and at the time it consisted of 39 wards and had >2 000 beds, making it the second largest hospital in the southern hemisphere.

Although academic publications were limited, the Department of Surgery established its name in the fields of thyroid and peptic ulcer disease.

Under significant duress and as part of a nationwide restructuring, Medunsa entered a forced but brief marriage with the University of the North (currently the University of Limpopo), whereby both Pietersburg and Mankweng hospitals became established academic satellite hospitals. At that time, there were only 2 general surgeons working in Polokwane; the other surgical specialties were not represented.

Pietersburg Hospital dates to the Anglo-Boer war, when a military hospital consisting mainly of corrugated iron was established to treat soldiers. Women and children were accommodated in their own wards at the hospital. A permanent and well-equipped hospital was finally built and opened in 1927. The geographic challenges were recognised early and after some lobbying, the International Red Cross donated the first ambulance, a 1929 model Chevrolet (Fig. 1).

The current Pietersburg Hospital opened in 1978, followed by the opening of Mankweng Hospital in 1988. There have been many illustrious heads of department in General Surgery, but Prof. Z Machowski (1996 - 2007) deserves special mention. He was responsible for elevating the Department of General Surgery in a truly academic fashion, focusing on a rigorous teaching and learning programme, and a strong research and scientific publication count. He published over 50 articles over the duration of half a century from 1967 - 2017.[2,3]




*Fig. 1. A picture of the first ambulance in South Africa, a 1929 model Chevrolet, donated to Pietersburg Hospital by the International Red Cross.*



*Fig. 2. The newly signed-off Limpopo Academic Health Complex. Picture courtesy of Hospital Design Group and Sakhiwo Health Solutions.*

## Present

Currently, the Limpopo Academic Complex has 6 full-time specialists in general surgery, 2 foreign-qualified consultants (MO3), 4 surgical registrars, 13 medical officers, and 16 interns. This department performs ~2 000 surgical procedures and ~4 500 surgical consultations annually. It also performs over 500 minor procedures in a day-case unit, receives referrals from 43 other hospitals and drains a large geographic area in Limpopo Province with over 6 million inhabitants. In addition, it provides teaching for registrars and general doctors, and it performs research and outreach for all Limpopo's hospitals. Over the last 10 years, it published 15 peer-reviewed academic manuscripts and managed to deliver over 50 academic papers at national and international congresses.

## Future

Plans to build a brand-new academic complex have been approved;

the new complex will harbour 16 state-of-the-art operating theatres and hopefully will accommodate at least 10 full-time general surgeons (Fig. 2). The Department of General Surgery has recently submitted its application to the Health Professional Council of South Africa to double the number of registrars from 8 to 16. We are hopeful that this request will be granted, paving the way for Polokwane to become a fertile ground for training a new generation of general surgeons in South Africa. A new medical school to be constructed on site next to the hospital complex is currently planned by the University of Limpopo.

**Declaration.** None.

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**Conflicts of interest.** None.

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# Audit of surgical specialty patients and beds at Pietersburg Hospital, Limpopo Province, South Africa in 2021

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**Background.** While the absolute number of hospital beds is usually discussed, adequate utilisation of beds is a far better instrument to measure departmental efficiency.
**Objective.** To measure the number of beds for each surgical specialty in Pietersburg Hospital as well as the average length of stay (LoS) to compare bed utilisation.
**Method.** We conducted a 1-day descriptive cross-sectional audit of patients admitted to surgical wards on 21 April 2021 at Pietersburg Hospital.
**Results.** There were huge discrepancies in the number of beds per surgical specialty as well as the LoS. Over one-third of surgical beds were occupied by patients waiting for either a computed tomography scan, surgical procedure, or transfer.
**Conclusion.** There is a need to address the functioning of the surgical specialties with regards to the number of beds allocated as well as the ideal average length of stay.

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Hospital beds are in great demand all over the world.[1] Hospital beds are expensive; in South Africa (SA), the ballpark figure per bed per year is ZAR1 million for secondary hospitals and ZAR2 million per year for academic hospitals. Hospital managers are therefore generally pressurised to keep the total number of beds as low as possible. Although the absolute number of beds is usually discussed, the precise utilisation of the beds is often neglected. This is a huge oversight if patients are kept unnecessarily admitted, and drives the costs enormously. There are obvious competing demands for beds by the non-cutting and cutting (surgical) specialties, and decisions around this are typically political and philosophical.

According to the World Health Organization, ~2 billion people around the world are estimated to have inadequate access to surgical care.[2] Surgical care is an integral part of health systems worldwide. However, delays due to multiple transfers of surgical patients are common, even in developed countries.[3-5] Pietersburg Hospital (PH) is a teaching hospital for the University of Limpopo, which is 31.5 km east of Polokwane city, the provincial capital. The hospital serves as the referral hospital for regional and district hospitals in the province. The hospital has 196 beds set aside for all adult surgical patients. Most of the beds (128) are reserved for male patients, while female patients have 68 beds. Various surgical specialties are responsible for bed allocation.

The audit reported in the present study is the first to describe the actual surgical specialty bed utilisation and the average length of stay (LoS) at a tertiary hospital in Limpopo Province, SA. In this hospital, patients are allocated to wards where beds are available, even if it is not the correct unit under which the patient should receive treatment. In an ideal situation, patients should be followed up and transferred to the correct ward as soon as a bed becomes available. If not, beds are unnecessarily occupied and this creates delay for those patients still awaiting hospital care and clinical procedures.[6] Patients are often denied acute surgical management due to unavailability of beds. Shortage of beds also affects the elective cases and surgical slates. If there are insufficient beds, procedures are cancelled. A shortage of intensive care unit beds alone is often the reason for cancellation of complicated surgical cases. PH has an ideal target of 77% bed utilisation rate and 7 days average LoS. However, the hospital consistently exceeds the bed utilisation rate target. We therefore embarked on an audit of surgical specialties with regards to the number of beds and the duration of hospital admission at PH. We intend that the definite bed utilisation for different surgical specialty will guide the hospital management to allocate the limited available resources to service patients more efficiently.

## Methods

We conducted a 1-day descriptive cross-sectional audit of patients admitted to surgical wards on 21 April 2021. All adult inpatients records were reviewed. Records belonging to a patient admitted to any of the studied surgical disciplines (general surgery, cardiothoracic, orthopaedic, neurosurgery, ear, nose and throat (ENT), maxillofacial, plastic surgery and urology) were included in the audit. Medical, gynaecological and obstetrics patients admitted to surgical wards were excluded from the audit. In addition, all children ≤12 years of age were excluded for the audit. Patient files were reviewed by the research team and a data collection sheet was used to record data from the files. Ward, gender, age, surgical discipline, and diagnosis of patients were recorded. Furthermore, inpatient days before the operation, inpatient postoperative days as well as the total LoS in hospital were documented for those patients who were operated on the day of audit. The collected data were captured using Microsoft Excel (Microsoft Corp., USA). The data were analysed using STATA software (version 16; STATA Corp., USA). Continuous variables were expressed as mean and standard deviation (SD). The categorical variables were described as proportions.

## Results

A total of 142 adult surgical patients were entered into the data collection forms during the audit period. Other surgical beds were either occupied by medical or paediatric patients. The patients admitted to the surgical wards during the 1-day audit are described in Table 1. The mean age of all the patients who were admitted was 42 years. Most of the patients were males (64%). More than one-quarter of the patients admitted to the surgical wards (27%) required orthopaedic surgical attention. The Department of Maxillofacial Surgery had the lowest number of inpatients (0.7%).

### Percentage operated

Although the Department of Orthopaedic Surgery had the highest number of admissions, only 11.9% of their patients underwent surgery. Almost 60% of their patients were still waiting for surgery on the day of audit (Fig. 1). We also calculated the percentage of surgical patients that were already operated on in the various surgical specialties. The Department of General Surgery had the highest number of operated patients (30%), followed by the Department of Neurosurgery (21%), and the departments of Plastic, Cardiothoracic and ENT conducted the same number of operations (4.8%) (Fig.2).

**Table 1. Descriptive summary of patients admitted to the surgical wards (*N*=142)**

| Variables | *n* (%)* |
|---|---|
| Gender | |
| Males | 91 (64) |
| Females | 51 (36) |
| Mean age, years | 42 |
| Surgical specialty | |
| Orthopaedic | 39 (27.8) |
| Neurosurgery | 30 (21) |
| General surgery | 27 (19) |
| Urology | 15 (10.6) |
| Cardiothoracic | 13 (9) |
| Plastic | 5 (3.5) |
| ENT | 4 (2.8) |
| Maxillofacial | 1 (0.7) |
| Multidisciplinary | 8 (5.6) |
| Operated patients | |
| Orthopaedic | 5 (11.9) |
| Neurosurgery | 9 (21.4) |
| General surgery | 13 (30.9) |
| Urology | 4 (9.5) |
| Cardiothoracic | 2 (4.8) |
| Plastic | 2 (4.8) |
| ENT | 2 (4.8) |
| Maxillofacial | 0 |
| Multidisciplinary | 5 (11.9) |
| Average LoS, days | |
| Orthopaedic | 28 |
| Neurosurgery | 16 |
| General surgery | 7 |
| Urology | 8 |
| Cardiothoracic | 10 |
| Plastic | 20 |
| ENT | 5 |
| Maxillofacial | 9 |
| Multidisciplinary | 29 |

ENT = ear, nose, and throat; LoS = length of stay.
*Unless otherwise specified.

### Average length of stay

The average LoS differed significantly per specialty, with the shortest being 5 days for ENT, and the longest being 28 days in the Department of Orthopaedic Surgery. Multidisciplinary (complex) patients had the longest LoS (29 days) in hospital admission duration (Fig. 3). Plastic surgery and neurosurgery also had long average LoS (20 and 16 days, respectively), while general surgery, urology, cardiothoracic and maxillofacial surgery patients had average LoS between 7 - 9 days.

### Reasons for extended hospital stay

We found that 46 patients were waiting for operations and half of them (50%; *n*=23) were orthopaedic patients (Fig. 4). Urology, general surgery, neurosurgery, plastic surgery, ENT, and multi-disciplinary surgical patients shared the remaining 50%. Seven patients were waiting for computed

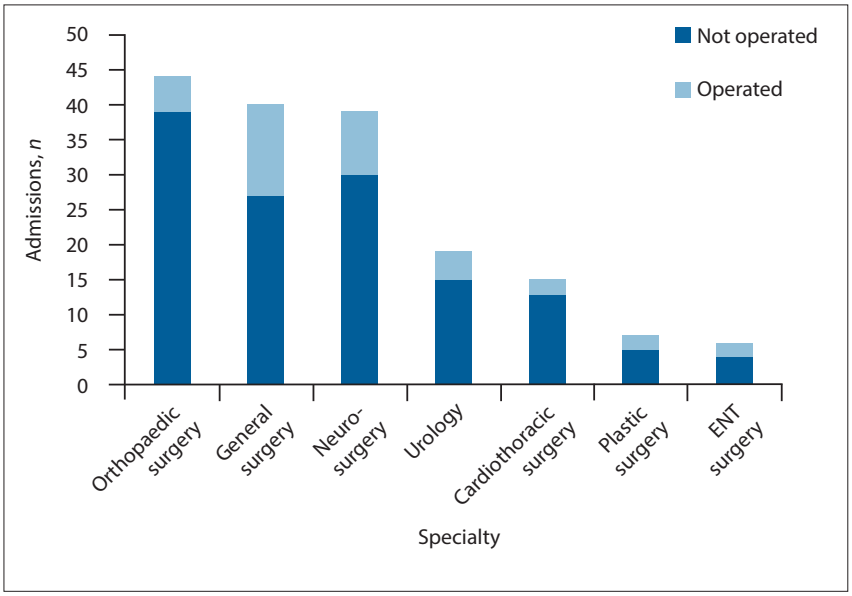



*Fig. 1. Total admissions and operated patients per specialty. (ENT = ear, nose and throat.)*

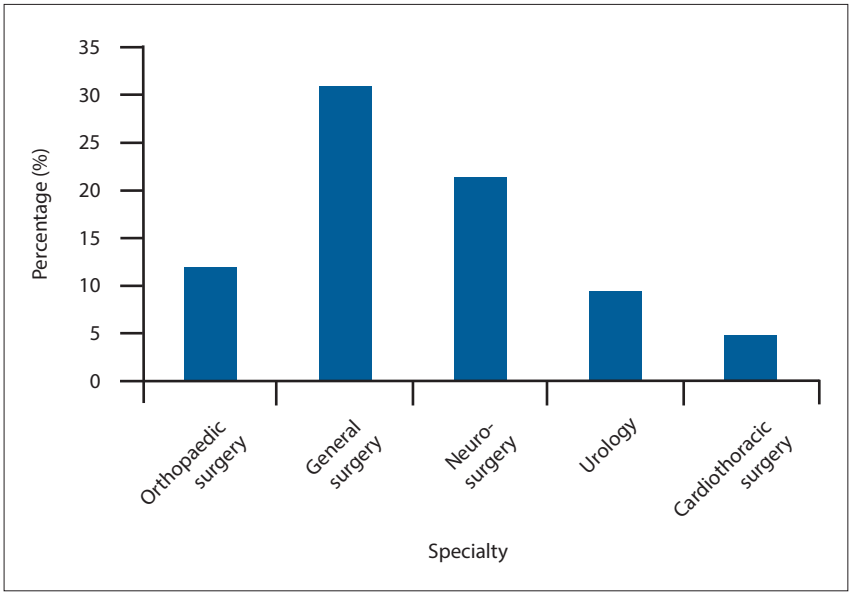



*Fig. 2. Percentage of patients operated per specialty.*

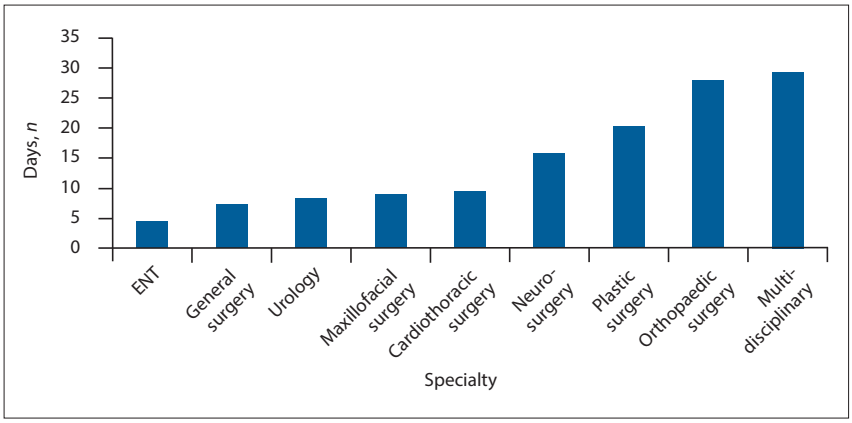



*Fig. 3. Average length of stay per surgical specialty. (ENT = ear, nose and throat.)*

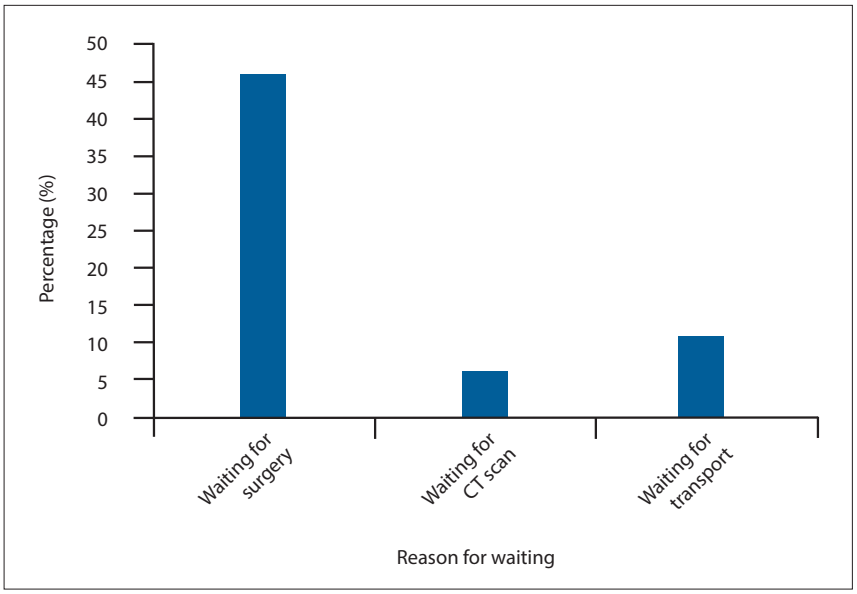



*Fig. 4. Reasons for surgical patients extended hospital stay.*

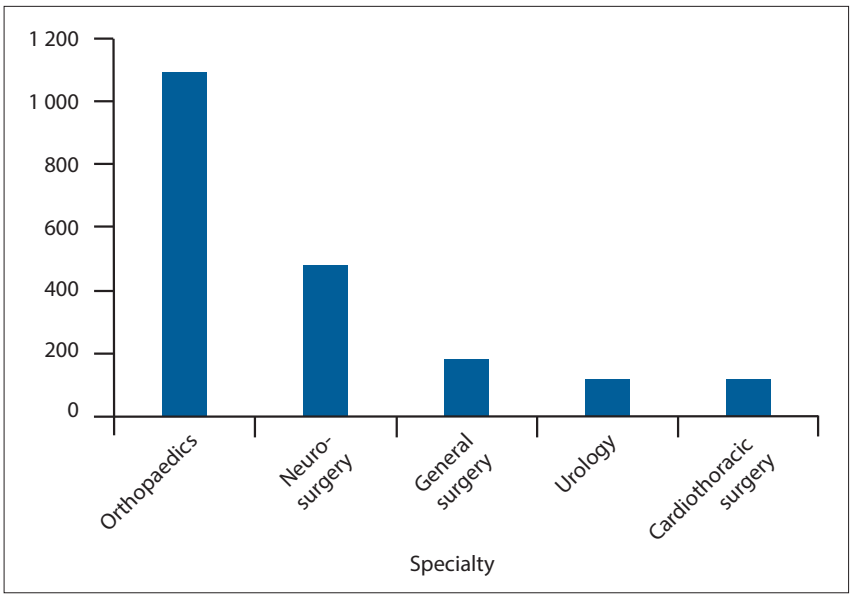



*Fig. 5. Surgical admissions hospital bedload.*

tomography (CT) scans, four of them were in general surgery and two in urology. Less than a quarter (20%) of neurosurgical admissions required rehabilitation. We also found that 11 patients were discharged but could not go home because they were waiting for transport.

