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Table of Contents

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Pancreatic Abscess: An Infection Occurring with Minimal Tissue Present

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Abstract

Pancreatic abscess typically occurs 4 weeks after acute pancreatitis begins and is defined as an infection of the pancreatic pseudocyst. There are other causes which include but are not limited to iatrogenic intra-abdominal procedures, chronic pancreatitis, and sending from distant sites. These abscesses are typically collections of pus that are within the region of the pancreas. There is also pancreatic necrosis that is seen among these abscesses. Here is a report on a case of a pancreatic abscess of unusual occurrence in a patient that had a near-total distal pancreatectomy. This is uncommon as the patient has very minimal pancreatic tissue remaining, yet still has developed this intra-abdominal abscess. These abscesses must be recognized quickly and removed to prevent further complications from occurring.

Keywords

Pancreatic Abscess, Pancreatic Pseudocyst, Pancreatitis, Pancreatectomy

1. Background

The Atlanta classification defines the verbiage commonly used to describe the infectious complications of acute pancreatitis. The definition of pancreatic abscess is known as a collection of purulent pancreatic material that is within a more-or-less defined fibrous tissue wall and contained in it. This distinguishes it from infected pseudocyst (an encapsulated collection of pancreatic juice from which bacteria can be grown) and infected necrosis (semi-liquefied peripancreatic tissue with positive microbial cultures). Infected necrosis is where most pancreatic abscesses start, typically longer than 4 weeks after acute pancreatitis has begun.

The patient would present with symptoms that include, but are not limited to fever, tachycardia, and failure of symptomatic improvement over several days from onset of acute pancreatitis. The diagnostics done that aid in determining the necrotizing infection of the pancreas include laboratory studies showing leukocytosis, bacteremia, and elevated inflammatory markers. Also, CT of the abdomen can show if there is gas within the pancreas or around the surrounding tissue. It can also show some collections of fluid around the pancreas.

The interesting part of this case is the existence of a collection of bacteria, pus, and gas around the pancreas with limited pancreatic tissue that tends to be a niche for abscess formation. The patient had most of the pancreas removed already, and yet was still able to develop an infection in the anatomic position of the pancreas status post pancreatectomy. There have been limited reports on abscess formation in individuals without pancreatic tissue. Therefore, there should be more reports to be able to find out the exact etiology of how the abscesses form without a niche for infection. The treatment entails broad spectrum antibiotics that are able to cover gram negative bacteria. Also, draining the infected material is necessary if there are signs of clinical deterioration. Prompt treatment is necessary to prevent severe complications from infection.

2. Case Report

The patient is a 56-year-old male with a past medical history of hyperlipidemia, pancreatic adenocarcinoma on chemotherapy, diabetes, 6 months prior status post near-total distal pancreatectomy, pancreatic pseudocyst (discovered 3 months earlier), and splenectomy that complained of progressive persistent worsening abdominal non-radiating pain in the left upper quadrant. There was associated bilious vomiting about eight times, nausea, chills, and abdominal distension; however, the patient did not complain of fever nor any bowel movement changes.

Vitals were stable and labs were insignificant (no leukocytosis or elevated inflammatory markers). There was significant increase in the size of the pancreatic cyst close to the head of the pancreas as well as gastric outlet obstruction seen on CT scan of the abdomen (Figure 1). Ampicillin/sulbactam was started for the

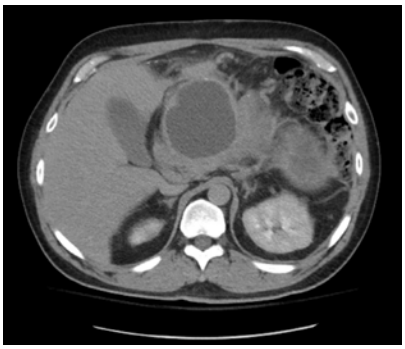

Figure 1. CT Abdomen and pelvis with contrast of the pancreatic abscess.

patient to cover gram negative bacteria as well as anaerobes. The Gastroenterology team was consulted and they evaluated the patient. On the day of presentation, it was decided to take the patient for EGD/EUS and cystogastrostomy (Figure 2). There was a stent placed [with drainage into the stomach], aspiration of the cyst, the purulent fluid was collected and the culture that was sent had come back positive for *Klebsiella pneumoniae* (resistant to ampicillin and sensitive to different antibiotics). Patient stated there was relief after the procedure, and he was sent home on Ciprofloxacin for 2 weeks. There was a follow-up EGD that was completed for necrosectomy and the stent was removed after which the patient reported great relief of symptoms.

3. Discussion

Pancreatic abscess can be caused iatrogenically when treating for necrotizing pancreatitis. [1] It can also happen in the absence of pancreatitis due to duodenal disease or biliary tract disease. [2] There should be a high index of suspicion for patients that have acute pancreatitis in which they don't improve after initial management. Moreso, when they have an elevated RANSON score of 3 - 7 which has 24% more likelihood of pancreatitis mortality. [3] Also, in chronic pancreatitis, patients with persistent abdominal pain should be evaluated as chronic pancreatitis could cause death and systemic inflammatory response syndrome. [4] The gold standard in diagnosis is CT scan with a sensitivity of 74% compared

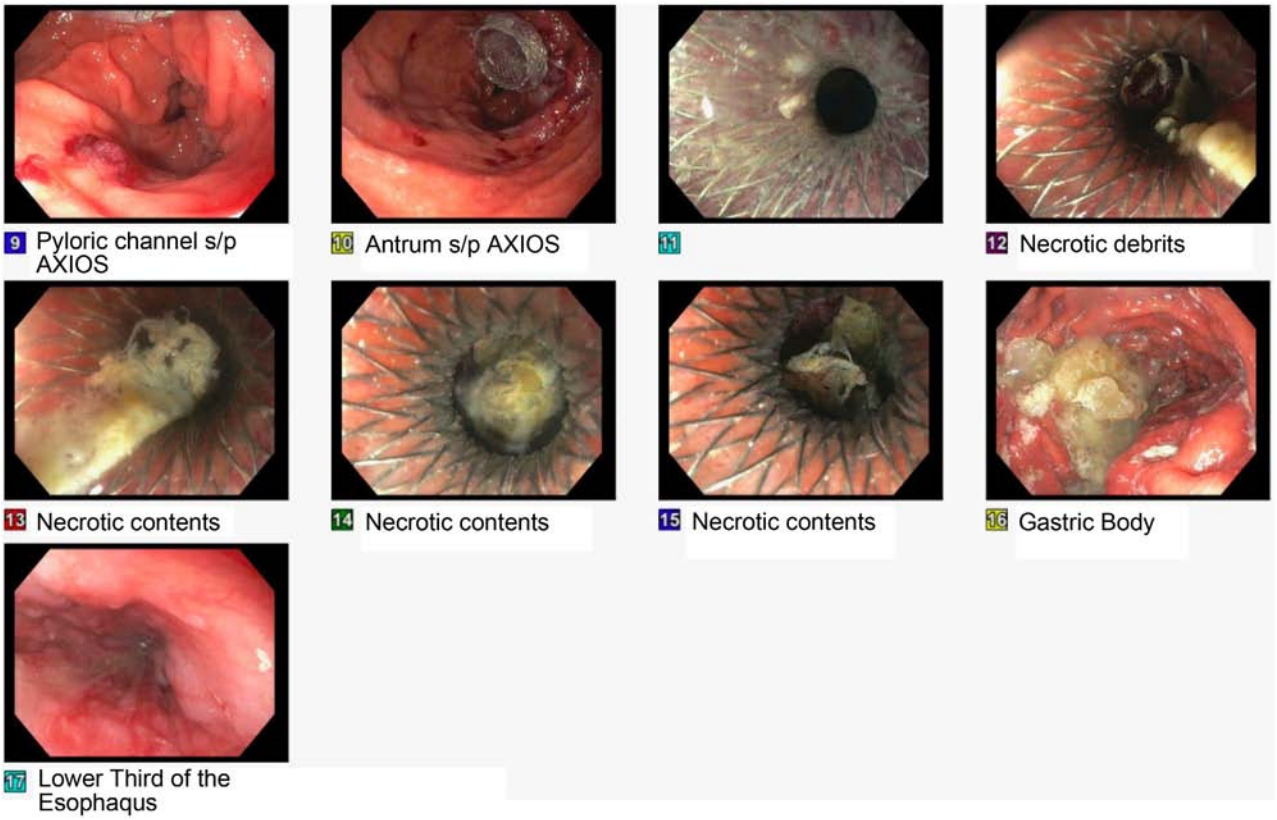

Figure 2. Intra-operativephotograph displaying abscess on upper GI endoscopy.