### Hospital bedload

We calculated the total hospital bedload of the various departments by multiplying the number of inpatients and the average LoS for the bigger surgical disciplines. The total hospital bedload of the Department of Orthopaedics was almost 6 times higher than the bedload of the Department of General Surgery (Fig. 5). The Department of Neurosurgery also had a bedload more than double that of the Department of General Surgery.

## Discussion

The number of male patients was significantly higher than the number of female patients. This may reflect community disease but is more likely to reflect a gender bias in surgical admissions. Similar predisposition was reported in KwaZulu-Natal, where 59.7% of the surgical load constituted male patients.[7] There is a great disproportion in the number of bed occupancies per surgical discipline. The number of surgical beds per specialty is a function of the number of patients presenting to the specialty and the LoS. The LoS is obviously influenced by several factors such as the time duration for work-up, waiting time for investigations such as CT scanning, the availability of theatres to perform the operations; but ultimately, it is a measure of departmental efficiency.[8] We found a substantial imbalance regarding the allocation of surgical beds to the various specialties. The greatest surgical bed occupancy was in the Department of Orthopaedic Surgery ($n$=39). In addition, patients admitted for orthopaedic attention had the longest average LoS (28 days), with some staying up to 57 days without any remarkable work-up. A study in Nepal[9] reported that an average LoS for orthopaedic inpatients at a tertiary hospital was 10.5 days.[9] A SA report on the burden and profile of spinal pathology in Cape Town recorded a median hospital stay of 19 days.[10] The average LoS was 7 days in the Department of General Surgery. We also found that half (50%) of the total surgical inpatients waiting for operations were from orthopaedic surgery. General surgery (30.9%) and neurosurgery (21%) contributed the highest proportions of the operated patients.

The calculated total hospital bedload per surgical department indicates the significant inequity regarding hospital beds per surgical discipline, reflecting the inefficiency and

cost of surgical beds. While these numbers may raise alarms for hospital clinical managers, we should not forget that several surgical disciplines are facing daily challenges. Not only does the number of specialists vary significantly per discipline, but the greatest challenge is the availability of theatre time. One of the greatest challenges has been the absence of a surgical emergency theatre. This has resulted in having to share the emergency theatre with the Department of Obstetrics and Gynaecology. In addition, if emergency cases fail to be operated during the night and after hours, the consequence is that the elective surgical slates are crashed, resulting in inefficient hospital bed utilisation, driving up cost and frustration for patients, doctors, and nurses.

## Conclusion

Surgical bed utilisation was most ineffective for orthopaedic and neurosurgery patients. Orthopaedic patients waited for theatre space longer than all other surgical specialties. The Department of General Surgery had the average LoS that was within the prescribed hospital protocol of 7 days. Effective bed management may be improved by the appointment of a bed manager to optimise bed utilisation and minimise unnecessary admissions. Based on this audit, we further recommend performing regular 6-monthly audits on the utilisation of surgical beds and have a fixed allocation of surgical beds according to the size and theatre slate allocation of the various surgical specialties.

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# Audit of surgical procedures in regional and central hospitals in Limpopo Province, South Africa

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**Background.** There is a paucity of data on the functioning and surgical procedures performed in rural hospitals in South Africa.
**Objective.** To determine the category of procedures performed at regional and tertiary hospitals in Limpopo Province, South Africa.
**Method.** We conducted a retrospective analysis of surgical procedures performed in the regional and tertiary hospitals in Limpopo Province during a 1-year period from 1 March 2019 to 29 February 2020.
**Results.** A total of 24 263 surgical procedures were performed during the study period. More than half of all cases (50.4%; *n*=12 252) were operated on at the tertiary hospitals while regional hospitals performed the remaining 12 011 operations.
**Conclusion.** There is a great necessity to alleviate the central hospitals from the bulk of surgical procedures.

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Limpopo Province is one of the most surgeon-deprived provinces in South Africa (SA). This represents a major challenge for healthcare, particularly for patients who require surgical procedures. Besides the serious shortage of surgical specialists, the vast geographic outlay of the province makes it very difficult for patients to reach a hospital where surgical procedures are offered. This results in delays in seeking medical attention, and in patients often arriving at very late stages of disease, further complicating effective surgical management. Surgical care is considered to be an integral part of health systems worldwide and these delays are tragic.[1]

The Limpopo Province covers an area of 125 754 km$^2$ and is populated by 5.98 million people.[2] The province is subdivided into five districts: Capricorn, Vhembe, Mopani, Sekhukhune and Waterberg. The majority of people in the province reside in rural areas. Each district has one regional hospital and a number of district hospitals. The province has two tertiary hospitals which are 30 km apart. The tertiary hospitals are in Capricorn district. One of the two tertiary hospitals is at Polokwane, the provincial capital.

Auditing surgical services provision is important, especially in rural provinces like Limpopo, where the minimal available resources are targeted at operational services, depriving local research activities. Auditing allows for improvement in the quality of services offered and identification of service areas that need improvement.[3] A study conducted in the Pietermaritzburg tertiary hospital found that 30% of their workload comprised operations that could be performed at a district level.[4] This finding concurs with the observation made by Bhuiyan and Mavhungu,[5] namely that hernia repairs and amputations were found to be the most common procedures performed on a Saturday list at Pietersburg Hospital (PH).

The provincial Department of Health has been trying to be proactive in launching a number of programmes aimed at alleviating the shortage of surgeons in the province. There is the surgical outreach programme where surgical specialists visit regional or district hospitals in a group to assist local surgeons to reduce the waiting list for patients who require surgery. Specialists involved include reproductive medicine specialists, urogynaecological specialists, plastic and reconstructive surgeons, paediatric surgeons, ENT surgeons, general surgeons, radiologists, maxillofacial surgeons, orthopaedic surgeons, urologists, ophthalmologists, cardiologists and anaesthetists.

The other programme (National Health Insurance grant AOS001/19/20) consists of accreditation of service providers for the provisioning of specialised clinical and surgical services for the Limpopo Department of Health for a period of 36 months. A specific grant was allocated for the 2019 - 2022 period to address surgical backlog in the province utilising private healthcare institutions.

## Methods

We conducted a retrospective descriptive record review of patients admitted to the regional and tertiary hospitals for operations in the period 1 March 2019 - 29 February 2020. The two academic hospitals are Pietersburg and Mankweng hospitals (PH and MH), and the five regional hospitals are Letaba, Mokopane, Philadelphia, St Rita's and Tshilidzini. All patients admitted to these hospitals for operations during the audit period were included in the present study. The operations included general surgery, nephrology, orthopaedics, urology, neurosurgery, ear, nose and throat (ENT), cardiothoracic, plastic and reconstructive, ophthalmology, maxillofacial, gynaecology, obstetrics and paediatric surgery. Theatre registers were used as a starting point for data collection. A data collection sheet designed for the audit was used to collect information from the theatre registers. A password-protected database in Excel (Microsoft Corp., USA) was created to record the information regarding operated patients. The integrity of the data was verified through an evaluation of internal consistency and assessment of missing data.

The statistical package in Excel (Microsoft Corp., USA) was used for data analysis. The categorical variables were described as proportions.

# Results

## General results

A total of 24 263 surgical procedures were entered into the database during 2019 - 2020. The surgical patients admitted and operated on for the 1-year period are shown in Fig. 1. More than half of the patients (50.4%; *n*=12 252) were admitted and operated on at the tertiary hospitals while regional hospitals performed 12 011 operations. Ophthalmology comprised over 41% (*n*=2 301) of the surgical workload at MH (Table 1).

## Obstetrics and gynaecology

Obstetrics and gynaecology comprised the majority (44.5%; *n*=10 768) of the total operations. Regional hospitals performed 72% of the obstetrics and gynaecology procedures (Fig. 2).

## General surgery

We found that 4 335 patients were operated in the various departments of general surgery. Tertiary hospitals contributed half (50%; *n*=2 092) of the procedures performed in general surgery (Fig. 3). The majority (50.1%) of general surgery patients admitted and operated at the regional hospitals were from Letaba Hospital. Tshilidzini Hospital performed fewer operations than Letaba Hospital during 2019 - 2020. Mokopane (3.8%) and Philadelphia (0.8%) contributed a relatively small number of operations (*n*=197; Fig. 3).

**Table 1. Surgical procedures performed at tertiary hospitals**

| | Mankweng Hospital, *n* | Pietersburg Hospital, *n* |
|---|---|---|
| General surgery | 973 | 1 155 |
| Gynaecology | 460 | 816 |
| Orthopaedic | 1 031 | 1 021 |
| Urology | 2 | 420 |
| ENT | 0 | 498 |
| Neurosurgery | 42 | 583 |
| Plastic surgery | 187 | 157 |
| Maxillofacial | 68 | 150 |
| Obstetrics | 231 | 1 494 |
| Cardiothoracic | 62 | 230 |
| Nephrology | 0 | 130 |
| Paediatric surgery | 291 | 19 |
| Ophthalmology | 2 301 | 0 |
| Total | 5 576 | 6 676 |

ENT = ear, nose and throat.

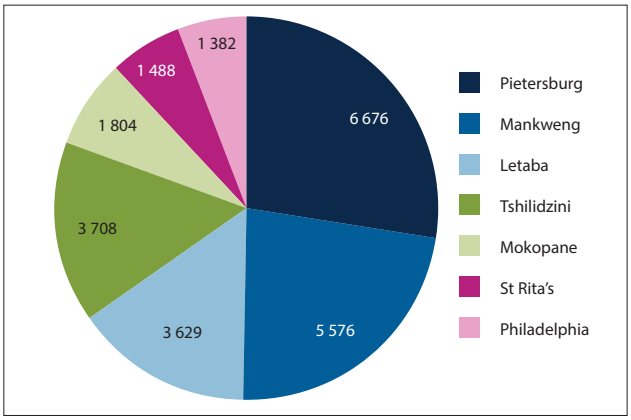



*Fig. 1. Total number of surgical procedures performed in Limpopo regional and academic hospitals from 1 March 2019 to 29 February 2020.*

## Orthopaedic surgery

We found that 4 056 of patients who were operated required orthopaedic attention. Tertiary (*n*=2 055) and regional (*n*=2 001) hospitals contributed nearly the same number of procedures during the audit period. Mokopane and Tshilidzini hospitals contributed more than half (52%) of the operations performed in regional hospitals, and Philadephia Hospital contributed only 13.7% (Fig. 4).

## Analysis of surgical procedures performed at the tertiary hospitals

Although the two tertiary hospitals have almost the same number of special units, nearly the same number of beds and theatres, the majority of operations were performed at PH (54%; *n*=6 676). Ophthalmology contributed more than 41% of operations performed at MH during the audit period. MH is one of only two facilities in the province rendering ophthalmology services.

# Discussion

This audit presents the distribution of surgical procedures performed in the rural province of Limpopo during 2019 - 2020. Over half (50.4%) of the operations were of patients admitted and managed at tertiary hospitals (Fig. 1). This is way above figures recorded in other studies conducted in SA. A study by van Straten[6] reported that 29% of patients discharged from Charlotte Maxeke Johannesburg Academic Hospital Department of Surgery were suitable for secondary level

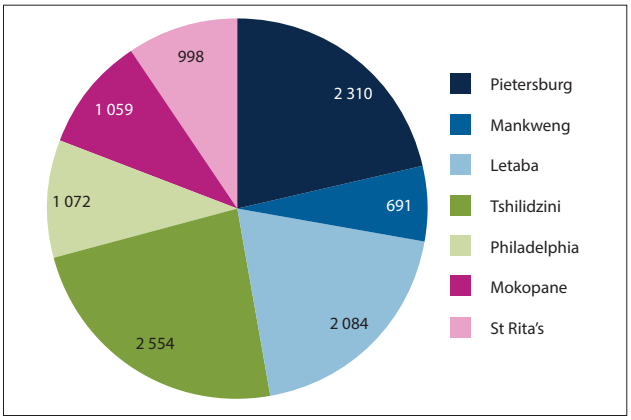



*Fig. 2. Total number of surgical procedures performed in the general surgical departments in regional and academic hospitals in Limpopo Province from 1 March 2019 until 29 February 2020.*

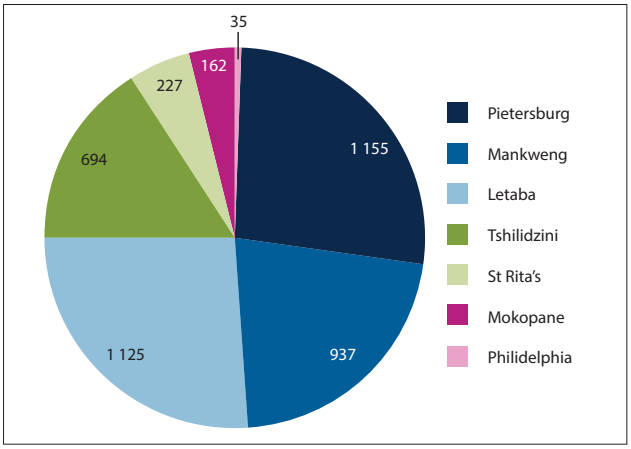



*Fig. 3. Total number of surgical procedures performed in the obstetrics and gynaecology departments of regional and academic hospitals in Limpopo Province from 1 March 2019 until 29 February 2020.*

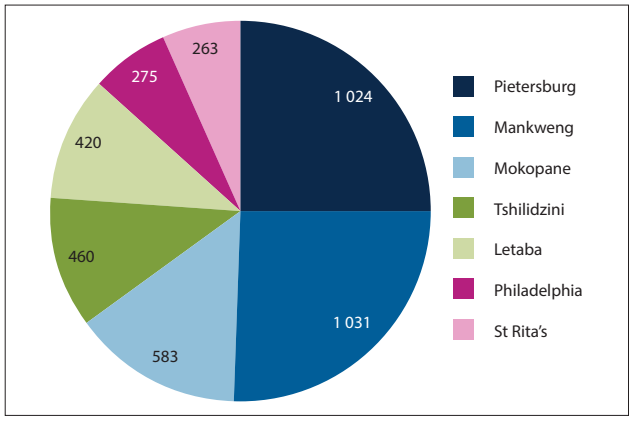



*Fig. 4. Total number of surgical procedures performed in the orthopaedic surgical departments in regional and academic hospitals in Limpopo Province from 1 March 2019 until 29 February 2020.*

care.[6] Lack of skills and resources in the public healthcare system has a tendency to result in upward referral due to local constraints.[4] This is particularly the case in surgery, which requires intricate healthcare systems to function more adequately. All operations are highly complex procedures, where the infrastructure (physical theatres) and the multitude of personnel (cleaners, nurses, anaesthetic staff and surgeons) all have to be fine-tuned to perfection to accommodate the patient.[1] Inappropriate upward referral of surgical patients is definitely not cost effective, since tertiary beds are approximately twice as expensive to run compared with beds in regional hospitals.[5]

More than 40% of surgical procedures performed at the tertiary and regional hospitals during the study period were obstetrics and gynaecology. The proportion of obstetrics and gynaecology operations was consistently higher for all regional hospitals, and a total of 72% of all obstetrics and gynaecology procedures were performed in regional hospitals. More than one-third of obstetrics and gynaecology procedures were performed at Tshilidzini Hospital. St Rita's Hospital contributed a very small number of gynaecology operations.

Although PH and MH are both tertiary hospitals of the same size (500 beds, 8 theatres each), PH performed more surgical procedures than MH. The majority of the operations performed at MH were for ophthalmology patients. PH and MH share nearly the same orthopaedic workload.

One of the major findings of this study was that 50% of the general surgery procedures were performed at tertiary hospitals. It was further noted that one regional hospital (Letaba) performed more than half of the total number of operations in regional hospitals, indicating the great disparity in number of operations performed in regional hospital. To empower regional hospitals to perform more cost-effective operations, an in-depth audit is required to identify constraints encountered by some regional hospitals. Philadelphia and St Rita's hospitals consistently contributed the lowest number of procedures for all surgical disciplines.

One of the greatest challenges in dealing with the large number of surgical patients in the central hospitals has been the absence of a dedicated surgical emergency theatre. This has resulted in the surgical departments having to share the emergency theatre with the departments of obstetrics and gynaecology. In addition, if emergency cases fail to be operated during the night and after hours, the unfortunate consequence has been that elective surgical theatre slates are crushed, resulting in very frustrated surgical patients and surgeons as well as increased inefficient hospital bed utilisation. The costs escalate, frustrating the patients, doctors and nurses.

## Conclusion

The present study describes the distribution of surgical workload in Limpopo Province, SA. It is clear that the tertiary institutions perform most of the operations, the majority of which should ideally be performed in regional hospitals. The most common surgical procedures performed are obstetrical and gynaecological. One tertiary hospital (MH) is overloaded with ophthalmology procedures. Although one hospital performed a significant number of general surgery operations (Letaba Hospital), this study indicates that there is a great necessity to alleviate the central hospitals from the bulk of surgical procedures. Key to the solution will be to staff the regional hospitals with adequately trained personnel as well as provide the relevant infrastructure and medical equipment to perform these surgical operations.

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# Profile of patients seen at Pietersburg and Mankweng breast cancer clinics in Limpopo

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**Background.** Breast cancer is the most common cancer diagnosed among women worldwide. It is the most prevalent cancer and leading cause of death among South African (SA) women. The increasing incidence of breast cancer is a major health concern. Until now, the distribution of breast cancer demography, stage at first presentation, and histological characterisation have not been studied in Limpopo Province, SA.
**Objectives.** To record the demographic profile of breast cancer patients, to report the stage at the time of presentation and to characterise the pattern of malignant disease in Limpopo, SA.
**Methods.** We conducted a retrospective descriptive review of the records of patients managed at Pietersburg Hospital oncology and Mankweng Hospital breast cancer clinics during the period 1 March 2015 - 28 February 2017. Stata was used to analyse data.
**Results.** A total of 248 patients with a mean age of 55 years were included for analysis, 7 males (3%) and 241 females (97%). Capricorn and Vhembe districts constituted 32% and 27% respectively. The majority (69%) of patients were diagnosed with disease stage III or IV. The most common histological type was invasive ductal cell carcinoma (IDC) (87%).
**Conclusions.** More than one-third of patients were younger than 50 years. The majority (69%) had an advanced breast cancer (stage III or IV). We recommend provision of mammography services in regional hospitals.