to 35% from ultrasonography. [5] Although, a subsequent fine needle aspiration can yield a sensitivity close to 100%, and is very important in distinguishing infection from sterile inflammation. [6] Aspirated fluids most commonly contain gram negative bacteria; however, rare tuberculosis infection and gram positive can be seen. [7] Invasive surgical cystoduodenostomy or cystogastrostomy, depending on where the abscess is located, shouldn't be postponed in symptomatic patients with infected pancreatic pseudocysts. They have much better results than doing antibiotic therapy by itself or endoscopic intervention. [8]

This patient had their pancreas near totally removed due to a diagnosis of pancreatic adenocarcinoma. Pancreatic cancer can often go unnoticed depending on the location of the malignancy. Symptoms go more noticeable if the malignancy is near the pancreatic head as opposed to the tail of the pancreas due to the close proximity to the biliary system. Some of the symptoms include nausea, belt-shaped epigastric pain, poor appetite, weight loss and weakness. The best treatment options consist of surgical resection, chemotherapy/radiotherapy, and supportive care including pain management. Surgical treatment with near total distal pancreatectomy as well as splenectomy is the choice for distal pancreatic malignancies. This entails exposing the pancreas first by entering the lesser sac. Then, exposure can be from a lateral to medial approach with mobilization of the pancreas and spleen from the retroperitoneum and vasculature with transection of the pancreas. It can also be performed with a medial to lateral approach with transection of the pancreas at the confluence of the superior mesenteric vein and splenic vein and then complete the dissection laterally. [9] After resection, chemotherapy and radiotherapy were promptly started to attempt to increase long term survival.

Even though most of the pancreas was removed in this case, the patient still was able to develop a pseudocyst at the anatomical position of the pancreas with the remaining tissue. Pancreatic pseudocyst is a collection of pancreatic fluid that typically forms after an episode of acute pancreatitis. The presentation is usually pressure effects causing biliary obstruction, gastric outlet obstruction, and duodenal obstruction. The procedure to help alleviate the pressure effects should be a cystogastrostomy. Endoscopic drainage in the presence of endoscopic ultrasound (EUS) is an important procedure in the management of pseudocysts, especially cysts indenting the stomach or duodenum and in the absence of necrotic tissue. [10] This basically entails drainage of the pancreatic fluid into the stomach and duodenum to alleviate the contents inside the pancreatic pseudocyst.

Most infections need a specific location to establish a biofilm and environment in which the organism can grow. The development of infection correlates with an immune response the body produces to get rid of said infection. This is typically done through innate and adaptive immunity starting with an inflammatory process. This leads to acute pancreatitis which then can progress to necrotizing pancreatitis, infected necrotizing pancreatitis, and then ultimately

walled-off necrosis. This is usually the case where the pancreas is actively affected and becomes dysfunctional due to the inflammation and infection. Altered lab values such as increased lipase and amylase levels, and persistent epigastric pain radiating to the back would indicate that. Upon closer examination, our patient had all of those characteristic findings without the pancreas being present with minimal tissue remaining.

4. Conclusion

Pancreatic abscesses can be life threatening and cause serious complications such as sepsis, disseminated intravascular coagulation, and systemic inflammatory response syndrome. The abscess must be removed immediately to prevent these complications from occurring. Especially, at the site of the pancreas which has a difficult time adapting to stressors such as inflammation and infections. Therefore, having an abscess develop when there is minimal pancreatic tissue is very rare since there isn't much tissue left to become necrotic and form an abscess.

Conflicts of Interest

None declared.

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Tiotropium Bromide/Olodaterol Related Acute Cognitive Impairments

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Abstract

Background: The use of anticholinergics has been on the rise. With the increase in population longevity, more medication-related cognitive impairments (ACIs) have been reported. These impairments result in significant morbidities. We present a case that stresses on the importance of being vigilant when prescribing anticholinergic medications, especially in the elderlies. **Case Report:** A case of ACIs related to the use of tiotropium bromide/olodaterol (*Stiolto Respimat*) is being reported in a 71-year-old white man with COPD. Treatment with budesonide 180 mcg/actuation, and tiotropium bromide/olodaterol (*Stiolto Respimat*) inhalers was initiated. Two days after initiating treatment, the patient developed ACIs which manifested by gait imbalance, short-term memory dysfunction, inability to remember his family members, or to take his medications. Tiotropium bromide/olodaterol (*Stiolto Respimat*) was discontinued. After three days, a full recovery of ACIs was reported. A month later, due to worsening dyspnea, the patient self-resumed the medicine. Similar ACIs were reported within two days of resuming treatment. Tiotropium bromide/olodaterol (*Stiolto Respimat*) was discontinued indefinitely. Full recovery of ACIs was reported. **Conclusion:** ACIs should be noted as a significant side effect of tiotropium bromide/olodaterol. Clinicians should be vigilant, when prescribing anticholinergic medications to elderlies.