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Breast cancer is the most prevalent cancer and leading cause of death among women worldwide.[1] The average lifetime risk of breast cancer for a woman in the USA has been estimated at 12.3% with about 41 400 deaths reported in 2018.[1] The global incidence increased from 1.7 million in 2005 to 2.4 million cases in 2015[2] and in Africa is predicted to double by 2050.[3] Incidence rates are lower in low- and middle-income countries (LMICs) than in high-income countries; however, the rates are increasing very rapidly in LMICs owing to adoption of a western lifestyle, including such habits as shorter breastfeeding time, use of postmenopausal hormonal therapy, late age at first term pregnancy or lower parity. Another risk factor of breast cancer is physical inactivity, leading to obesity.[4] The incidence in sub-Saharan Africa was estimated to be 22.4 per 100 000 cases in 2018.[5] Breast cancer mortality rates in LMICs remain high as a result of late presentations and inadequate access to good healthcare.[6]

Breast cancer, along with cervical cancer, has been identified as a priority for the national healthcare services in South Africa (SA).[7] The SA National Cancer Registry reported breast cancer in 2014 as a leading cause of cancer deaths among women.[8] A 5-year mortality rate of 47% was recorded for SA women.[9] Breast cancer as a social problem has become an urgent challenge in LMICs. It is increasing dramatically, with 19.7 million cases projected to occur in the next decades.[10,11]

This present study is the first to report the demographic profile, stage at presentation, and the characteristics of breast cancer patients in Limpopo Province, SA. Before March 2015, breast cancer patients were managed by surgeons in the general surgery department, together with patients admitted for other surgical conditions. Breast cancer patients would wait 3 - 6 months for operations. In March 2015, a multidisciplinary clinic for the care of breast cancer patients was established at Mankweng Hospital. This hospital is a tertiary teaching institution of the University of Limpopo located 30 km east of Polokwane, the provincial capital.

The clinic at Mankweng is the only such facility in Limpopo serving the population of 5.98 million people.[12] The clinic operates once a week, staffed with adequate personnel, but does not have its own oncology and radiation facilities; for these services, the clinic is dependent on the radiation department at Pietersburg Hospital 30 km away.

The main objective of this study was to record the demographic features of attending patients, stage at presentation and histological patterns of malignancy identified in breast cancer patients treated at Mankweng. We anticipate that the information obtained from this study will guide the authorities responsible for provincial policy on breast cancer prevention, treatment and resource allocation programmes.

## Methods

We conducted a retrospective, descriptive, cross-sectional record review of patients managed at Mankweng breast cancer clinic during the period March 2015 - February 2017. Files with full correct data of all patients diagnosed with breast cancer were included in the study; incomplete records were excluded. The primary inclusion criterion was histological confirmation of breast cancer. A password-protected data bank in Excel (Microsoft 2013, USA) was created to record information on breast cancer patients. The clinic registers were used as a starting point for data collection. Patients' files were retrieved from the hospital archive to compile the data bank. The analysed variables were age, gender, home district of patient, stage of the disease and histological type of malignant tumours.

The statistical software package Stata (Stata Corp., USA) was used for data analysis. Continuous variables were expressed as means and standard deviations (SDs). Patients were allocated by age to one of

five categories. Stages at presentation were grouped into early (stages I and II) and late (stages III and IV). The categorical variables were described as proportions and frequency tables. Ethical approval was obtained from the Pietersburg-Mankweng Research Ethics Committee (ref. no. PMREC-01UL2017).

## Results

A total of 291 patients' files formed the primary database for this study. Forty-three patients' records were removed from the list because of incomplete information; therefore 248 patients' records were finally included for analysis. Table 1 shows data of the breast cancer patients during the 2-year study period. The mean age was 55 years. Women younger than 50 years of age comprised 38% of the total (Table 1); 8% were younger than 35 years. Females comprised 97% of all cases. The majority of patients admitted to the clinic came from the Capricorn district. Most of them were at an advanced stage III or IV (*n*=170; 69%); patients with stages I and II comprised only 31% of total admissions. We found that women aged 50 - 64 years were in much more advanced stages as compared with the other age groups (Fig. 1). The majority of patients (87%) presented with invasive ductal cell carcinoma (IDC). Colloid carcinoma was present in 3.6% and ductal carcinoma *in situ* (DCIS) in 3%, together constituting nearly 7%. Mucinous carcinoma was present in 2%, papillary in 2%, medullary in <1%, lobular carcinoma *in situ* (LCIS) in <1%, and mixed ductal and lobular carcinoma was found in a relatively small number (*n*=3; Table 1).

**Table 1. Descriptive summary of breast cancer patients managed at the clinic (*N*=248)**

| Variables | *n* (%)* |
|---|---|
| Mean age (years) | 55 |
| Gender | |
| Males | 7 (3) |
| Females | 241 (97) |
| Age (years) | |
| 20 - 34 | 21 (8) |
| 35 - 49 | 75 (30) |
| 50 - 64 | 84 (34) |
| 65 - 79 | 55 (22) |
| >79 | 14 (6) |
| Home district | |
| Capricorn | 80 (32) |
| Vhembe | 68 (27) |
| Mopani | 39 (16) |
| Waterberg | 34 (14) |
| Sekhukhune | 26 (11) |
| Stage at first presentation | |
| I & II | 78 (31) |
| III & IV | 170 (69) |
| Histological type | |
| Ductal cell carcinoma | 217 (87) |
| Colloid carcinoma | 9 (4) |
| Mucinous carcinoma | 4 (2) |
| Papillary carcinoma | 4 (2) |
| Lobular carcinoma | 2 (1) |
| Ductal carcinoma *in situ* | 7 (3) |
| Lobular carcinoma *in situ* | 1 (<1) |
| Medullary carcinoma | 1 (<1) |
| Mixed ductal and lobular carcinoma | 3 (1) |

*Unless otherwise specified.

## Discussion

The main objective of this study was to report patients' demographic profiles, stages of disease at first presentation, and characterise the histological type of breast cancer for all patients included in this research at Mankweng Hospital, a tertiary hospital in Limpopo.

Of the nine provinces of SA, Limpopo is the fifth largest, and covers 125 754 km$^2$.[12] The population is ~5.98 million, and Limpopo Province is administratively divided into five districts: Capricorn, Vhembe, Mopani, Sekhukhune and Waterberg. Each district has a regional hospital: Tshilidzini, Letaba, St. Rita's, Philadelphia, and Mokopane hospitals. Pietersburg and Mankweng are the tertiary hospitals in the province, situated in Capricorn district. All patients diagnosed with breast cancer in the public sector, with a confirmed histological diagnosis, attend the breast oncology clinic. Mammography services are only available at Pietersburg and Mankweng hospitals, dealing with all patients from the whole province, which results in long waiting lists for mammography investigations.

We found that 32% of the patients came from Capricorn district. There are various possible reasons for this; for example, it could be a true reflection since all breast cancer patients around Mankweng are referred directly to the clinic. Another explanation is that breast cancer patients from other districts seek alternative help because of complex pathways to access the clinic.

The mean (SD) age of breast cancer patients at the time of diagnosis was 55 (14.4) years. This is similar to other studies conducted in SA. In a study conducted at Chris Hani Baragwanath Academic Hospital, Johannesburg, results of mean (SD) age were similar: 54.4 (14.2).[13]A study conducted to understand the pathway of breast cancer diagnosis among women in Cape Town found the mean age to be 52 years.[14] In our series, 38% of patients were below the age of 50 years. Some studies from Africa also report mean age below 50 years.[15] The study by Azubuik *et al.*[16] recorded that breast cancer in Africa tends to occur in relatively younger age groups and among premenopausal women compared with the western population.

To date, there has been no evidence related to high risk of breast cancer in the HIV-positive population. However, strong evidence suggesting younger age at diagnosis for the HIV-positive population as compared with the HIV-negative population has been presented. An SA report by Van Zyl *et al.*[17] found the mean (SD) age at presentation of breast cancer in the HIV-positive group to be ~10 years younger (44.86 (9) years), compared with the entire population (54.56 (13.62) years) and the HIV-negative group (53.18 (12.48) years). Another study, by Kohler *et al.*,[18] reported that in Malawi, 55% of cases occurred in women below the age of 50 years. We do not know why many patients

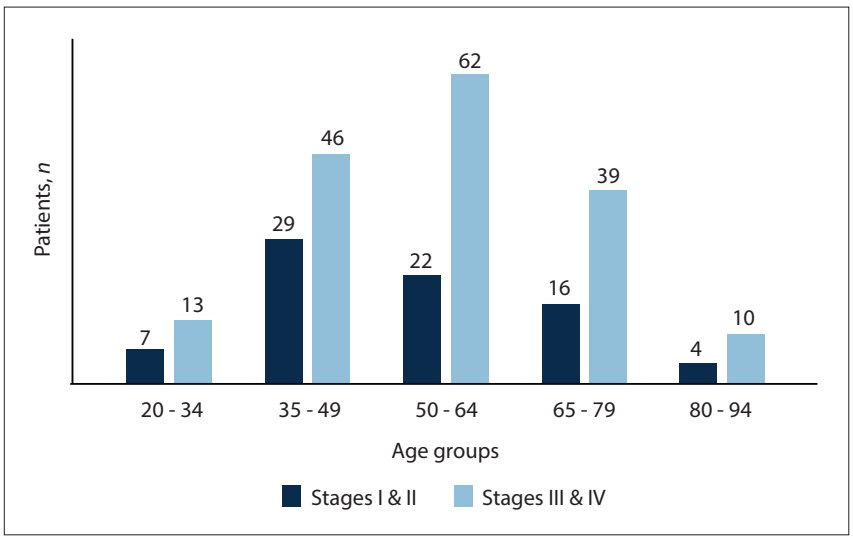



*Fig. 1. Distribution of patients by breast cancer stage and age.*

in our study are young. Globally, breast cancer occurrence in young patients (<40 years) constitutes 7% of all diagnosed breast cancer.[19]

Nearly 70% of the patients in our study were diagnosed with already advanced cancers. However, the 50 - 64-year-old age group presented much later as compared with other groups. In this subgroup, 83% of patients came markedly late. Advanced stage at presentation has been reported in an LMIC, Kenya, with as many as 89% of patients with a late stage of cancer.[20] In an urban SA clinic in Johannesburg, two-thirds of patients presented with locally advanced breast cancers.[21]

Early diagnosis has a profound implication for prognosis, survival and personal or social costs; therefore early detection of breast cancer should be prioritised.[22] Primary healthcare services have an important role to play in breast care education, and promotion of cancer symptoms awareness. In Limpopo, there are no mammography facilities in any regional hospitals. Consequently, patients have to travel up to 300 km to Pietersburg or Mankweng for mammograms. This is expensive for patients, makes waiting lists much longer, and establishing the final diagnosis is significantly delayed. Many of these patients present too late to health service facilities, contributing to higher mortality, morbidity and also to considerably high costs. Regional hospitals in Limpopo should be equipped with well-functioning mammography facilities which are essential in early diagnosis of breast cancer. In addition, they should be staffed with personnel trained on breast cancer care.

Most of the women in our study had IDC (87%). A similar trend was found in Malawi where IDC was the most common histological type (86%).[18] Nearly 80% of patients required mastectomy.

The best treatment for advanced breast cancer is surgery, chemotherapy and radiotherapy. In addition, endocrine therapy and monoclonal antibody trastuzumab is required according to hormonal and HER 2-receptor status. The surgical treatment is often the only modality available in most low-resource settings where modified radical mastectomies are the most commonly performed operations.

## Conclusion

In conclusion, this study has defined the breast cancer population in the newly established breast cancer clinic in the rural province of Limpopo, northern SA. More than one-third of our participants were younger than 50 years and nearly 10% were younger than 35 years (8%). Most of them came from Vhembe and Capricorn districts. Advanced stage at presentation is still a challenge in this institution.

A further investigation to determine the factors contributing to advanced stage at presentation would provide information on the causes and reasons for such undesirable delays in the health service system. Information obtained from this study may help in guiding the establishment of prevention strategies. Mammography machines should be made available in regional hospitals.

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**Conflicts of interest.** None.

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# Profile of molecular subtyping of breast cancer and clinico-pathological features in Mankweng Hospital breast oncology clinic, Limpopo Province, South Africa

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**Background.** Breast cancer is recognised as a heterogeneous disorder, comprising a number of subcategories of several cellular compositions, molecular alterations as well as clinical behaviour. Across the world, research has been able to show that the most common molecular subtype is luminal A, followed by triple negative and human epidermal receptor 2 (HER2)-positive (non-luminal) subtype. However, another study found that the most common molecular subtype was HER2/neu amplification, suggesting that subtypes case frequencies differ in different people.

**Objectives.** To determine the case frequency of molecular subtypes of breast cancers and the associated clinicopathological features in women from Limpopo Province, South Africa.

**Method.** We performed a retrospective, cross-sectional descriptive study from July 2021 - June 2021 at Mankweng Hospital breast oncology clinic. The inclusion criterion was all women with histologically confirmed breast cancer.

**Result.** We identified 222 women who met the inclusion criteria, and the age range (median) was 25 - 91 (54.8) years. The majority of the women came from the Vhembe district (28%; *n*=62), followed by Capricorn district (26%; *n*=59), Mopani district (17%; *n*=38), Sekhukhune district (16%; *n*=35), and Waterberg district (13%; *n*=28). Histology revealed that the most common type was invasive ductal carcinoma (no special type; 91.44%; *n*=203), followed by invasive mucinous carcinoma (4%; *n*=9). The most predominant molecular subtype was luminal B (48.19%; *n*=107), followed by luminal A (22.97%; *n*=51), triple negative (17.12%; *n*=38) and 11.75% (*n*=26) overexpressed HER2. More than one-third of the cancers were HER2-positive (40.54%; *n*=90), and 59.46% (*n*=132) were HER2-negative. The majority of patients presented with late-stage cancer (62.16%; *n*=138), and the rest presented with early-stage (I and II) disease (37.84%; *n*=84).

**Conclusion.** The majority of our patients had luminal subtypes and hormonal receptor-positive breast cancers, which should be associated with very good clinical outcomes. However, the majority of patients presented late with advanced-stage disease and high Ki-67 expression. Therefore, research is required to help us understand why in our context patients present late with advanced-stage disease.

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Breast cancer is the most common cancer in women and the second most common cancer overall, worldwide.[1] Over the years, the demographics have changed, lifespan has increased and in turn, there has been an increase in the aged population. These changes have also been accompanied by an increase in the number of individuals diagnosed with breast cancer, even more so in developing countries.[2] The increase in the incidence of breast cancer has not been accompanied by an increase in mortality, suggesting that there has been aggressive screening and detection of breast cancer, coupled with better clinical management of breast cancer patients.[3]

Breast cancer is recognised as a heterogeneous disorder, comprising a number of subcategories of cellular compositions, molecular alterations as well as clinical behaviour.[4] Phenotypically identical breast tumours, which are histologically similar, can present with a wide spectrum of clinical outcomes and response to therapy. Over the years, due to the availability of hormone-receptors and human epithelial growth factor receptor 2(HER2/neu)-based determination techniques, classification has been based on immunohistochemistry, genetic and molecular findings.[4,5] In the past, breast cancer was classified based on clinicopathological features such as tumour stage and grade, and other morphological features such as histological types, proliferation status and lymph vascular infiltration. However, this alone could not account for the differences in prognosis and response to therapy.[6] With the discovery of molecular classification >30 years ago, there has been an appreciation of genetic diversity in breast cancer.[4] This has led to molecular classification systems being recognised and appreciated as a useful tool for predicting the response to treatment and to predict prognosis and guide therapy in patients with breast cancer.[7]

Classifying breast cancer into varied molecular subtypes in an important step in therapeutic decision-making. Classic immunohistochemistry markers such as hormone receptors including oestrogen receptor (ER) and progesterone receptor (PR) along with HER2, play a vital role in molecular subtyping.[5] Newer methods including gene expression profiling using DNA microarrays have also been developed, which are therapeutically important in molecular classification.[4] However, immunohistochemical analysis based on hormone receptors and HER2 is preferable and commonly used in clinical practice as this method has been found to be easy, cost effective and provides similar results for molecular subtypes.[7]

There are five main intrinsic or molecular subtypes of breast cancer that are based on the genes a cancer expresses. According to the St Gallen Consensus 2011,[8] molecular subtypes of breast cancer are classified based on immunohistochemistry into luminal A (ER+/PR+/HER2–/Ki-67low), luminal B (ER+/PR+/HER2–/+/Ki-67high), HER2-overexpression (ER–/PR–/HER2+) and triple negative breast cancers (TNBCs; ER–/PR–/HER2–).[8] Molecular subtypes can be

broadened and explained thoroughly as follows:[9-11] luminal A breast cancer is hormone-receptor positive (ER and/or PR-positive), HER2-negative, and has low levels of the Ki-67, which helps control how fast cancer cells grow. Luminal A cancers are low-grade, tend to grow slowly and have the best prognosis. Luminal B (HER2-negative or HER2-positive) breast cancer is hormone-receptor positive (ER and/or PR-positive), and either HER2-positive or HER2-negative with high levels of Ki-67. Luminal B cancers generally grow slightly faster than luminal A cancers and their prognosis is slightly worse. Triple-negative/basal-like breast cancer is hormone-receptor negative (ER and PR-negative) and HER2-negative. This type of cancer is more common in women with *brca1* gene mutations. Researchers are unsure why this type of cancer is also more common among younger and Black women.[12] HER2-enriched breast cancer is hormone-receptor negative (ER and PR-negative) and HER2-positive. HER2-enriched cancers tend to grow faster than luminal cancers and can have a worse prognosis, but they are often successfully treated with targeted therapies aimed at the HER2 protein, such as trastuzumab, pertuzumab, lapatinib, neratinib, and T-DM1 or ado-trastuzumab emtansine. Ki-67 is an indicator of tumour proliferation and an elevated/high Ki-67 is associated with poor prognosis. In the absence of reliable measurement of Ki-67, it has been proposed that an alternative method such as tumour grade can be used to distinguish between luminal A and luminal B (HER2-negative) subtypes.[8] Among the five subtypes of breast cancer, the distribution of pathological grades showed a significant difference ($p<0.001$),[13] suggesting that it is of therapeutic importance.[8] Systemic therapy and management strategies for patients with breast cancer have been developed based on molecular subtypes. Endocrine receptor-positive cancers have been proven to have good clinical response to endocrine therapy, while non-endocrine receptor cancers have been shown to respond to cytotoxic therapy.