Keywords

Cognitive Impairment, Stiolto, Tiotropium Bromide/Olodaterol, COPD

1. Introduction

Tiotropium bromide/olodaterol (*Stiolto Respimat*) is a long acting anticholinergic and a beta$_2$-adrenergic agonist inhaler, which is indicated for the long-term,

once-daily maintenance treatment of patients with chronic obstructive pulmonary disease (COPD) [1] [2]. The elderlies are particularly vulnerable to anticholinergic-related acute cognitive impairments (ACIs). A case of anticholinergic-related ACIs related to the use of tiotropium bromide/olodaterol (*Stiolto Respimat*) is being reported. A recent review of the literature indicates that such an adverse effect has not been reported. No similar reports were found in the literature which makes this case helpful to add new information to the medical literature.

2. Case Report

A 75-year-old white man, with a history of 20 pack-year smoking and COPD, presented with exertional dyspnea. Past medical history was significant for diabetes, and COPD. Medications were albuterol, and metformin. There was no history of allergies, or alcohol abuse. Physical examination was remarkable for decreased breath sounds bilaterally. Chest radiograph showed signs of hyperinflation. Laboratory values were normal except for a HbA1C of 7.2% (normal range ≤5.7%). Spirometry showed moderate COPD, with a 32% improvement with bronchodilators use.

There were no contraindications to use of tiotropium bromide/olodaterol (*Stiolto Respimat*) such as, heart disease, hypertension, a history of seizures, thyroid disorders, glaucoma, kidney disease, or enlarged prostate/urination problems. Treatments with budesonide 180 mcg/actuation, and tiotropium bromide/olodaterol (*Stiolto Respimat*) inhalers were initiated. Two days after initiating treatment, the patient developed gait imbalance, short-term memory dysfunction, difficulties remembering his family members, or taking his medications. Mini-Mental Status Examination could not be performed. Treatment with tiotropium bromide/olodaterol (*Stiolto Respimat*) was discontinued. After three days, a full recovery of ACIs was reported. A month later, due to worsening of dyspnea, the patient self-resumed treatment with tiotropium bromide/olodaterol (*Stiolto Respimat*). Similar ACIs were reported within two days of medications use. Tiotropium bromide/olodaterol (*Stiolto Respimat*) was discontinued indefinitely. Full recovery of ACIs was reported.

The application of Naranjo scale revealed a score of eight, indicating a probable adverse drug effect (**Table 1**) [3]. The use of the World Health Organization-The Uppsala Monitoring Center system for standardized case causality assessment revealed a casualty term of "certain" (**Table 2**) [4].

3. Discussion

3.1. Anticholinergics

Acetylcholine blocking agents are commonly prescribed. The elderlies have higher exposure to anticholinergics, and they are more vulnerable to anticholinergic-related ACIs [5] [6].

In addition, aging is accompanied by a decline in hepatic and renal drugs

Table 1. Naranjo algorithm. [3]

	Yes	No	Do not know or not done	Our patient
(1) Are there previous conclusive reports on this reaction?	+1	0	0	0
(2) Did the adverse events appear after the suspected drug was given?	+2	−1	0	+2
(3) Did the adverse reaction improve when the drug was discontinued or a specific antagonist was given?	+1	0	0	+1
(4) Did the adverse reaction appear when the drug was readministered?	+2	−1	0	+2
(5) Are there alternative causes that could have caused the reaction?	−1	+2	0	+2
(6) Did the reaction reappear when a placebo was given?	−1	+1	0	0
(7) Was the drug detected in any body fluid in toxic concentrations?	+1	0	0	0
(8) Was the reaction more severe when the dose was increased, or less severe when the dose was increased?	+1	0	0	0
(9) Did the patient have a similar reaction to the same or similar drugs in any previous exposure?	+1	0	0	0
(10) Was the adverse event confirmed by any objective evidence?	+1	0	0	+1
Totals				8

>9: definite adverse drug reaction; 5 - 8: probable adverse drug reaction; 1 - 4: possible adverse drug reaction; 0: doubtful adverse drug reaction.