It is important to identify patients benefiting from hormonal therapy and treatment targeting the HER-2/neu receptors. To achieve this, it is important to determine the correlation of HER-2/neu expression and hormone (ER, PR) receptor status in relation to the clinicopathological features of breast cancer. Histological subtypes of breast cancer refer to the growth pattern of the tumours. These patterns have been associated with distinctive clinical presentations and/or outcomes. To date, the most common subtype is invasive ductal carcinoma of not otherwise specified (IDC-NOS) or of no special type (IDC-NST).[15] Special types of breast cancer account for up to 25% of breast cancers and up to 17 distinct types have been described by the World Health Organization.[15] There has been no clear correlation between histological subtypes and clinical behaviour of these tumours, hence the molecular array analysis has allowed for more understanding on tumour behaviour than just looking at histological subtypes.

The main objective of the present study was to determine the case frequency of breast cancer molecular subtypes using immunohistochemistry and the associated clinicopathological features of women at Mankweng Hospital breast oncology clinic, Limpopo Province.

## Methods

The present study is a retrospective, cross-sectional descriptive study of breast cancer patients who presented at Mankweng Hospital breast oncology clinic between July 2020 and June 2021. All patients with histologically confirmed breast cancer were included in the present study. Patients with missing information, including incomplete immunohistochemistry profile and males, were excluded from the present study. The clinic registers were used as a starting point for data collection. Patients' files and histology were retrieved from the hospital archive to compile the data bank. The collected data were transferred to a password-protected data bank in Excel spreadsheet (Microsoft Corp., USA). The following data were retrieved from the patients' files: age, district, type of breast cancer, staging, grading (according to the Nottingham modification of the Bloom-Richardson system),[5] Ki-67 index, and oestrogen, progesterone and HER2 receptor status.

### Statistical analysis

Data were analysed using Statistica software (version 7.1; TIBCO software, USA) and SPSS version 23 (IBM Corp., USA). The patient demographics were summarised using descriptive statistics. Dependent variables that were normally distributed were summarised using means and standard deviations. The comparison between normally distributed variables was done by performing the Student's *t*-test and analysis of variance was used to compare means between more than two groups. Correlations between continuous variables was done using regression modelling and Pearson's coefficient was calculated. A $p<0.05$ was considered statistically significant.

### Study setting

Mankweng Hospital breast oncology unit is situated in Turfloop/Sovenga, Limpopo Province, South Africa. It is a tertiary hospital providing breast oncology services, among other services, to all the population of the Limpopo Province. Ethical approval was obtained from the Research Ethics Committee of the Polokwane/Mankweng Hospital complex (ref. no. PMREC 26 MAY UL 2021/C).

## Results

We identified a total of 222 women who met the inclusion criteria into the present study. The majority of the patients (25%) were in the 50 - 60 years age group, followed by 40 - 50 years (24%), 60 - 70 years age group (18%), and 30 - 40 years age group (14%) (Fig. 1). The results show that the majority of affected patients were >50 years; however, there was also quite a good number of young patients.

The most common subtype in the present study was luminal B (48%; HER2-positive (29%) and HER2-negative (19%)), followed by luminal A (23%), triple negative (17.12%) and HER2-overexpression/non-luminal (12%) (Fig. 2). This correlates with findings from most studies that have shown that luminal types of breast cancer are the most common molecular subtype. The majority of luminal B (31%; $n=69$) and HER2-negative (33%; $n=73$) cancers were detected in late stages.

The majority of patients had oestrogen receptor (ER)-positive (68%; $n=151$) cancer, followed by progesterone receptor (PR)-positive (59%; $n=132$) cancer in our present study. With regards to HER2 status, the majority of patients had cancers that were HER2-negative ($n=132$; 59%) compared with individuals with HER2-positive cancers.

The majority of the patients in the present study had disease at Grade 2 (61%; $n=134$) followed by Grade 3 (29%; $n=63$) and Grade 1 (10%; $n=22$) (Table 1). For Grade 1, the most dominant subtypes was luminal A (6%; $n=14$), and for Grade 3, triple negative breast cancer was more prevalent (13%; $n=28$; $p<0.0001$). This evidence shows that the luminal types of breast cancer are less aggressive that the non-luminal cancers.

We found that luminal A cancers were predominant for low (<10%) Ki-67 index (10%; $n=22$), followed by luminal B (4%; $n=8$), HER2 (3%; $n=6$) and triple negative (1%; $n=3$) ($p<0.0001$). This evidence further suggests that luminal A is associated with better prognosis and good clinical outcomes as compared with the other subtypes. For the high (>20%) Ki-67 index, we found that luminal B was the most dominant (20%; $n=44$), followed by triple negative cancer (15%; $n=33$), HER2 (6%; $n=14$) and luminal A (<1%; n=1; $p<0.0001$). This further shows the aggressiveness of luminal B subtype and poor clinical outcomes. High Ki-67 was found in patients mostly in the late stages of disease (28%; $n=63$). Although Ki-67 index is a valuable biomarker

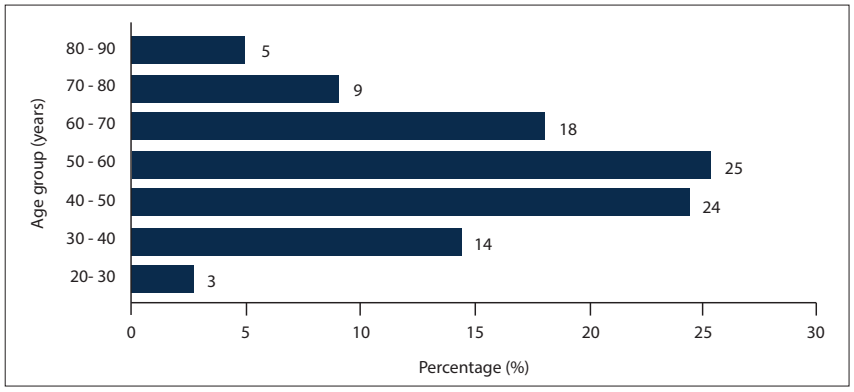



*Fig. 1. Age of the patients presenting at Mankweng breast oncology clinic between July 2020 and June 2021.*

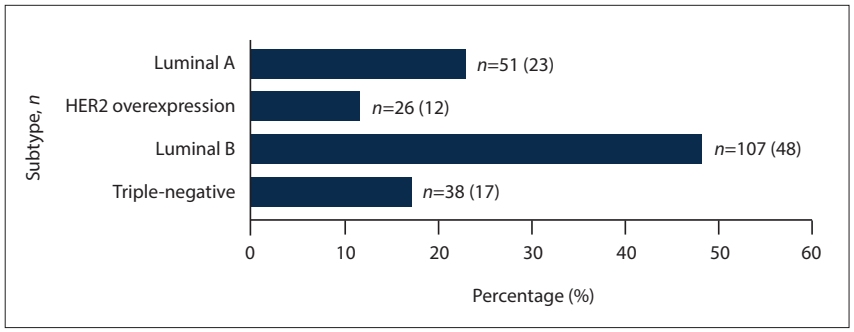



*Fig. 2. Molecular subtypes of breast cancers seen in patients presenting at Mankweng breast oncology clinic between July 2020 and June 2021 (N=222). The subtypes are expressed in actual numbers as well as percentages.*

in breast cancer, no independent prognostic significance of Ki-67 has been established.[22]

The majority of the patients in the present study were from Vhembe district (28%), followed by Capricorn district (26%), Mopani district (17%), Sekhukhune district (16%), and Waterberg (13%) (Table 1).

On the molecular subtype classification, it is evident that luminal B is the most common subtype (48%), followed by luminal A (23%), then triple negative (17%) and the least prevalent was HER2-overexpression molecular subtype (Table 2).

## Discussion

According to histological type, the most common cancer in our present study was the invasive ductal carcinoma (no special type; 91.4%). Looking at a 10-year retrospective study done in South-Western Nigerian[16] women, the most common histological type was invasive ductal carcinoma of no special type (88.9%). Although early diagnosis is a key determinant factor for breast cancer survival, delay in presentation and advanced-stage diagnosis are common challenges in developing countries.[17] The majority of patients (62.16%) in our study presented at late stage (III and IV). This can be attributed

**Table 1. Descriptive summary of breast cancer patients (*N*=222)**

| | *n* (%) | Early stage (I & II), *n* (%) | Late stage (III & IV), *n* (%) | *p*-value |
|---|---|---|---|---|
| Age, 25 - 91 years | 222 (100) | 83 | 137 | |
| <50 | 93 (42) | 33 (15) | 60 (27) | 0.5800 |
| >50 | 129 (58) | 51 (23) | 78 (35) | |
| Molecular subtype | | | | |
| Luminal A | 51 (22.97) | 24 (11) | 27 (12) | 0.04 |
| Luminal B | 107 (48.19) (HER2-negative = 43 (19)) | 38 (17) | 69 (31) | |
| HER2-overexpression without ER/PR | 26 (11.71) | 5 (2) | 21(9) | |
| Triple negative | 38 (17.12) | 17 (8) | 21 (9) | |
| HER2 status | | | | |
| HER2+ | 90 (40.54) | 25 (11) | 65 (29) | 0.0107 |
| HER2– | 132 (59.46) | 59 (27) | 73 (33) | |
| Grade | | | | |
| Grade 1 | 23 (10) | 7 (3) | 15 (7) | 0.7301 |
| Grade 2 | 136 (61) | 51 (23) | 83 (38) | |
| Grade 3 | 63 (29) | 26 (12) | 37 (17) | |
| Ki-67 index | | | | |
| Low | 40 (18) | 16 (7) | 24 (11) | 0.2471 |
| Intermediate | 90 (40.54) | 39 (18) | 51 (23) | |
| High | 92 (41.44) | 29 (13) | 63 (28) | |
| District | | | | |
| Sekhukhune | 35 (16) | - | - | - |
| Mopani | 38 (17) | - | - | |
| Capricorn | 59 (26) | - | - | |
| Waterberg | 28 (13) | - | - | |
| Vhembe | 62 (28) | - | - | |

HER2 = human epidermal receptor 2; ER = oestrogen receptor; PR = progesterone receptor.

**Table 2. Histology type**

| Subtypes | *n* (%) |
|---|---|
| Invasive carcinoma (no special type): ductal | 203 (91.44) |
| Invasive carcinoma: mucinous | 9 (4) |
| Invasive carcinoma: neuroendocrine | 2 (0.9) |
| Invasive carcinoma: micropapillary | 1 (0.45) |
| Invasive carcinoma: tubular | 1 (0.45) |
| Invasive carcinoma: lobular | 1 (0.45) |
| Invasive carcinoma: metaplastic carcinoma (squamous cell carcinoma) | 3 (1.35) |
| *In situ* carcinoma: ductal | 2 (0.9) |

to several factors including lack of education, seeking alternative methods such as traditional doctors, and fear of surgery.

The mean age at diagnosis of breast cancer has been found to be at ~40 - 50 years.[10,11] A South-Western Nigerian[16] study found the mean (range) age to be 49.7 (20 - 89) years and the most affected age group was 50 - 59 years. Similarly, a study from India[6] revealed that their patients were younger, with the average age at the time of diagnosis of 50.5 years and 7% of patients were <35 years compared with those in a Western case series. This has also been corroborated by other African studies that have also reported a mean age <50 years.[18] We found the mean (range) age at diagnosis to be 54.8 (25 - 91) years and patients <40 years of age accounted for 17% of individuals presenting to the clinic.

Breast cancer, particularly triple negative disease, was found in younger women with an age range of 40 - 60 years,[9,10] and patients usually presented at an advanced stage of disease.[12] A retrospective study conducted China[19] showed that young women ≤35 years were more likely to get basal cell-like/triple negative breast cancer (36.9%) compared with other subtypes,[19] indicating that younger individuals are more likely to get aggressive disease.[12,13]

In the present study, the prevalence of triple negative breast cancer was the same (9%) for all age groups (>50 and <50 years). Moreover, the majority of the patients presented with grade 2 and 3 cancers regardless of age group. This evidence is suggestive of the aggressive nature of triple negative breast cancer subtype; however, age does not seem to be a contributing factor.

Studies across the world have shown that the most common molecular subtype is luminal A, followed by triple negative and HER2-positive (non-luminal) subtype.[4,8,20] However, a study by Cardoso *et al.*[10] found that the most common molecular subtype was the HER2/neu amplification, suggesting that differences in case frequencies of subtypes do exist between different populations.

Hormone receptor-positive breast cancer cells have either ER or PR, or both. These breast cancers can be treated with hormone therapy drugs that lower oestrogen levels or block oestrogen receptors. Hormone receptor-positive cancers tend to grow more slowly than those that are hormone receptor-negative. Women with hormone receptor-positive cancers tend to have a better outlook in the short-term, but these cancers can sometimes come back many years after treatment.[21] Most of the patients in our study presented with advanced disease; however, the majority of the patients with advanced stage had non-luminal cancer, suggesting that indeed hormone receptor-positive tumours might have a better clinical outcome. We cannot comment much on these, as other confounding factors such as time of onset of symptoms and progression of disease were not looked at in the present study.

A study conducted in Indonesia[20] found that luminal A subtype of breast cancer was commonly found in women >50 years of age ($p$=0.028), low-grade cancer ($p$=0.09), negative lymph node metastasis ($p$=0.034) and stage III ($p$=0.017).[20] Even though the difference was insignificant, luminal A subtype breast cancer was mostly found in small size breast cancer ($p$=0.129). HER2-positive subtype breast cancer was more commonly diagnosed with large size, positive lymph node metastasis and poor grade. Triple negative/basal-like cancer was mostly diagnosed among <50 years old women.[20]

## Study limitations

The present study was retrospective and some patients had missing records. We also observed poor note-keeping and inability to trace patients' histology results.

## Conclusion

The majority of our patients had luminal subtypes and hormonal receptor-positive breast cancers, which should be associated with very good clinical outcomes. However, the majority of patients presented late with advanced-stage disease and high Ki-67 expression. Therefore, research is required to help us understand why in our context patients present late with advanced-stage disease.

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# Adenomyoepithelioma of the breast: A rare case from the Mankweng Hospital breast oncology clinic, Limpopo Province, South Africa

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Adenomyoepithelioma of the breast is a rare benign breast neoplasm. It is characterised by the proliferation of both epithelial and myoepithelial cells. Although it is benign, adenomyoepithelioma has a potential for recurrences and malignant transformations. Here, we report a case of a 69-year-old woman with a breast adenomyoepithelioma that had been resected twice before her admission to Mankweng Hospital. It was a fast-growing tumour involving the retro-areolar area and left inner quadrant of the breast. Applied treatment included wide-simple mastectomy with sentinel axillary lymph nodes biopsy.

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Adenomyoepitheliomas of the breast are rare benign breast neoplasms. They are characterised by proliferations of both epithelial and myoepithelial cells. Epithelial cells resemble those normally covering the mammary ducts. Myoepithelial cells include specialised epithelial cells with a myoid differentiation. They contain normal components of the lobular units of the breast tissue lying between the epithelial layer and basement membrane of ducts along with acini.[1]

Although adenomyoepitheliomas are benign neoplasms, they have a potential for recurrences and malignant transformations. The malignant adenomyoepithelioma is difficult to differentiate from other benign diseases such as intraductal papillomas, tubular adenomas, or sclerosing adenosis.[2]

## Case presentation

A 69-year-old, postmenopausal woman presented to hospital with an 18-month history of a tumour in the left breast. She reported being previously treated with a local excision of the breast mass 16 months ago at her community hospital when the mass was smaller, but a few months later the painful mass recurred and was growing rapidly. The patient had repeat resection of the recurrent tumour at the same local hospital 7 months before her admission to our institution, as the tumour continued to grow. There was no family history of breast cancer. The physical examination revealed breast asymmetry, a mobile and irregular breast mass measuring 14 cm × 9 cm in the retro-areolar and left inner quadrant region with an old 3 cm scar (Fig. 1). The axillary lymph nodes were not palpable. Mammogram revealed left breast high-density irregular mass with indistinct margin posteriorly. The size of the mass was 12.9 cm × 5.7 cm on a craniocaudal view, extend from the retro-areolar region and the left inner quadrant. The tumor was associated with scattered fine microcalcifications. There was no focal or diffuse skin thickening. The tumour was a BIRADS-5 breast tumour. The histology of an excisional biopsy revealed morphological features of adenomyoepithelioma with the neoplasm noted to extend to resection margins. Immunohistochemistry revealed that the tumour was positive for P63 and CD10, highlighting the presence of myoepithelial cells, and it was also CK7-positive, indicating the presence of luminal epithelial cells. Simple mastectomy with a sentinel lymph node biopsy was done successfully without any complications. Histological features of mastectomy specimens were in keeping with adenomyoepithelioma, showing all resection margins free of tumour and a reactive follicular hyperplasia in axillary lymph nodes.

## Discussion

Neoplasms of pure myoepithelial or mixed epithelial origin have been described in the salivary glands but are rare in the breast.[3] The first case of breast adenomyoepithelioma was described by Hamperl[2] in 1970. Since then, about 150 cases have been reported in the literature.[4] Most patients with adenomyoepithelioma are elderly,[1,3] although it has also been reported in younger patients. The specified

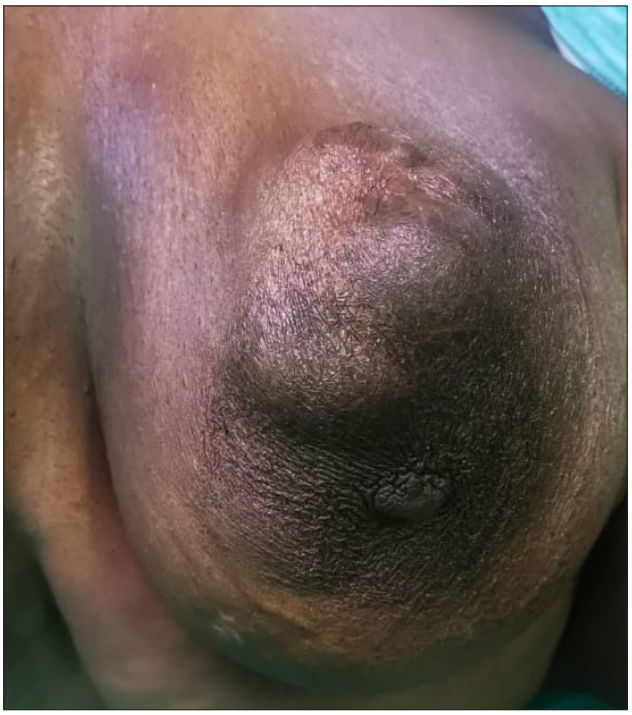


*Fig. 1. Location of the mass in the retro-areolar area.*

age ranges from 22 - 92 years, with a mean onset age of ~60 years.[2] Tumours appear usually as a solitary, nodular palpable mass. Mastalgia and nipple discharges are reported rarely.[1,2,5] Our patient presented with a nodular mass associated with pain. Adenomyoepitheliomas have been classified histologically as tubular, lobulated, or spindle-cell types of growth patterns.[5] The most common microscopic type is the tubular type. Spectrums of histological patterns depend on noticed relative amounts of proliferating glandular and myoepithelial cells.[6] Immunohistochemical investigations of adenomyoepitheliomas reveal epithelial cells that stain positive to cytokeratin (CK), and myoepithelial cells that are stained with antibodies to smooth-muscle actin, smooth-muscle myosin, calponin, p63, desmin, and S-100.[4,7] Indeed, we found the presence of both epithelial and myoepithelial cells in our case as indicated by cells that were positive for CK, and P63 and CD10, respectively.