Table 2. WHO-UMC causality categories. [4]

Causality term	Assessment criteria	Yes/No
certain	Event or laboratory test abnormality, with plausible time relationship to drug intake.	Yes
certain	Cannot be explained by disease or other drugs.	Yes
certain	Response to withdrawal plausible (pharmacologically, pathologically).	Yes
certain	Event definitive pharmacologically or phenomenologically (*i.e.*, an objective and specific medical disorder or a recognized pharmacological phenomenon).	Yes
certain	Rechallenge satisfactory, if necessary.	Yes
	Final outcome	Certain

clearance, decrease in central nervous system (CNS) cholinergic activities, and an increase in the blood brain barrier (BBB) drugs permeability [5] [6]. Although studies in rats have shown that tiotropium bromide/olodaterol does not cross the BBB [2], this has not been evaluated in humans.

Acetylcholine is an important neurotransmitter in the brain. Muscarinic acetylcholine receptor antagonists induce state-dependent ACIs [7]. Anticholinergics have been suggested to disturb neural networks involved in learning and memory, decrease levels of brain phosphatidycholine, and increase the formation of β-amyloid [8]. Boustani *et al.* developed the Anticholinergic Cognitive Burden (ACB) scale, one of many other cognitive burden assessment scales, as a tool to identify the severity of anticholinergics-related ACIs [5] [6]. The scale ranks anticholinergic activity of medications into four categories, ranging from no anticholinergic activity (=0) to definite/high anticholinergic activity (=3) [5] [6]. Medications with an ACB rating of 1 have an uncertain impact on cognition [5] [6] [9], while those with an ACB rating of 2 or 3 have established, clinically relevant cognitive anticholinergic effects [5] [9]. There is no gold standard for defining medications with anticholinergic effects, and the ACB does not correlate with medication doses [6] [9]. A study by Rudolph et al. validated that higher ACB scores were associated with increased risk of peripheral and central anticholinergic adverse effects [10]. Anticholinergic activities may not arise exclusively from an individual agent with strong anticholinergic effects [9] [11]. Co-prescribing multiple medications with low ACB scores may result in ACB scores of 3 [9] [11].

3.2. Tiotropium Bromide/Olodaterol (*Stiolto Respimat*)

Tiotropium bromide works by inhibiting the action of acetylcholine through muscarinic M3-receptors in bronchial smooth muscles [1] [2]. Each dose (one dose equals two actuations) delivers 5 mcg of tiotropium bromide and 5 mcg of olodaterol [2]. The medicine has a plasma protein binding of 72%, and pharmacokinetics steady state is usually reached by day seven after ongoing therapy [1] [2]. Although it may lead to anticholinergic signs and symptoms at high doses [2], none were reported following a single inhaled dose of 282 mcg of tiotropium bromide in six healthy volunteers [2]. Although, studies in rats have shown that tiotropium bromide does not cross the BBB [2], this has not been evaluated in humans.

3.3. Blood Brain Barrier

BBB has tight junctions (TJs) which prevent paracellular transport of compounds into the brain [12]. TJs can be opened under normal conditions to allow the temporary introduction of compounds into the brain, as well as under pathological conditions, for example, after ischemic stroke [12]. Substances cross the BBB by a variety of mechanisms [13]. One example includes drugs that bind to a protein with the conformation of the protein changes while interacting with capillary walls and a drug molecule is freed from the complex into CNS [14]. Another way is that a drug crosses the BBB through permeable capillaries in which

dense fenestrated capillaries permit free communications between the brain and blood [15], or through a leaky BBB that exhibits increased permeability, such as in the case with people who have cerebral amyloid angiopathy (CAA) [12] [16] [17] [18], or with new openings in TJs like after suffering an ischemic stroke [12].

3.4. Possible Explanations of the Development of ACIs in This Patient Are

1) Tiotropium bromide/olodaterol (*Stiolto Respimat*) may have entered the CNS, after binding to a protein which facilitates the crossing of the BBB [13], direct entry may also occur through areas with fenestrated capillaries [15], leaky BBB secondary to either age-related CAA [5], or through new openings in TJs of BBB that developed after suffering an ischemic stroke [12]. Although this patient does not have a confirmed diagnosis of CAA, he has diabetes which may contribute to the development of CAA [19].

2) Being elderly is associated with a reduction in central cholinergic activities (5), and an increased sensitivity to the development of anticholinergic related ACIs [5]. These associations may explain the development of anticholinergic related ACIs, only after three doses/days of initiating treatment and before reaching a steady state.