The radiological features of breast adenomyoepithelioma are not well described. Predominant ultrasound and mammogram findings demonstrate an irregular mass with suspicious imaging findings.[1,4] In our case, investigations showed the irregular mass and fine microcalcifications, BIRADS-5 highly suggestive of malignancy.

Like other adenomyoepitheliomas described in the literature, recurrence may be associated with incomplete resection of the original tumour. Reported recurrences appear as soon as 4 months and as late as 23 years after primary tumors excisions.[4] Our patient had the recurrence twice within 18 months of presentation. The recommended surgical treatment of adenomyoepithelioma involves wide-local excisions with confirmed negative resection margins. Simple mastectomies or extended resections are advocated for cases with incomplete margin excisions.[2] We offered our patient the simple mastectomy with a sentinel lymph node biopsy. Surgical margins were free of tumour cells with no malignant deposits to axillary lymph nodes. The patient is continuing with follow-ups at the Mankweng breast oncology clinic to assess the outcomes.

## Conclusion

Adenomyoepitheliomas of the breast have a risk of recurrence and are best treated with wide-local excisions obtaining clear surgical margins. Close follow-up is essential to assess recurrences and/or malignant transformations.

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# Micropapillary carcinoma of the breast: A case review at Mankweng Hospital breast oncology clinic in Limpopo Province, South Africa

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Invasive micropapillary carcinoma (IMPC) of the breast is a clinically aggressive rare form of breast cancer. Patients with IMPC present with higher clinical stages, higher histological degrees, higher rate of lymph-vascular invasion and axillary lymph node extracapsular extension. In this case report, we seek to explore and share our experience of invasive micropapillary carcinoma of the breast and give a literature review of the standard of care.

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Breast cancer is the most common cancer in females.[1] Invasive micropapillary carcinoma (IMPC) of the breast is a clinically aggressive and rare form of invasive ductal carcinoma (IDC), accounting for <6% of breast cancer cases.[2,3] There are no specific distinguishing features to differentiate between IMPC and IDC, and 80% of patients have lymph node metastasis at presentation with histological findings highly positive for oestrogen receptor (ER) and human epidermal growth receptor-2 (c-erbB-2) (88% and 84%, respectively).[4-6] IMPC was first described in 1980, and it was thought that patients with IMPC experience worse outcomes than those with IDC because of its higher propensity for lymph-vascular invasion and lymph node metastasis.[4-8] The main objective of this case report is to share our experience with IMPC and give a literature review of the standard of care. Ethical approval was obtained from the Pietersburg/Mankweng Hospital Research Ethics Committee (ref no. PMREC 25 AUGUST UL 2021/E).

## Case presentation

An 81-year-old African female patient presented at Mankweng Hospital breast oncology clinic (Limpopo Province, South Africa) as a referral from a peripheral hospital. The main complaint was progressive swelling of the left upper limb involving the ipsilateral breast. According to the patient, she had a prick on the left hand for more than 18 months, then her upper limb was progressively swelling and ultimately led to left breast involvement. She consulted various traditional healers at the time when she started experiencing symptoms; however, there was no improvement to her condition. It is at this point that she started seeking medical attention at her local hospital more than a year after the onset of her symptoms. A biopsy on the breast mass was done on the initial presentation prior to breast oncology referral.

She was a healthy individual, multiparous with a total of 5 children. The onset of menarche and menopause is not known, and she had no significant family history of breast cancer.

Upon examination, the left upper limb was swollen from the fingers all the way through to the shoulder joint and also involving the left breast. There were multiple ulcerated lesions and masses of various sizes on the breast, axilla and shoulder region (Fig. 1). There was notable peau d'orange skin changes and nipple retraction. There were no obvious abnormalities detected on the contralateral upper limb, and cardiovascular, respiratory, abdomen and musculoskeletal systems.

Histopathological evaluation of the incision biopsy of the left breast mass showed skin-surfaced tissue, invasive neoplasm, and small nests of malignant cells, largely involving the lymphatic vessels. There were markedly pleomorphic cells that displayed brisk mitotic activity and showed no tubule-forming behaviour. No evidence of ductal carcinoma *in situ* was displayed in the tissue section. These features are in keeping with IMPC.

The patient was referred to the medical oncology clinic; however, she ultimately succumbed to her illness before the date of her treatment.



*Fig. 1. Advanced left-sided breast cancer with ulcerated lesions, masses of various sizes and also extending to the left upper limb.*

## Discussion

The most common presentation of IMPC is a breast lump (61%) that may be associated with nipple retraction and/or erythema. The left breast has been shown to be commonly involved (71% of the IMPC cases), followed by the right breast (25%) and both breasts in 3% of the cases.[2]

Imaging studies show features of a typical breast malignancy, with MRI further showing features of lymphatic infiltration.[2,5] This implies that MRI can be used for diagnosis and treatment planning.[5]

Patients with IMPC present with higher clinical stages, higher histological degrees, higher rate of lymph-vascular invasion and axillary lymph node extracapsular extension.[7,8] IMPC patients have been shown to have a more unfavourable prognosis for loco-regional recurrence than IDC patients. However, there is no statistically significant difference between patients with IMPC and IDC as indicated by relapse-free survival (odds ratio (OR) 2.04; 95% confidence interval (CI) 1.63 - 2.55) and local regional recurrence-free survival (OR 2.82; 95% CI 1.90 - 4.17),[6,7,9-12] suggesting that radical or proactive clinical therapy is unnecessary. Treatment is individualised to include tailored therapeutic interventions or multidisciplinary approaches.

## Conclusion

Invasive micropapillary carcinoma is a rare aggressive variant of breast cancer. Its frequent lymph-vascular invasion and high tumour grades correlate with its aggressive nature; however, no significant difference in overall survival has been proven yet. Patients must be encouraged to seek medical attention early as this can aid in better prognosis, and reduced morbidity and mortality.

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# Retrosternal goitre at Pietersburg Hospital, Limpopo Province, South Africa: A case report

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Retrosternal goitre presents in 2 - 19% of all thyroidectomies. Surgical removal is the treatment of choice. We report a case of an anterior retrosternal goitre, which was removed by a combined cervical/sternotomy approach.

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A retrosternal goitre (RG) is an enlarged thyroid gland extending into the mediastinum. Retrosternal goitre is diagnosed when 50% of the thyroid gland is below the thoracic inlet.[1,2] The presence of RG is documented in 2 - 19% of all thyroidectomies.[2]

Most RGs are situated in the anterior mediastinal compartment. Posterior mediastinal goitres are uncommon, comprising 10 - 15% of all mediastinal goitres.[3]

The rate of malignancy in reported surgical series is low (6 - 21%).[4] Large RG may cause airway and oesophageal compression; therefore, surgery is indicated when the diagnosis is confirmed.[5]

## Case report

A 63-year-old woman with a history of goitre for >10 years was referred from one of the regional hospitals in Limpopo Province, South Africa. The patient reported dysphagia and odynophagia. Local examination showed a diffuse swelling/large mass on the anterior aspect of the neck. Her comorbidities were asthma and diabetes mellitus type I. The diagnoses of a massive RG was suspected by a thyroid ultrasound, which showed a multinodular goitre with retrosternal extension. Chest X-ray showed an anterior mediastinal mass with deviation of the trachea. The diagnosis was confirmed with a contrast-enhanced computed tomography (CT) scan of the neck and chest, which showed significantly enlarged thyroid with anterior mediastinal extension bilaterally and the left lobe extending down to the superior border of the heart (Figs 1A and B).

The thyroid function test was as follows: TSH 0.70 MIU/L, T4 (8.2 pmol/L), and T3 (4.0 pmol/L). Fine-needle aspiration confirmed the diagnosis of a multinodular goitre with no evidence of malignancy. The patient was prepared for surgery. An awake intubation was done using fibreoptic laryngoscopy by our anaesthetic team. The patient was positioned in a supine position with the neck extended by placing a shoulder roll in between the scapulae. We performed the surgery using a combined cervical incision and midline sternotomy. First, we made collar-shaped incision in anterior aspect of the neck. The thyroid gland was exposed though sharp dissection of the layers of the wall of the neck.

The thyroid gland was mobilised from the right side. After dissection of the right lobe, we continued to the left side. The recurrent laryngeal nerves were identified bilaterally and preserved. The thyroid arteries and veins were divided and ligated. A partial sternotomy was done, and the intrathoracic portion of the gland was removed by blunt finger dissection. The thyroid gland with retrosternal extension was completely removed successfully (Fig. 2).

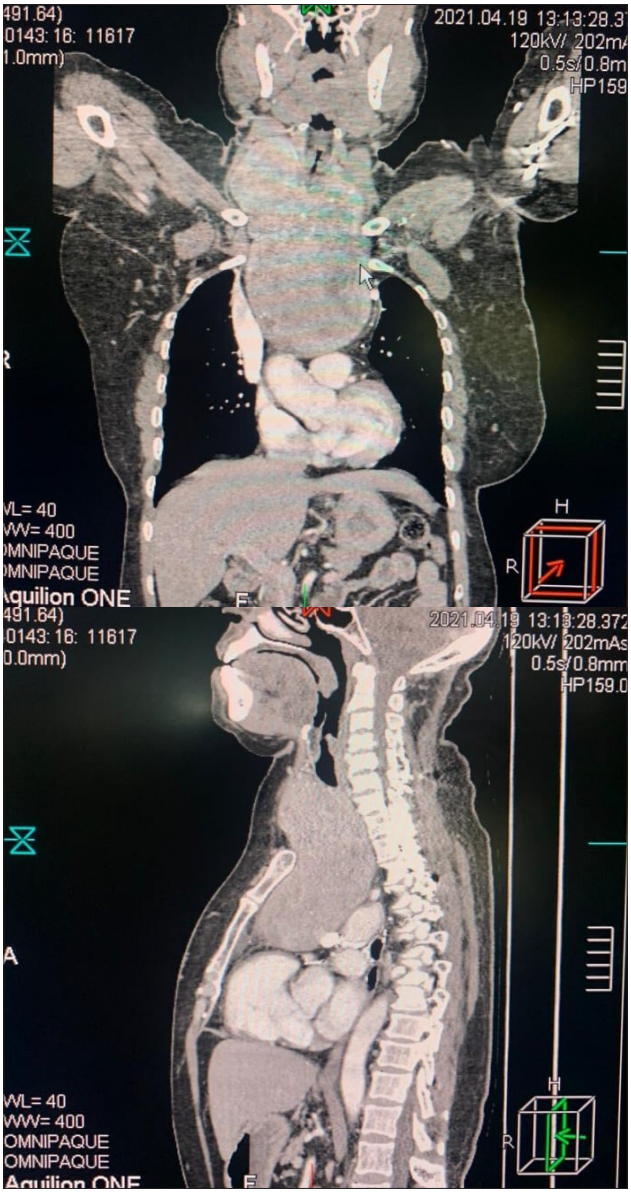



*Fig. 1. Antero-posterior and lateral views of contrast-enhanced computed tomography scan of the neck and chest, demonstrating a multinodular goitre with extending retrosternally up to the superior border of the heart.*

Haemostasis was achieved, and the mediastinal pleura was intact. A suction drain was inserted, and the wound closed in layers (Fig. 3). The patient was doing well postoperatively, with voice changes. She had a mild hypocalcaemia of 1.92 mmol/L, with a normal parathyroid hormone level of 6.2 pmol/L. She was discharged on day 7 after the operation and was put on treatment with eltroxine (100 µg daily) and calcium gluconate (500 mg daily). During follow-up at the clinic, histology showed a 585 g goitre with no evidence of malignancy, only features of multinodular goitre.

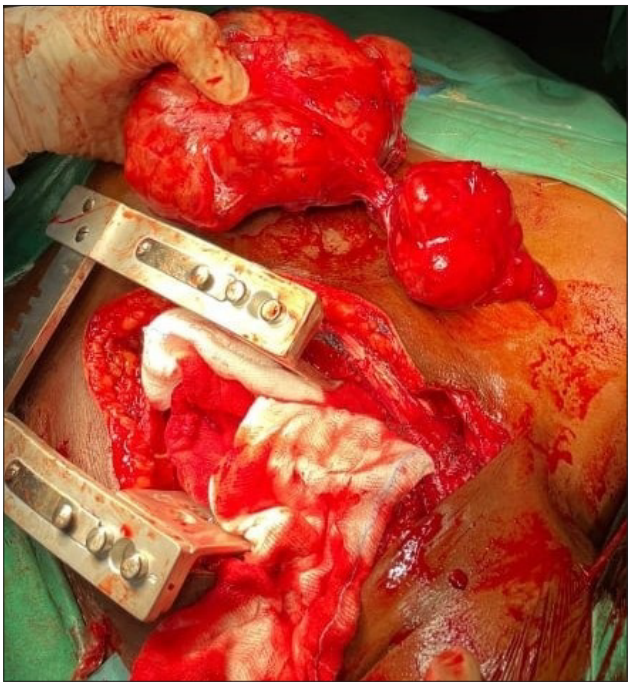


*Fig. 2. Partial sternotomy and removal of the retrosternal thyroid mass.*



*Fig. 3. A suction drain was inserted and the wound was closed with staples.*

## Discussion

Massive long-standing goitres are common in iodine-deficient areas. RGs are more common among women, the symptoms are related to compression of the airway and pressure on mediastinal structures.

One of the most reliable classifications is considering the degree of the intrathoracic extension of the thyroid gland:

- largely intrathoracic (more than 80%);
- partially intrathoracic (more than 50%, but less than 80%); and
- substernal goitre (more than 50% remaining in the neck).[6]

Surgical removal of a RG is a challenging procedure, cervical approach is suitable for 95% of the cases. The need for sternotomy increases greatly if a significant proportion of the gland is located in the mediastinum or the RG is in a retrotracheal or retro-oesophageal position, or if the intrathoracic component is significantly larger than the cervical one.[4]

## Conclusion

RG is a rare condition. A CT scan should always be included in the pre-operative diagnostic work-up when RG is suspected.[2] Surgical removal is the treatment of choice in such cases. Combined cervical collar incision and sternotomy gives good exposure and makes it easy to remove large RGs.

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# Tracheal injury in a toddler

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Penetrating neck injuries are uncommon in the paediatric population. The initial management of these patients can be challenging to the emergency room physician, and the surgeon that performs the operative treatment. The nature of these injuries tends to be very complicated since, typically, the patient presents with either excessive bleeding or a compromised airway due to the damage of vital structures in the neck area such as the trachea and carotid-sheath, and lack of corresponding protection from the vertebral bone. Here, we report a traumatic case of a 2-year-old girl that was referred to our unit after surviving an attempted murder by a deranged family member that slit her throat with a saw-toothed knife. The patient sustained a near complete slit of her throat, which was repaired primarily with satisfactory postoperative results.

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A stab wound to the neck is a relatively uncommon condition in paediatrics. It is potentially dangerous due to the presence of vital structures in the neck and requires emergency management. The neck is made up of vital structures such as jugular veins and carotid arteries, the larynx and trachea, the oesophagus and the thyroid gland, all these structures are densely related. The management of penetrating neck injuries is clinically challenging as more than one of these structures are likely to be involved in a single incident. The mechanism of injury usually determines the extent of tissue damage and the treatment options. Stab wounds are relatively low-velocity injuries but can still lead to a life-threatening clinical scenario, requiring immediate surgical intervention.

## Case

A 2-year-old girl was referred to the paediatric surgery unit at Polokwane/Mankweng Hospital from FH Odendal Hospital in Limpopo Province, South Africa. The history provided by a neighbour was that the child was stabbed on the neck by her mother, known to have severe mental health issues, who attempted to kill her children after a domestic dispute with their father.

On immediate inspection, the child arrived in respiratory distress, non-intubated and gasping for air. There was minimal bleeding in the area of the injury, and the child kept the neck in flexion to maintain her airway patent for breathing. On further assessment, the child was conscious but could not talk, and breathing with difficulty, with an oxygen saturation of 98% on room air.

The child was haemodynamically stable and pale with a pulse rate of 102 beats per minute, which was regular, and good volume.

The neck examination revealed a visible slit and open throat with saliva and air leaking through the wound (Fig. 1). The laceration was in the left and right anterior neck triangle with bilateral left and right sternocleidomastoid and thyroid-hyoid muscles completely cut. The trachea was visibly cut open anteriorly about 60 - 70%, both the carotid arteries and jugular veins were bruised but not obviously perforated or bleeding. There was associated swelling at point of entry and tenderness with mild subcutaneous emphysema. Of note was a ragged appearance of skin and subcutaneous tissue without any major neurological deficit.

A blood gas, full blood count, electrolyte, urea, and creatinine analysis were performed, and all were normal. The patient was assisted by a specialist paediatric surgeon and anaesthesist, intubated while in the emergency unit and immediately taken to theatre for emergency surgery.

In theatre, the patient was placed in a supine position with the neck hyperextended. After draping, a neck exploration was performed, and the findings of the surgery were a completely severed right and left anterior neck triangle sternocleidomastoid muscle with 60 - 70% of the trachea circumference severed anteriorly (Fig. 2). The carotid arteries and jugular veins were both bruised, but not actively bleeding. The nerves and other organs of the anterior triangles such as the thyroid and thymus were all spared. The operative area was mechanically cleaned and irrigated repeatedly with saline, following which the trachea was sutured and repaired with 7 interrupted sutures using Vicryl 3.0 on a round needle (Fig. 3). Both the left and right anterior neck triangle muscles were approximated with Vicryl 3.0 and finally the skin was closed with Monocryl 4.0 (Fig. 4). The patient was taken to the paediatric intensive care unit (ICU) and intubated for both ventilation and stenting the trachea for 5 days.