4. Conclusions

Tiotropium bromide/olodaterol (*Stiolto Respimat*)-related ACIs have not been reported previously in the literature. Tiotropium bromide/olodaterol (*Stiolto Respimat*) should be considered to have a high ACB score. Prescribers may utilize ACB scale to discuss the potential ACIs related to the use of Tiotropium bromide/olodaterol (*Stiolto Respimat*) in elderlies [5]. Such information should be utilized to assure patients' safety [9]. The ACIs of anticholinergics require further analysis. Healthcare providers should attempt to limit prescribing anticholinergics whenever possible, especially in elderlies [7].

ACIs should be included as an adverse effect of tiotropium bromide/olodaterol (*Stiolto Respimat*) in the regulatory document.

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Author Contributions

We both authors contributed equally to this manuscript.

Declaration about Ethics Approval and Informed Consent Statement

Written informed consent was obtained from the patient for the publication of this case report.

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Evaluating Inpatient Hospital Bed Need at the Community Level

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Abstract

An important component of health care planning at the community level is the identification of inpatient hospital bed capacity. In the United States, hospitals are major providers of patient care and the largest sources of health care expenses. This study evaluated inpatient hospital capacity for major services including adult medicine, adult surgery, and obstetrics. It was based on local and regional demographics, admissions per capita, inmigration, and inpatient lengths of stay. The study also involved the use of the methodology to estimate bed need based on a reduction in hospital admissions and discharges of 15 percent. This level has been the experience of area hospitals between 2019 and 2022. The study also included the use of the bed need methodology to estimate the hospital utilization based on a decline in inpatient lengths of stay. It resulted in a decline in hospital occupancy in the hospital service area from 1213.1 to 1012.6 patients based on 80 percent occupancy and the best practice hospital stays in the region.

Keywords

Hospitals, Hospital Bed Need, Health Planning

1. Introduction

Health care planning has historically been a challenging issue in the United States. Per capita health care costs have been higher than those of other nations throughout the twentieth and twenty-first centuries [1] [2].

A large proportion of these costs have been generated by acute hospitals. These providers are the largest sources of inpatient care in most communities. They account for the care provided to patients with the highest severity of illness [3] [4] [5].

Inpatient hospital utilization includes adult medicine and adult surgery, the largest inpatient services in the United States. It also includes additional services such as obstetrics, pediatrics, neonatology, and psychiatry.

The planning of these services in an efficient manner is important to support the ability of hospitals to serve community and regional populations. Such planning needs to account for community and regional demographics, as well as inpatient utilization and other resources.

Closely related to inpatient hospital utilization at the community level is the need for efficiency. This factor is usually evaluated with respect to staffing, pharmaceuticals, and testing.

One of the most important resources involved in health care planning during the twenty-first century has been inpatient nursing. It is essential for hospitals to maintain sufficient nursing staff in order to serve the populations of their communities [6].

During the twenty-first century, other clinical factors have had a major impact on inpatient hospital utilization. One of the most important issues has been the impact of the coronavirus [7].

The planning of inpatient hospital services is closely related to bed need at the community level. In this context, bed need is a product of several factors including demographics, admissions, inmigration, lengths of stay, and occupancy [8].

This study reviewed the development of a hospital bed need methodology in one community in Upstate New York. It evaluated the impact of these factors on hospital utilization to demonstrate their relative importance from a quantitative perspective.

The format will need to create these components, incorporating the applicable criteria that follow.

2. Population and Method

The original Central New York bed need summary was developed by the Central New York Health Systems Agency as part of its planning activities during the 1970s. The bed need summary has been updated by the Hospital Executive Council since the 1980s.

The utilization data in this methodology have been updated during 2007, 2019, and 2023.

The bed need algorithm includes the following components. These components are based on inpatient hospital data from the New York Statewide Planning & Research Cooperative System (SPARCS) and the Hospital Executive Council.

Resident population by Resident County and age level;

Inpatient admission rates by Resident County and age level;

Inmigration to Onondaga County hospitals by Resident County and age level;

Inpatient lengths of stay in Onondaga County hospitals by age level;

Inpatient hospital occupancy by age level.

Brief summaries of the bed need methodology for each of these components follow.

Resident population by county and age level.

The basis of inpatient bed need for health care providers is based on the resident populations of their service areas. The bed need methodology for Central New York is based on the following counties.

Broome	Madison
Cayuga	Oneida
Chenango	Onondaga
Cortland	Oswego
Delaware	Otsego
Franklin	St. Lawrence
Herkimer	Tioga
Jefferson	Tompkins
Lewis	

The current versions of the bed need methodology are based on populations for 2025 and 2030. These data were developed by county and age level by the Cornell University Program on Applied Demographics.

The methodology includes the following age levels.

Ages 18 - 44 years, young adults

Ages 45 - 64 years, older adults

Ages 65 - 84 years & 85 years and over, elderly

Data from the Cornell University Program has indicated that populations of most Central New York Counties have declined in recent years.

Inpatient admission rates by Resident County and age level.

After resident populations, the next component of the bed need methodology includes inpatient admission rates by age level and Resident County.

Inpatient admission rates among the hospitals increased with additional population age levels for high utilization patients. The use of admission rates in the methodology results in projections of numbers of inpatients by county and age level.

Population admission rates for 18 - 44 years, young adults, were relatively low because most of these individuals are not admitted to hospitals. Inpatient admission rates for individuals aged 65 years and over increase because these residents required more frequent use of hospital services.

The following admission rate ranges were developed through use of the methodology with the Central New York region. These rates increased with increasing age.

Ages 18 - 44 years	0.020 - 0.061
Ages 45 - 64 years	0.045 - 0.094
Ages 65 - 84 years	0.099 - 0.250
Ages 85 years and over	0.180 - 0.615

Resident admission rate information was based on New York Statewide Planning & Research Cooperative System (SPARCS) data.

Inmigration to Onondaga County hospitals.

After inpatient admission rates, the next component of the methodology is inmigration to hospital county by resident county and age level. Inmigration rates among the counties are based on demographic and economic use of health care services in the region. It is also based on the proximity of each county to Onondaga County.

The largest inmigration rates are produced by Onondaga County and the four counties that are contiguous to Onondaga including Oswego, Madison, Cayuga, and Cortland. The inmigration rates to Onondaga County hospitals within the Central New York region have not changed appreciably during the last several years.

A summary of inmigration rates by age level follows. These rates declined with decreasing age.

Ages 18 - 44 years	0.018 - 0.969
Ages 45 - 64 years	0.009 - 0.966
Ages 65 - 84 years	0.008 - 0.973
Ages 85 years and over	0.002 - 0.979

Resident inmigration rate information was based on New York Statewide Planning & Research Cooperative System (SPARCS) data.

Inpatient lengths of stay in Onondaga County hospitals by age level.

After inmigration to Onondaga County hospitals, the next component of the methodology is inpatient lengths of stay in the Onondaga County hospitals by age level. Lengths of stay are determined by the number of patient days generated by patients in Onondaga County hospitals. These stays are produced by Central New York residents throughout the Central New York region.

In the current use of the bed need methodology, lengths of stay were employed based on hospital inpatients by age level. In a second component of the methodology, lengths of stay were employed based on the most efficient provider in the region, St. Joseph's Hospital Health Center.

The lengths of stay are listed below.

	Combined Syracuse Hospitals	St. Joseph's Hospital Health Center
Ages 18 - 44 years	4.2 days	3.2 days
Ages 45 - 64 years	6.0 days	5.0 days
Ages 65 - 84 years	6.5 days	5.6 days
Ages 85 years and over	6.2 days	5.2 days

Inpatient hospital occupancy by age level.

The final component of the bed need study was hospital occupancy by age level. This was developed by dividing the average daily census for each of the age levels by 80 percent. This occupancy has been used nationally to identify optimum inpatient hospital utilization.

3. Results

The use of specific indicators in the bed need methodology has allowed the me-

thodology to address updated changes in hospital utilization. These changes were based on updates in projected populations, hospital admissions, hospital inmigration, and lengths of stay.

This analysis described the use of the Central New York bed need methodology to evaluate the impact of hospital inpatient utilization in Central New York. Relevant data are described in Table 1.

Units

This information described the relative impact of inpatient hospital utilization within the service area of the Syracuse hospitals. It included Onondaga County, the demographic and clinical center of the region; the four counties contiguous to Onondaga including Cayuga, Cortland, Madison, Oswego; and other counties within the region, Broome, Chenango, Delaware, Franklin, Herkimer, Jefferson, Lewis, Oneida, Otsego, St. Lawrence, Tioga, and Tompkins.

The study data were based on the inpatient census of the Syracuse hospitals by Resident County and age level. These indicators were related to community and area populations, admission rates, inmigration, lengths of stay, and occupancy. All of these indicators except lengths of stay were based on the utilization of community services. Lengths of stay were based on inpatient use within the Syracuse hospitals.

The study data demonstrated that the average daily census of the combined Syracuse hospitals in 2023 were 970.5 patients. On the basis of a national occupancy

Table 1. Central New York inpatient hospital bed need summary.