*Fig. 1. Initial aspect of the anterior neck area on presentation.*

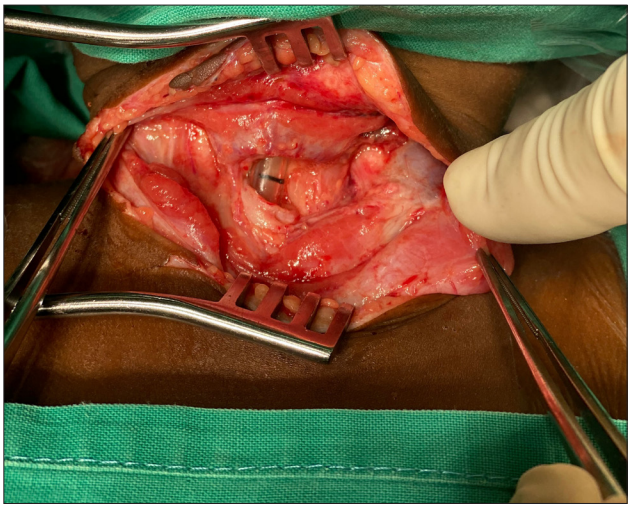


*Fig. 2. Intraoperative view with the endotracheal tube visible in the severed trachea.*

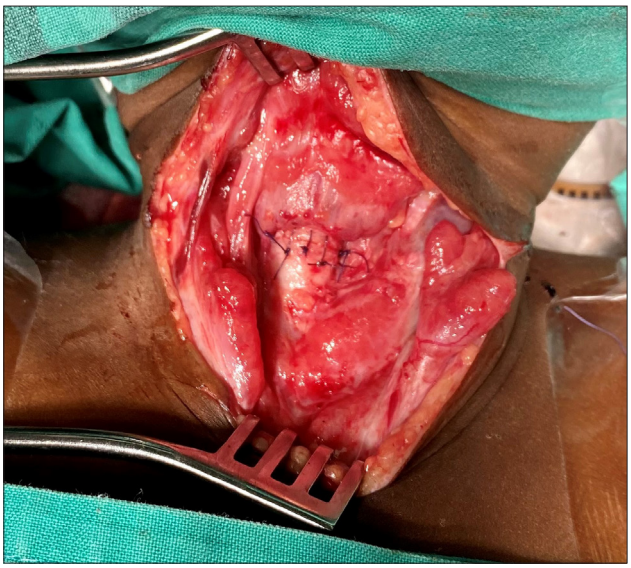


*Fig. 3. View of the trachea after repair with interrupted vicryl sutures.*



*Fig. 4. Aspect of the anterior neck after closure of the skin.*

## Discussion

Penetrating neck injuries are defined as any injury that bridges the platysma muscle. They are potentially life-threatening injuries because of the vital structures in this critical area. In the paediatric population, they are uncommon injuries but when encountered, they prove to be challenging to the frontline medical personnel.

Children have a short neck hosting several important organs such as respiratory (larynx, pharynx), gastrointestinal (oesophagus), endocrine (thymus and thyroid gland), neuromuscular (nerves, carotid arteries, and jugular veins) and skeletal muscles. It is therefore a very difficult area with limited access for operative repair of damaged organs.

Penetrating injuries of the neck are considered life-threatening injuries as they can cause airway obstruction and severe bleeding resulting to hypovolaemic shock. Stab wounds to the neck are usually caused by sharp objects intentionally or unintentionally.

The most frequent symptoms are bleeding from the wound or the mouth due to injuries of the blood vessels, pharynx, larynx or oesophagus, or respiratory distress from tracheal injures depending on the zones of the neck penetrated.

In these types of injuries, it is paramount to secure the airway by intubation or tracheostomy to stop the bleeding by digital compression or catheter tamponade of the bleeding channel and early treatment of shock.

Most of these cases might require surgical exploration in the operating theatre, but in stable patients, imaging can be performed to evaluate the extent of the injuries.

The neck can be divided into three anatomical zones, and this can assist in the prognostication and management of penetrating neck wounds. Zone I extends from the lower border of the cricoid cartilage to the clavicles and thoracic outlet. Within this zone, the trachea, the great vessels, the oesophagus, the upper mediastinum, the lung apices, and the thoracic duct are located. Injuries in this zone have the highest mortality compared with the two other zones. Zone II includes the area between the cricoid cartilage and the angle of the mandible. Enclosed within this region are the carotid and vertebral arteries, jugular veins, pharynx, larynx, oesophagus, and trachea. Zone III involves the area above the angle of the mandible up to the base of the skull and includes the distal extracranial carotid and vertebral arteries as well as segments of the jugular veins. Injury to the index patient was between zone I and II of the neck, as the patient only suffered injuries to the sternocleidomastoid muscle and to the trachea while the carotid arteries and jugular veins were spared.

Prompt initial assessment and institution of management should be carried out according to the advanced trauma life support (ATLS) principles, prioritising the life-threatening conditions first. The ATLS guidelines established by the American College of Surgeons prioritise the airway, breathing and circulation control.

Management of penetrating neck injury ranges from surgical exploration based on the patient's clinical stability or radiological and endoscopy findings.

For stable patients, there is controversy in management algorithms, but the current trend is selective exploration as was followed in this case report. It should be noted that clinical indications for mandatory exploration include active bleeding, pulse deficit, increasing subcutaneous emphysema, haematemesis, haemoptysis, stridor, and worsening hoarseness.

Our patient was kept intubated in the paediatric ICU for 5 days, after which she was discharged to the general ward. The follow-up of the patient was uneventful as she developed no postoperative sequelae or tracheal stenosis. She was referred for post-traumatic counselling.

## Conclusion

This case report demonstrates that rapid resuscitation and early surgical management can be lifesaving and result in good clinical outcome.

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**Author contributions.** Equal contributions.

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**Conflicts of interest.** None.

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# Laparoscopic repair of pericardio-diaphragmatic rupture: A case report

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Diaphragmatic rupture following blunt trauma is a common pathology which has good outomes when discovered early and treated. The common practice has been to manage these patients with either a laparotomy or thoracotomy, with some reports showing the safety of laparoscopy. We present a case of a patient who presented with a pericadio-diaphragmatic rupture who was managed successfully using laparoscopy.

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Blunt diaphragmatic injury can be easily missed at initial presentation, especially in a setting without herniation through the defect. Patients who are diagnosed with diaphragmatic trauma need urgent surgery to prevent herniation of abdominal content or complications associated with herniation. The general management of these patients is a laparotomy or thoracotomy. There have been reports of laparoscopy used to treat these patients; however, this is not widely practised. We present a case of pericardio-diaphragmatic rupture which was managed successfully using laparoscopy.

## Case

A 37-year-old male patient was brought to the emergency room as a referral from a district hospital following a motor vehicle accident. On arrival, his vital signs were as follows: blood pressure of 99/67, pulse of 91, with a respiratory rate of 24 breaths per minute and oxygen saturation at 95% on face mask. He had a left intercostal drain inserted for a clinically diagnosed pneumothorax at the referring hospital. Examination of the cardiovascular system did not reveal any pathology. His Glasgow Coma Scale result was 14/15. He had multiple abrasions and some small lacerations which were not actively bleeding. Clinically there were no fractures noted. All parameters on his arterial blood gas were within normal ranges.

The chest X-ray (CXR) showed a loop of bowel in the left hemithorax with mediastinal shift to the right (Fig. 1). There were associated fractures of the 8th to 10th ribs on the ipsilateral side. No brain injuries were noted on the brain computed tomography (CT) scan. A diagnosis of blunt diaphragmatic rupture with bowel herniation was made and the patient was referred to the surgeons. He was taken for laparoscopic diaphragmatic hernia repair.

Intraoperatively a pericardio-diaphragmatic rupture was discovered, and the stomach and transverse colon had herniated into the chest (Fig. 2). There was no bowel injury from the intercostal drain and there were no other intra-abdominal organ injuries. After reduction of the herniating contents, we proceeded to do laparoscopic repair of the injury. We used interrupted non-absorbable braided polyester suture (Fig. 3). He later developed a lung infection which was managed medically. He was discharged after 2 weeks in hospital after the lung pathology had cleared (Fig. 4).

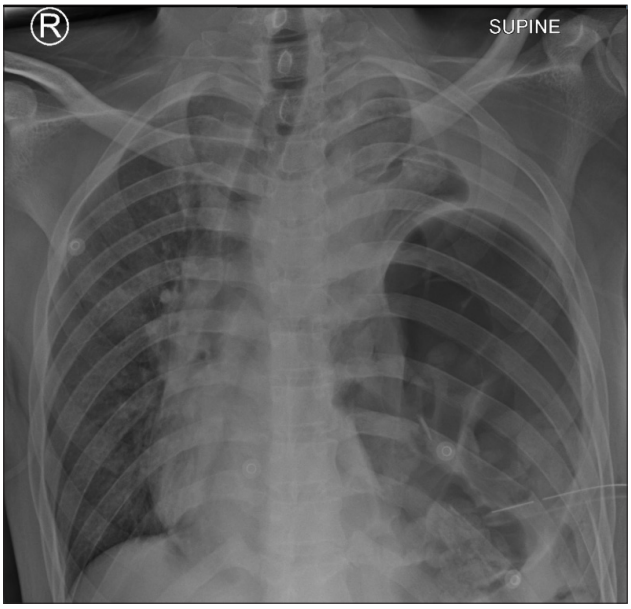



*Fig. 1. Chest X-ray showing a loop of bowel in the left hemithorax with mediastinal shift to the right.*

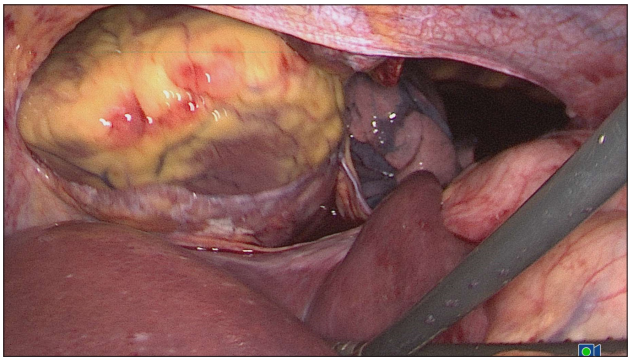


*Fig. 2. Pericardio-diaphragmatic rupture with the stomach and transverse colon herniated into the chest.*

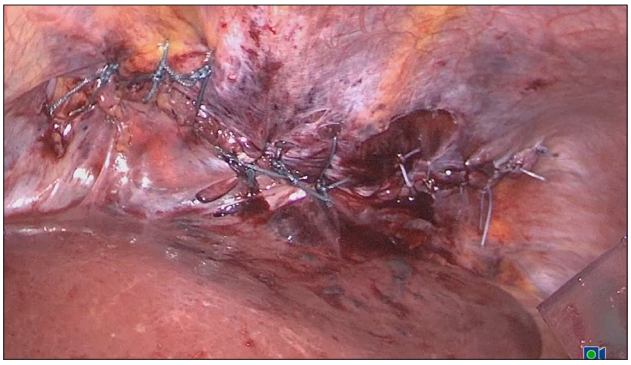


*Fig. 3. Interrupted non-absorbable braided polyester sutures.*

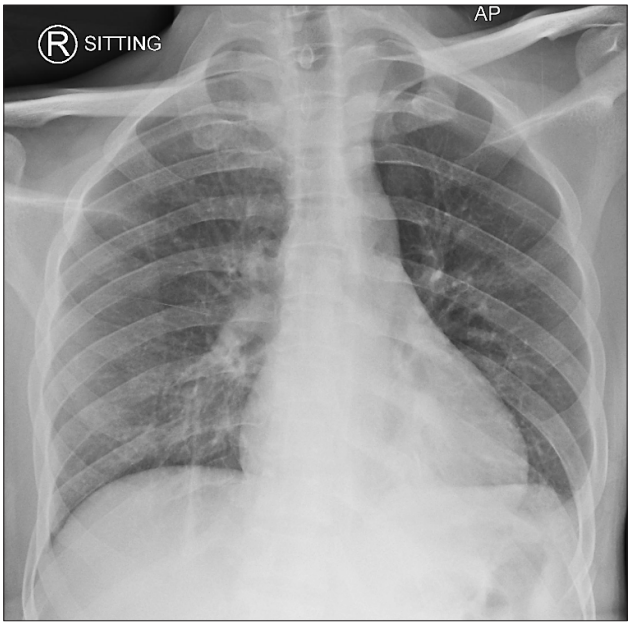



*Fig. 4. Chest X-ray 2 weeks after surgery.*

## Discussion

Traumatic diaphragmatic injury (TDI) is a common condition which may easily be missed. It may result from both penetrating and blunt trauma with penetrating trauma responsible for the majority of cases. It is vital to have a high index of suspicion for TDI in patients with penetrating trauma to the thoraco-abdominal region.[1] In the setting of blunt trauma, TDIs are usually associated with other injuries and may be picked up during investigations for the other injuries. There are no specific symptoms associated with diaphragmatic injury and, because diaphragmatic injuries can be associated with other injuries, they can easily be missed. Patients may present with difficulty in breathing and shock due to the associated injuries. On CXR, TDI may be easily identified when there is associated herniation of intra-abdominal viscera into the chest. The presence of a nasogastric tube or an air-fluid level above the level of the diaphragm can be a diagnostic feature of this pathology. In the absence of herniation, however, the role of a CXR is limited in these patients. Just like the CXR, a CT scan has a high sensitivity and specificity for diagnosing diaphragmatic injury with herniation. It may also be used to determine the viscera which have herniated and other associated injuries.[2,3] Both radiological investigations may miss right-sided diaphragmatic injuries because of the presence of the liver on the right, which usually prevents herniation in the acute phase. The challenge in managing diaphragmatic injuries becomes even more pronounced in the setting of an associated pericardial rupture. This may be suspected if pneumopericardium is noted on radiological imaging. However, in some cases, it may only be detected intra-operatively, as was noted with our case.

TDIs can be managed from either the chest or abdomen, depending on the surgeon's preference. In our institution we have adopted an abdominal approach for all patients with a clinical diagnosis or suspicion of TDI. A thoracic approach is used if there is an associated injury to intrathoracic organs that needs surgical intervention. An intra-abdominal approach allows for exploration of the abdomen and surgical management of associated organ injuries.[4] Whether to repair the diaphragm open or laparoscopically depends on the available expertise. However, we believe that laparoscopy is a viable option for the management of these patients. We offer patients the benefits of laparoscopy, which include less postoperative pain and a shorter hospital stay, especially in the setting of an isolated diaphragmatic injury.

During the repair of the hernia, the goal is to approximate the edges of the defect in a tension-free manner. The recommended material is a non-absorbable suture, as was used in our patient. If approximation of the edges is not possible, then a mesh may be used, bearing in mind the potential complications associated with the use of a mesh in this setting.[5]

## Conclusion

We present a case of a pericardio-diaphragmatic hernia which was repaired successfully using the laparoscopic approach. We propose that whenever the necessary expertise is available, such patients should be offered laparoscopic repair as a standard of care.

**Declaration.** None.

**Acknowledgements.** None.

**Author contributions.** MLP: Performed the surgery and managed the patient; wrote the manuscript. MNL: Co-managed the patient and assisted in writing the manuscript. ABvA: reviewed the manuscript and edited it before submission for publication.

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**Conflicts of interest.** None.

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# Portal vein injury due to blunt abdominal trauma

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Portal vein injuries associated with blunt abdominal force trauma are associated with high mortality. The fatal outcome may be related to various factors, including clinical state at presentation, concurrent injuries and surgical skill during laparotomy. A case of portal vein injury following blunt abdominal trauma sustained in a motor vehicle accident is described.

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The portal vein is formed by union of the superior and inferior mesenteric veins together with the splenic vein behind the liver.[1] Injury to the portal vein is considered rare but carries a high mortality rate.[2] We describe a case of portal vein injury following blunt abdominal trauma sustained in a motor vehicle accident. We review case clinical records and postmortem findings.

## Case

### Clinical history

A 19-year-old woman was referred to our tertiary hospital from a peripheral hospital as a polytrauma case following a motor vehicle accident. She had been a passenger on the back of a 'bakkie' on the day of referral. Injuries sustained included abdominal wall abrasions, two open abdominal wounds with disembowelment, as well as multiple long-bone fractures (right humerus and left tibia). On presentation she was fully conscious with a Glasgow Coma Scale score of 15/15. Her blood pressure was 90/60 mmHg, her heart rate was 100 bpm, her respiratory rate was 26/min and she maintained saturation at 97% on room air. She was fully resuscitated with intravenous fluids and blood products. She was booked for an exploratory laparotomy, wound washout and abdominal wall repair.

The procedure was performed on the day of presentation and extended into the next day. Intraoperatively, the inferior epigastric vessels and branch of common iliac vein were noted to be actively bleeding and were ligated. The abdominal organs including the liver and spleen were reported as intact. The abdomen was washed out and an intra-abdominal drain was left.

Postoperatively the patient was kept in theatre because there was no intensive care bed available. She developed hypotension and tachycardia. She subsequently died 24 hours postoperatively in the operating theatre while still awaiting admission to the intensive care unit.

As per the Inquest Act[3] and Health Professions Amendment Act[4] of the South African legislature, this death is considered unnatural. This case was referred by the South Africa Police Services (SAPS) to the forensic pathology laboratory for postmortem examination. The examination was performed approximately 24 hours post mortem.

### Postmortem findings

Therapeutic measures included laparotomy wound, wound suturing (stapling), intra-abdominal drain placement and orthopaedic backslabs supporting the fractured limbs.

Body surface findings:

- There was a large vertical brush abrasion on the left outer side of the torso.
- There were stapled wounds on the lower abdomen.
- Large area of bruising around the upper aspect of the left thigh around the hip joint.

Internal organ findings:

- The peritoneal cavity contained 600 mL of blood (both fluid and clotted blood). The clotted blood was predominantly localised at the right upper abdominal quadrant.
- There was an incomplete laceration of the portal vein (Fig. 1). This was associated with surrounding clotted haematoma. The haematoma extended around the porta hepatis and into the lesser sac of the stomach (Fig. 2). The gallbladder and the external biliary tracts were intact. The liver was pale with patchy haemorrhagic areas.

Other significant findings included shocked lungs and pale kidneys.

The loops of intestine, the bowel mesentery and the spleen were unremarkable.

## Discussion

Portal vein injuries are considered rare injuries with a high mortality.[2] The mortality rate of traumatic portal vein injury has been reported to range from 50% to 70%.[5]

More commonly, the mechanism of traumatic portal vein injury is penetrating force, either gunshot wound or stab wound, with a minority of cases as a result of blunt force trauma.[2,5] The outcome of blunt force portal vein injuries has been noted to be better than that of penetrating force injuries.[1]

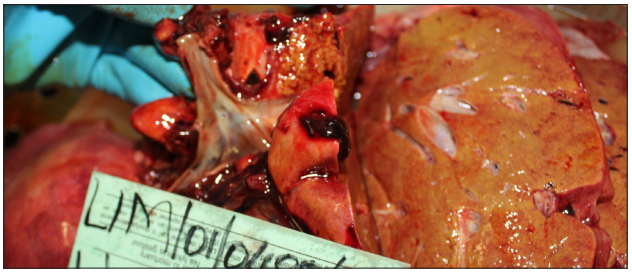


*Fig. 1. Visceral surface of the liver showing the incomplete laceration of the portal vein and cut section of the right liver lobe.*

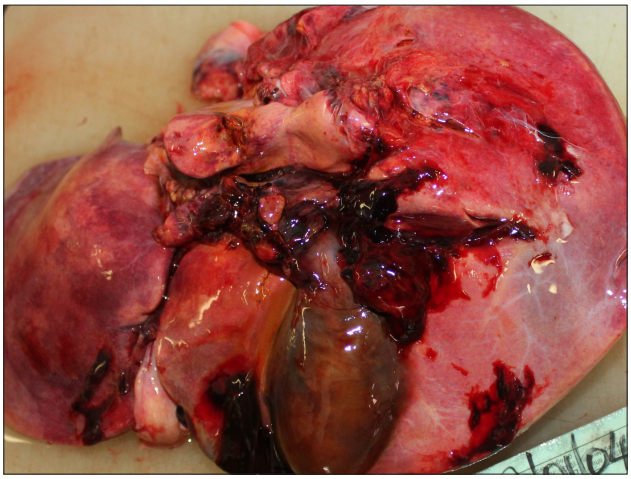


*Fig. 2. Visceral surface of the liver showing haematoma around the porta herpatis.*

Motor vehicle accidents are reported as common causes of blunt abdominal trauma.[1,6] Our case was not an exception to the noted trend as she had been a passenger in a motor vehicle accident.

Blunt injuries to major abdominal vessels are rare.[7] Death associated with major abdominal vascular injury has been reported to be associated with the technical difficulty of isolating the injured vessels, and the commonly encountered haemorrhage obscuring the surgical field.[2] The high mortality associated with portal vein injury has been noted to be related to the difficulty in controlling haemorrhage.[1]

Hypotension or the presence of shock at the time of admission has reportedly been associated with increased risk of mortality.[2] In addition, the presence of additional extra-abdominal injuries increases the risk of mortality owing to blunt abdominal trauma.[8] Blunt abdominal trauma secondary to motor vehicle accidents does not occur in isolation; the presence of extra-abdominal injury may also distract managing clinicians from serious abdominal pathology.[6]

Our patient presented in a state of circulatory shock with a systolic blood pressure of 90 mmHg. There were also extra-abdominal and additional injuries including multiple limb fractures, which may have increased the risk of mortality.

Various modalities may be used in assessment of patients with blunt abdominal trauma. These include physical examination, diagnostic peritoneal lavage, computed tomography (CT) scan, ultrasonography, laparoscopy and laparotomy.[9] The choice of modality to be applied in assessing the injuries would depend on the availability of resources and the clinical state of the patient. Hypotension is one of the indications for emergency laparotomy for blunt abdominal trauma, performed among other indications for haemorrhage control.[10] In the present case, emergency laparotomy was performed and bleeding vessels that were identified were ligated; solid and hollow viscus injuries were ruled out.

When diagnosed and identified, traumatic portal vein injuries are considered most difficult to manage and are more commonly associated with other upper abdominal injuries including injuries to the hepatic artery and extrahepatic biliary duct.[5,11]

In our case, despite intra-abdominal organ exploration during laparotomy, portal vein injuries were missed or not recognised. Missed abdominal injuries carry a high mortality and require complete surgical exploration and early re-operation in cases with multiple injuries.[12]The majority of deaths following blunt force trauma are reported to be due to unrecognised abdominal injuries or under-appreciation of the severity of abdominal injuries.[13]

## Conclusion

Portal vein injury following blunt force trauma to the abdomen may be a very rare event; however, full abdominal examination and exploration during laparotomy to exclude such injury should be performed. There should be a low threshold for early re-exploration in cases of persistent postoperative hypotension.

**Declaration.** None.

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**Author contributions.** ABvA supervised the article written by NR.

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**Conflicts of interest.** None.

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# Tongue granuloma: An unusual complication of potassium permanganate ingestion

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Potassium permanganate ($KMnO_4$) is a powerful oxidising agent. In its raw form, it is an odourless, sweet-tasting, dark-purple substance, available in ready-to-use solutions, pellets, tablets, crystals and powder form. In clinical practice historically, it has been used as an antiseptic and antifungal agent. In rural South African communities, however, $KMnO_4$ has many traditional uses, including use as a snake repellent, a treatment for constipation, joint pains, open wounds, urticaria and even for casting out spells. $KMnO_4$ is kept in most households in rural Limpopo Province, and is therefore easily accessible by children, and alluring because of its sweet taste and similarity to candy. The corrosive effects of $KMnO_4$ ingestion on the gastrointestinal tract are secondary to the formation of potassium hydroxide, a strong alkaline corrosive which causes liquefactive necrosis, allowing deep penetration into mucosal tissue as cells are destroyed. The most common adverse effect of $KMnO_4$ ingestion observed in our practice, and reported in this case report, is an oesophageal stricture. This adverse event often results in children dying from severe gastrointestinal bleeds or complications of tracheoesophageal fistula associated with upper airway obstruction.

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Potassium permanganate ($KMnO_4$) is a powerful oxidising agent. In its raw form, it is an odourless, sweet-tasting and dark purple substance, available in ready-to-use solutions, pellets, tablets, crystals and powder form.[1] It is readily accessible to our rural population over the counter at most local stores and without prescription at pharmacies. In clinical practice, historically it has been used as an antiseptic and antifungal agent. In rural South African (SA) communities, $KMnO_4$ has many traditional uses, including: use as a snake repellent, by mixing it in water and sprinkling it around the yard; treating constipation, joint pains, open wounds, and urticaria; and even for casting out spells.[1] The modes of administration differ, as they involve bathing in the solution, oral ingestion, enema administration and herbal compresses. $KMnO_4$ is kept in most households in our population for such uses, and is therefore easily accessible by children, and alluring because of its sweet taste and similarity to candy.[1]

Symptoms and complications of $KMnO_4$ ingestion in children have been documented, and include dysphagia, odynophagia, nausea and vomiting, the result of gastrointestinal oedema, erosion and ulcerations of the gastrointestinal epithelium.[2] Severe complications include oesophageal perforation, mediastinitis associated with upper airway obstruction, hepatic and renal toxicity, and cardiovascular depression.[2] The most common adverse effect of $KMnO_4$ ingestion observed in our practice, and reported in this case report, is oesophageal stricture. Many patients have died from severe gastrointestinal bleeds and tracheoesophageal fistula associated with upper airway obstruction.[2] The corrosive effects of $KMnO_4$ ingestion on the gastrointestinal tract is secondary to the formation of potassium hydroxide, a strong alkaline corrosive which causes liquefactive necrosis, allowing deep penetration into mucosal tissue as cells are destroyed.[2] Its over-the-counter availability has contributed to its harmful potential being overlooked. It is reported that children ingest $KMnO_4$ after mistaking it for sweets or juice.[1]

## Case

A 3-year-old girl presented to casualty after ingestion of $KMnO_4$ crystals, following which she had episodes of vomiting and difficulty in breathing. On arrival, she was conscious but irritable, crying, with tachypnoea and stridor. Her vitals were as follows: heart rate 140 bpm, respiratory rate 29 breaths per minute, and oxygen saturation ($SpO_2$) was 74% on room air. On physical examination, her oral cavity showed a very swollen tongue, with brown stains on the tongue and teeth. Her airway was obstructed by the swollen tongue and stridor was present. Her breathing was rapid. Systemic examination was unremarkable. All her laboratory values were normal. Chest radiograph was normal. Her past medical history was unremarkable. She was intubated and admitted to the intensive care unit (ICU) for 3 days. Our service was consulted 3 days after ICU admission and extubation. As this was 72 hours post trauma, endoscopy could not be done.

After extubation, the patient had hypersalivation and was not tolerating oral feeds. She was given total parenteral nutrition (TPN). A barium swallow on day 14 revealed irregularity and narrowing of the proximal oesophagus, with no evidence of perforation.

She underwent endoscopy and was found to have a stricture 10 cm into the proximal oesophagus. Balloon dilatations were performed to a pressure of only 2 mmHg. A decision was made to place a gastrostomy tube.

Three weeks post trauma she presented with a mass on the top of the tongue which was pulling the tip of the tongue superiorly and posteriorly (Fig. 1). On examination, an assessment of a tongue granuloma as a complication of caustic ingestion was made. Complete excision was done in theatre (Fig. 2).

Follow-up endoscopies were attempted but full dilation was still not possible because of the stricture being tight; the only option left was surgical management. The patient was then taken for a resection of the affected stricture and anastomosis. A barium swallow was done on day 5 post surgery (Fig. 3) which showed no leak of contrast and she was discharged, with a follow-up appointment in 2 weeks.

Two weeks after surgery she had saliva leaking from the cervical incision, which was evidence of anastomotic breakdown.

## Discussion

Caustic and corrosive substance ingestion causes tissue injury by

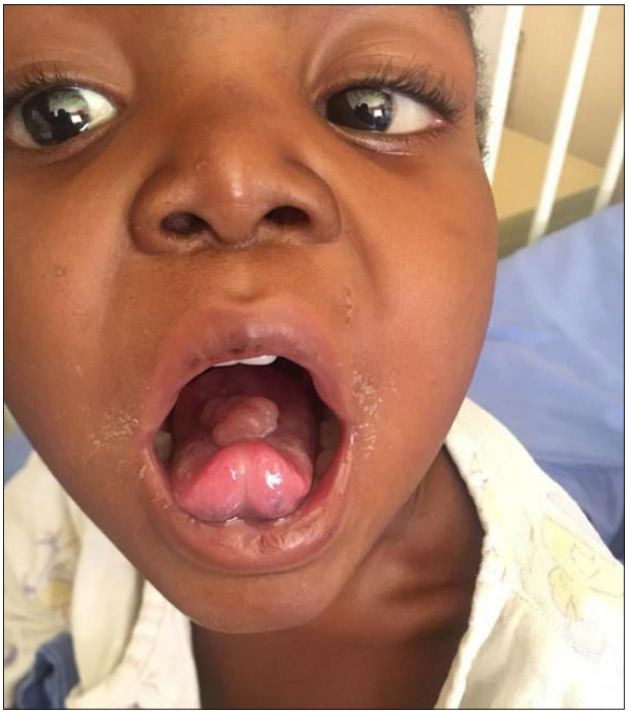


*Fig. 1. Granuloma pulling the tip of the tongue superiorly and posteriorly.*



*Fig. 2. Post excision of the granuloma.*

chemical reaction.[3] Both acidic and alkaline substances are involved (Table 1).[2] Ingestion of these substances can be deliberate, as in suicide in adults, or accidental, in children under 6 years old.[4] The outcome of ingesting these substances can be devastating and depends on several factors, e.g. the physical form of the ingested product, type, amount, concentration, pre-ingestion condition of tissues and duration of contact.[2] Commonly ingested substances in SA, including domestic cleaning products, with their pH values, are listed in Table 2.

Strong acids are the most commonly ingested corrosive chemicals. They cause immediate severe oropharyngeal pain. This may be the reason they are usually consumed in small volumes compared with alkaline substances. They have less surface tension and pass rapidly through the oesophagus, resulting in fewer oesophageal injuries.[2] They most commonly cause gastric injuries.



*Fig. 3. Contrast swallow 5 days after resection of oesophageal stricture and anastomosis.*

**Table 1. Acid and alkaline substances**

| Type | Example |
|---|---|
| Alkali | Sodium hydroxide, potassium hydroxide, (oven cleaners, liquid agents, liquid drain cleaners, disc batteries), calcium and lithium hydroxide (hair relaxers), ammonia (household cleaners), dishwasher detergents |
| Acid | Sulphuric acid, hydrochloric acid, nitric acid (toilet bowel cleaners, swimming pool cleaners, rust removers) |
| Bleaches and other caustics | Hypochlorous acid (bleach - generally neutral pH commercially), peroxide (mildew remover) |

**Table 2. Commonly ingested acid and alkaline substances**

| pH | Examples of solutions |
|---|---|
| 0 | Battery acid, strong hydrofluoric acid |
| 1 | Hydrochloric acid secreted by stomach lining |
| 2 | Lemon juice, gastric acid, vinegar |
| 3 | Grapefruit juice, orange juice, soda |
| 4 | Tomato juice, acid rain |
| 5 | Soft drinking water, black coffee |
| 6 | Urine and saliva |
| 7 | Pure water |
| 8 | Sea water |
| 9 | Baking soda |
| 10 | Great Salt Lake, milk of magnesia |
| 11 | Ammonia solution |
| 12 | Soapy water |
| 13 | Bleach, oven cleaner |
| 14 | Liquid drain cleaner |

Strong alkaline substances produce deep injuries by adhering to the mucosa of the mouth and oesophagus, mostly sparing the stomach.[2] They combine with tissue proteins to cause liquefactive necrosis and saponification, leading to full-thickness damage and vascular thrombosis. Granular products cause more serious injuries owing to prolonged-contact mucosal time.[2] Ingestion of alkaline disc batteries containing 45% solution of potassium hydroxide or sodium hydroxide leads to leakage and damage to the oesophagus within 1 hour and perforation in 8 - 12 hours. Emergency removal is mandatory.[2]

Following caustic ingestion, patients may be asymptomatic or present with nausea, vomiting, dysphagia, odynophagia, drooling, abdominal pains, respiratory distress and stridor.

Initial management includes airway management, fluid resuscitation and stabilisation. Assessment of oesophageal/gastric injury through flexible upper endoscopy should be done within 24 - 48 hours of ingestion, unless there is evidence of perforation, which can be seen on chest and abdominal X-rays. The injured oesophagus is weakest between day 7 and day 21 post ingestion;[2] therefore endoscopy should not be performed later than 5 days post ingestion to minimise risk of bleeding and perforation.[2]

Patients with no symptoms, no oral lesions and vague history do not have to undergo endoscopy. They can be given oral fluids and go home after being observed for a few hours.[2] Classifica tion of caustic injuries is similar to that of burns. This classification is based on endoscopic evaluation and is used to predict clinical outcome and course.[5]

Grade 0 - 2a injuries can take oral fluids and be discharged once symptoms resolve. Grade 2b - 3 injuries should be observed for 24 - 48 hours before starting feeds.[2] Proton pump inhibitors, antibiotics and antifungal agents are given for injuries classified as grade 2b and above. Oesophageal strictures are common in severe injuries. They occur in 70% of patients with grade 2b and in 100% of patients with grade 3 injuries. Patients with grade 2b - 3 injuries should have a barium swallow 2 - 3 weeks after injury to check for a possible stricture.[2]

After a stricture has been identified, the cornerstone of non-operative treatment is dilatations performed with a balloon dilator or semi-rigid Savary-Gilliard bougies (Cook Medical, USA). When non-operative management fails, operative management becomes necessary. Currently accepted surgical management includes resection of the affected segment with end-to-end anastomosis or oesophageal replacement.

## Conclusion

Easy access to a dangerous substance such as $KMnO_4$ causes devastating injuries and long-term morbidity among children of Limpopo Province and the country as a whole. Its benefits do not outweigh its dangerous effects. Failure to store the chemical substance in child-proof containers over many years is a clear indication of lack of insight related to its effects. Community educational programmes regarding the dangers of $KMnO_4$ and its storage are needed. Most importantly, it is imperative for the Department of Health to red flag this substance and make it illegal to sell it over the counter, if not ban it completely.

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**Author contributions.** NM initiated the concept and drafted the manuscript. EM read, edited, supervised and approved the manuscript.

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**Conflicts of interest.** None.

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# Missed traumatic diaphragmatic hernia and literature review

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The diagnosis of traumatic diaphragmatic rupture owing to blunt or penetrating injuries may be missed in acute case presentations. Mortality in patients with acute blunt injuries is highest in those with associated organ damage. The diagnosis of diaphragmatic injuries may be missed because of delayed case presentation or delayed diagnosis. Diaphragmatic injuries should be suspected in all patients with blunt or penetrating injuries of the chest and abdomen. Special care must be taken during the insertion of intercostal drains to the chest in order to avoid iatrogenic injury to the stomach, bowel and other organs, particularly in cases when a missed diaphragmatic injury cannot be excluded. We share in this article our experiences with two cases of missed traumatic diaphragmatic injuries, one on the left and the other on the right side.

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The diagnosis of traumatic diaphragmatic rupture owing to blunt or penetrating injuries may be missed in acute case presentation. Surgical treatment is almost always required in order to reduce herniated organs and repair defects.[1] Missed diaphragmatic injuries may occur as a result of delayed case presentation or a delayed diagnosis.[1] The rate of initially missed diaphragmatic injury ranges from 12% to 66%, and they may even be overlooked during laparotomy.[2] Diaphragmatic injuries should be suspected in all patients with blunt or penetrating traumatic injury of the chest and abdomen.[3] Such injuries were first described in a letter written by Sennertus to Hildan in 1541, who documented the autopsy finding of a herniated stomach through a diaphragmatic injury caused by a self-inflicted stab wound.[4] Diaphragmatic injuries occur more commonly with penetrating trauma than blunt trauma as penetrating trauma is more frequently related to stabbings.[1] Penetrating injuries of the diaphragm tend to be smaller, often measuring less than 2 cm, they are more likely to be occult and often result in a delayed diagnosis.[5] A high index of suspicion must be maintained in order to prevent diagnostic errors of diaphragmatic injuries or related complications, particularly penetrating trauma of the lower chest or upper abdomen.[5,6] A missed diaphragmatic injury may result in delayed herniation with an increased mortality rate of between 36% and 48% when diagnosed late.[6] Here we share our experience of two cases of missed traumatic diaphragmatic injury, one on the left and the other on the right side. Ethical approval was obtained from Pietersburg/Mankweng Research Ethics Committee (ref. no. PMREC 21 JULY UL 2021/B).

## Cases

### Case 1

An 18-year-old male patient was referred from a local hospital with a 2-day history of a stab wound in the left chest just below the nipple and an intercostal drain (ICD), which was inserted under the premise of a simple pneumothorax. The patient was transferred to our institution, Mankweng Hospital, because no improvement in condition was observed. Upon arrival at our hospital, the patient was haemodynamically stable. There was a chest laceration in the left 5th intercostal space with ICD *in situ*, which had drained 700 mL of blood. Auscultation revealed decreased air entry on the left side of the chest. The abdomen was not distended, and neither tender nor rigid. The chest X-ray (CXR) (Fig. 1) displayed a left-sided haemothorax and elevated left hemidiaphragm. We diagnosed a diaphragmatic hernia. Subsequent exploratory laparotomy revealed stomach and transverse colon herniated into the chest cavity with an additional grade 1 splenic injury. The diaphragmatic hernia was repaired, ICD repositioned, and the splenic injury did not require surgical intervention. The patient suffered no further complications and was later discharged in good general condition.

### Case 2

A 30-year-old male patient was transferred from a peripheral hospital to Mankweng Hospital, 48 hours after being assaulted, with multiple stab wounds in the chest and abdomen. On examination, the patient was haemodynamically stable, with normal palpable pulses, and no obvious active bleeding observed. Auscultation revealed decreased air entry bilaterally. An ICD had been inserted on the right side

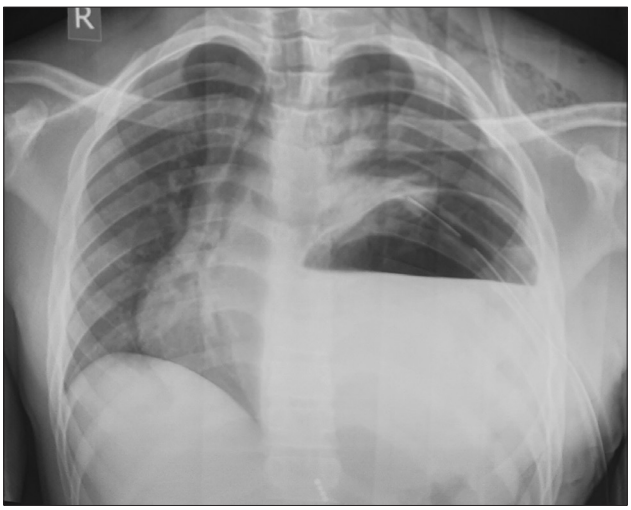



*Fig. 1. Chest X-ray displaying a left-sided haemothorax and elevated left hemidiaphragm.*

of the chest. There was a stab wound below the angle of the right scapula, and another stab wound in the left hypochondrium, which had been sutured. The abdomen was peritonitic. The CXR showed a left-sided haemopneumothorax; therefore a second ICD was inserted on the left side. The patient gave consent for exploratory laparotomy. Intraoperatively we found a 2 cm-long perforation of the transverse colon with leaking faeces. The perforation was repaired in the standard way. Post-operatively, on the ward, the patient developed respiratory distress. On the basis of the subsequent CXR (Fig. 2), a right-side diaphragmatic hernia (bowel) was suspected. A computed tomography (CT) scan of the chest (Fig. 3) revealed a right posterior traumatic diaphragmatic hernia, bilateral haemopneumothorax with passive atelectasis, a right loculated pneumothorax and grade 2 liver injury. The patient was referred to the cardiothoracic unit of a provincial academic hospital for further management.

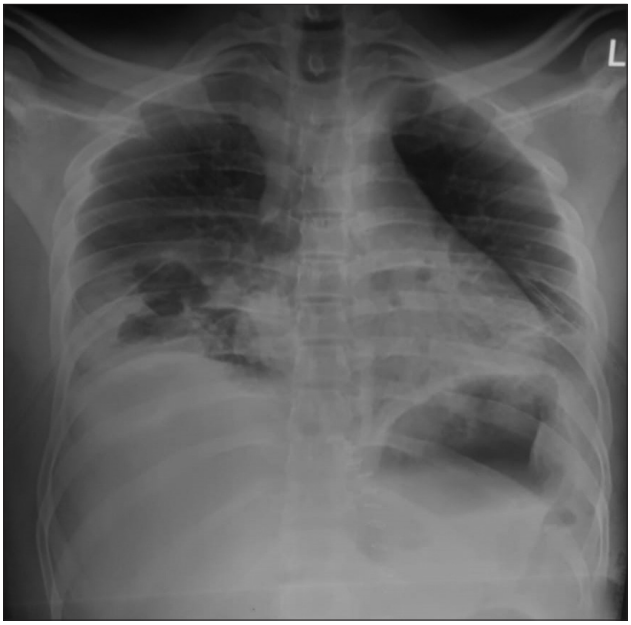



*Fig. 2. Chest X-ray suggesting a right-side diaphragmatic hernia of the bowel.*

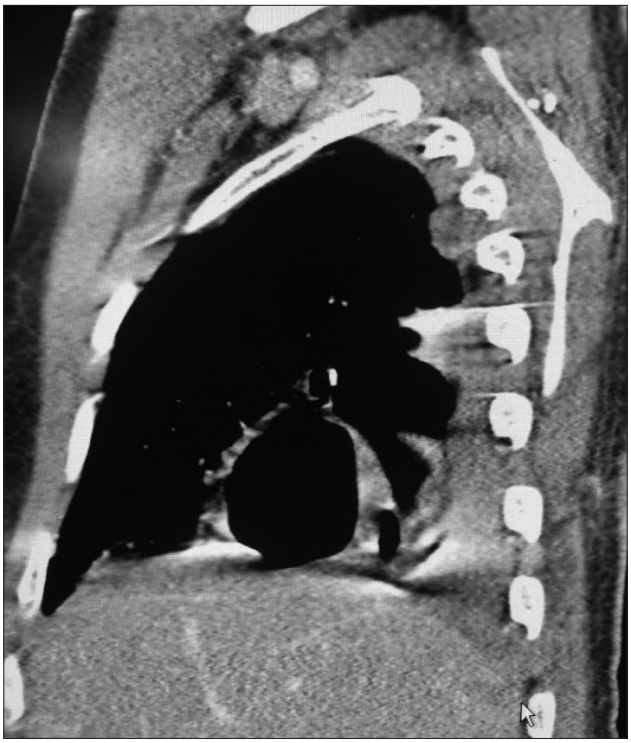


*Fig. 3. Computed tomography scan of the chest revealing a right posterior traumatic diaphragmatic hernia.*

## Discussion

The diaphragm is rarely injured alone, and most patients have concomitant abdominal, head or thoracic injuries. Splenic ruptures or liver lacerations are not uncommon injuries in patients with diaphragmatic trauma.[1] Any penetrating injuries to the abdomen or chest from the T4 to T12 dermatome anteriorly and L3 region posteriorly should be considered to have potential diaphragmatic injuries. Left-sided injuries are more common, but small penetrating injuries are more likely to be occult, which frequently result in a delayed diagnosis.[3] Although chest tube insertion is a commonly performed procedure in hospitals and is a lifesaving procedure for a pneumothorax, it may cause perforation of a herniated stomach through a diaphragmatic injury if the diagnosis of diaphragmatic injury is missed.[7] In our first case, simple pneumothorax was incorrectly diagnosed, and an ICD was placed as the definitive treatment. Subsequent lack of clinical improvement resulted in patient transfer to Mankweng Hospital. At our institution, the chest X-ray strongly suggested the presence of diaphragmatic hernia with pneumothorax. Laparotomy revealed that the stomach and transverse colon had herniated into the chest cavity. After reduction of the herniated organs, the appropriate hernia repair was successfully done. The patient recovered without further complications and was discharged home shortly afterwards. Late occult hernias cause more complications requiring more difficult operations, thoracotomy or laparotomy. Blunt-trauma-related diaphragmatic ruptures occur when intra-abdominal pressure suddenly rises above the tensile strength of the diaphragmatic tissue. Blunt traumas produce larger, radial tears, often measuring 5 - 15 cm.[4] The incidence of right-sided diaphragmatic injuries is low because of the cushioning effects of the liver. When right-sided injuries to the diaphragm are present, the morbidity and mortality rates are higher, owing to other associated injuries being more severe.[8]

A history of thoraco-abdominal injuries must be thoroughly obtained from patients, while being aware of possible diaphragmatic injuries. A high index of suspicion and use of radiological investigations is essential for prompt correct diagnosis.[6] Delayed diagnosis is common, and it can occur as late as 15 years following an initial injury.[9] If the correct diagnosis is missed, patients may be referred later with herniation of bowel contents into the chest, obstructions, or strangulations of intra-abdominal organs.[1] Herniation on the right side is missed more commonly,[6,10] as was evident in our second case.

Intra-abdominal injuries may be excluded by a detailed clinical examination along with radiological investigations, and if available, a minimally invasive surgical approach. The placement of a nasogastric tube may also be helpful in making the diagnosis. Injuries to the diaphragm do not heal spontaneously; therefore operative repair is always required for left-sided injuries, and for most right-sided injuries.[8]

A review of delayed presentation of diaphragmatic ruptures found chest radiographs for left-sided injuries were diagnostic in 46% of patients, and in 17% for right-sided.[8] On occasion, the CXR might show the pathognomic signs of a diaphragmatic injury, such as a nasogastric tube within the chest, hepatic displacement into the right hemithorax or herniated bowel loops inside the chest, with or without focal constrictions of the viscus at the herniation site. Herniations at the costophrenic angle may be misdiagnosed on chest radiograph, appearing as pleural effusions or a haemothorax. CT scans are very useful in detecting diaphragmatic injuries.[6]

With increasing utilisation of laparoscopy and thoracoscopy, more diaphragmatic injuries are diagnosed correctly. In a 2007 study,[6] the diagnostic accuracy of thoracoscopy in occult diaphragmatic injuries after penetrating injury was 100%. Laparotomy appears to be more appropriate in cases with haemodynamic instability, peritonitis and when intra-abdominal lesions are suspected. During laparotomy, regardless of the suspected diagnosis, full examination of the whole diaphragm should be undertaken.[4] The use of non-absorbable sutures is widely recommended. Interrupted and continuous techniques are equally effective and, while simple sutures are sufficient in small defects, large defects require a synthetic mesh.[6,11]

## Conclusion

A high index of suspicion must be maintained in order to prevent the incorrect diagnosis and complications of missed diaphragmatic injuries. These injuries may result in herniation or strangulation of abdominal organs into the thoracic cavity through traumatic defects in the diaphragm. Proper care needs to be taken when inserting ICDs in order to avoid iatrogenic injury of the stomach, bowel and other organs, especially in cases of suspected diaphragmatic injuries.

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**Author contributions.** Both authors made substantial contributions to the following: data gathering and literature research; and gaining ethical approval. MR was responsible for initial writing of the manuscript and MMZUB for final writing and editing.

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**Conflicts of interest.** None.

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# Advanced breast cancer in a case of Down syndrome: Presenting a rare occurrence from Mankweng Hospital breast oncology clinic, Limpopo Province, South Africa

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Down syndrome is a genetic condition characterised by the presence of all or part of an extra chromosome 21 and is linked to a spectrum of medical and phenotypic features. Chromosome 21 is associated with tumour suppressor gene expression. Individuals with trisomy 21 have tend to have societal and hormonal risk factors for breast cancer. Here, we present a case of a 26-year-old female patient who presented at Mankweng Hospital breast oncology clinic with a left breast lump. She was born with downs syndrome and early on from birth was noted to have hypothyroidism and no other associated congenital defects. This young lady and her mother started noticing a lump in her left breast, which had been progressively growing over the past 2 years. It was not painful, was no associated with skin changes or nipple discharge and no axillary masses were noted.

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Down syndrome is a genetic condition characterised by the presence of all or part of an extra chromosome 21 and is linked to a spectrum of medical and phenotypic features.[1-3] Chromosome 21 is associated with tumour suppressor gene expression, and the presence of the extra chromosome allows for some favourable effects, making it one of the most powerful natural protection agents against many solid tumours such as breast cancer in women.[3] On the other hand, individuals with trisomy 21 tend to have societal and hormonal risk factors for breast cancer, including frequent nulliparity, lack of breastfeeding, physical inactivity and high body mass index,[4] and unfortunately they are also prone to blood cancers such as leukaemia.[5]

The life expectancy of individuals living with Down syndrome has increased markedly from 25 to 60 years in the past 30 years.[6] With that came questions as to whether screening policies for breast cancer should also apply to people with Down syndrome as compared with the general population. In particular screening policies such as mammography have been looked at. It was found that it did not serve much of a clinical benefit and to be financially costly. The cost per finding was high, hence the benefit of mammograms is questionable, and the potential for harm appears to be greater as studies have demonstrated that <1% of the women with Down syndrome develop breast cancer.[6-9]

Dey *et al.*[2] reported the first case of triple negative breast cancer, and we report a similar case in a 26-year old woman with breast cancer in Down syndrome subtype luminal A. We are hoping to bring further insights into this rare condition and spark research that will assist in gaining more insights into this condition. Ethical approval was obtained from Pietersburg/Mankweng Hospital Research Ethics Committee (ref. no. PMREC 26 MAY UL 2021/B).

## Case

A 26-year-old female patient presented at Mankweng Hospital breast oncology clinic as a referral from a peripheral hospital. She was born in a rural township as one of six siblings. At a young age, her mother noticed that her development was grossly delayed compared with the other children. She was born with Down syndrome and was noted to have hypothyroidism. No other associated congenital defects were detected at birth. She was solely cared for by her family and was never able to go to school due to need for special schooling and the family's financial constraints.

This young lady and her mom started noticing a lump in her left breast, which had been progressively growing over the past 2 years. It was not painful, had no associated skin changes or nipple discharge, and no axillary masses were noted. Menarche was reported to have been at 15 years of age, she experienced regular menstrual periods, was not on contraception and has never been pregnant.

Although she was noted to have low thyroid levels at birth, she was not on treatment and was clinically euthyroid. She had no previous operations and no comorbid conditions of note. The patient had completed neo-adjuvant therapy within a week of presenting to the clinic. Prior to chemotherapy, she was assessed as stage 4 breast cancer, with a tumour size of 7 cm in its greatest diameter in the left upper outer breast quadrant. There was no skin or chest involvement, but there was ipsilateral axillary lymph node involvement and metastasis to the thoraco-lumbar spine detected on bone scan. Family history as well as social history was non-contributory. Upon examination, she was found to be of short stature and had physical features in keeping with Down syndrome. Vitals were stable, with blood pressure at 100/67 mmHg and pulse at 75 beats per minute. She was apyrexial and weighed 65.5 kg. Breast examination showed asymmetrical breasts with left breast showing a bulge over the upper outer quadrant. No skin changes, and no palpable axillary lymph nodes. There was a palpable mass on the outer upper quadrant that was 5 cm in its widest diameter. It was not attached to the skin of the chest wall. The cancer was clinically stage 4, with bone metastasis to the 9th and 5th lumbar vertebrae. The rest of the. The rest of the systematic examination was unremarkable. Histology results from a core biopsy confirmed an infiltrating ductal subtype/carcinoma of no special type. Modified Nottingham-Bloom-Richardson grading score was a total score of 7 (tubules = 3, pleomorphism = 3, mitoses = 1), making it a grade 2 or moderately differentiated adenocarcinoma. Immunohistochemistry revealed that the cells were oestrogen

receptor positive, progesterone receptor positive, c-erbB positive and 8% of the cells were Ki-67 positive, making it a luminal B (HER2-positive) molecular subtype. Mammogram findings were breast imaging – reporting and data system (BI-RADS) 5, which was highly suggestive of malignancy on the left breast. Bone scan revealed bone metastasis localised to the 9th thoracic and 5th lumbar vertebrae. Tumour marker (CA 15-3) was 7. The patient had a good clinical response to chemotherapy and a simple mastectomy was done.

## Discussion

This case is similar to the previously described case of triple negative breast cancer in Down syndrome.[2] However, to the best of our knowledge, it is a first of its kind to be described as an advanced stage 4 luminal B (HER2+) breast cancer in an African female. Among the many genes expressed in chromosome 21, of particular importance is *runx1*. Runt-related transcription factor 1 (RUNX1), also known as acute myeloid leukaemia 1 (AML1) protein or core-binding factor subunit alpha-2 (CBFA2), is a protein that is encoded by the *runx1* gene in humans.[10] RUNX1 plays a critical role in the early stages of haematopoiesis, is often expressed in breast epithelium, and is deregulated during tumorigenesis. It has been noted that *runx1* functions as both an oncogene and tumour suppressor gene in breast cancer, acting as a tumour suppressor in oestrogen receptor-positive tumours and an oncogene in oestrogen receptor-negative tumours.[10] Understanding the role of RUNX1 does provide some insight into why individuals with Down syndrome have a higher risk of leukaemia and a reduced case frequency of breast cancer. More studies are needed to further clarify this, and hopefully in future we will be able to propose screening techniques for individuals living with Down syndrome who may have an increased risk of also developing breast cancer rather than using the same screening techniques used for screening non-Down syndrome patients, which has been shown to be of no clinical benefit and is costly.[8]

The patient in the case study had breast cancer, which was classified with the use of immunohistochemistry as luminal B (oestrogen receptor-positive, progesterone receptor-positive, HER2+ and Ki 67 of 8%) molecular subtype. Based on a study conducted at Third Hospital of Nanchang City[11] over the period 2005 - 2015, luminal B was found to the commonest subtype, and the majority of the affected individuals were below the age of 50 years ($p$=0.018). Furthermore, luminal B has been associated with unfavourable clinical outcomes such as poorer disease-free survival, increased risk of early relapse, appears to be limited to the early period after surgery and within the first 5 years after diagnosis, predisposition to relapse in bone and pleura similar to luminal A, with bone metastasis more common than lung, relative insensitivity to endocrine therapy compared with luminal A subtype and relative insensitivity to chemotherapy compared with basal-like and HER2-positive subtypes.[12-14] With such poor clinical outcomes, the need for early detection, diagnosis and individualised treatment strategies remains of crucial importance, more so for individuals living with Down syndrome, as other than having intellectual disability, social and financial constraints, they suffer from other medical conditions that can alter adherence to treatment and follow-up as luminal-B breast cancer has been shown to have poor response to hormonal and chemotherapy. [13] Management stills remains a challenge for individuals with luminal-B breast cancer.

## Conclusion

Luminal-B subtype remains a clinically important classification of breast cancer with prognostic and potential predictive implications. Due to the nature of the impairments in individuals with Down syndrome, such as intellectual disability, it may be difficult for early recognition of many conditions, breast cancer included, and hence poses an early detection and diagnostic challenge. For these reasons, an understanding of the relationship between breast cancer, molecular subtypes and Down syndrome is vital for researchers and clinicians, and for the education of individuals living with Down syndrome and their families, more so for the formulation of individualised treatment strategies. More research is encouraged to further guide our understanding and aid in the formulation of management protocols relevant to this population.

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