	Average Daily Census Based on Combined Syracuse Hospitals Lengths of Stay	Average Daily Census Based on 15% Reduction in Inpatient Discharges for Combined Syracuse Hospitals	Average Daily Census Based on St. Joseph's Hospital Health Center Lengths of Stay
Resident County			
Onondaga County	597.6	508.0	498.0
Cayuga County	52.2	44.4	44.0
Cortland County	23.1	19.6	19.3
Madison County	44.3	37.7	37.2
Oswego County	100.3	85.3	83.8
Other	153.0	153.0	127.8
Total	970.5	848.0	810.1
Average Daily Census at 80% Occupancy	1213.1	1060.0	1012.6

rate of 80 percent, these patients would account for an average daily census of 1213.1 patients. The actual number of certified inpatient beds in the service area of the Syracuse hospitals was 1338.

This average daily census was employed as a baseline for follow-up health care planning in the combined Syracuse hospitals. This follow-up evaluation was developed based on potential changes in inpatient admissions and lengths of stay.

The first follow-up analysis involved the reduction of inpatient admissions by fifteen percent. This reduction was based on an actual fifteen percent decline in hospital discharges that occurred between 2019 and 2022 in the service area of the Syracuse hospitals. It resulted in a reduction in the average daily census adjusted for occupancy from 1213.1 to 1060.0 patients.

The second follow-up analysis was based on a reduction in lengths of stay consistent with the best practice within the service area of the Syracuse hospitals. This practice has been demonstrated by St. Joseph's Hospital Health Center over an extended period of time. It would result in a decline in the average daily census adjusted for occupancy from 1213.1 to 1012.6 patients.

4. Discussion

An important component of health care planning at the community level is the identification of inpatient hospital bed capacity. In the United States, hospitals are major providers of patient care and the largest sources of health care expenses.

This study evaluated inpatient hospital capacity for major services including adult medicine, adult surgery, and obstetrics. It was based on local and regional demographics, admissions per capita, inmigration, and inpatient lengths of stay. The study employed a quantitative methodology for identifying the combined impact of these factors.

The bed need methodology also included limitations. The structure of the methodology was useful in identifying the use of inpatient hospital utilization. At the same time, it contained limitations related to the content of the information concerning hospital services.

The analysis provided examples of the use of a bed need methodology that has been used in Upstate New York. These examples were based on the impact of changes in hospital utilization.

The basis of the methodology involved the application of the study variables to generate an estimated average daily census of 970.5 patients for January-December 2025. When adjusted for 80 percent occupancy, this census became 1213.1 patients.

The study also involved the use of the methodology to estimate bed need based on a reduction in hospital admissions and discharges of 15 percent. This level has been the experience of area hospitals between 2019 and 2022.

This decline in inpatient utilization was generated by the movement of inpatients to outpatient settings, especially adult surgery. A reduction in resident

populations at the community level also contributed. It resulted in a decline in the estimated hospital occupancy from 1213.1 to 1060.0 patients.

The study also included the use of the bed need methodology to estimate the hospital utilization based on a decline in inpatient lengths of stay. It resulted in a decline in hospital occupancy in the hospital service area from 1213.1 to 1012.6 patients based on the best practice of hospital stays in the region. This was larger than the decline generated by the reduction in inpatient discharges.

The bed need methodology may be used to project increases in hospital utilization, however, this would require larger numbers of high utilization populations, such as the elderly, or longer lengths of stay. A rise in younger adults would probably not measurably increase the need for hospital occupancy because they are not major users of inpatient services.

Conflicts of Interest

The authors declare there are no conflicts of interest regarding the publication of this paper.

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A Case of Cerebrospinal Drainage for Paraplegia Complicated by Acute Aortic Dissection (Stanford B) Followed by TEVAR in the Subacute Phase

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Abstract

The patient is 50-year-old man. He was admitted to our hospital with a strong back pain and diagnosed as an acute type B aortic dissection. On the second day of hospitalization, he developed symptoms of paraplegia, and we considered TEVAR, but we were concerned that TEVAR intervention in the acute phase might worsen the dissection, so we first placed a cerebrospinal drainage (CSFD) device, which resulted in improvement of his symptoms. Thereafter, although his lower limb mobility was fine, he underwent thoracic stent graft aortic repair (TEVAR) in the subacute phase due to worsening ULP. The patient had a good postoperative course and was discharged home unassisted. The initial placement of CSFD was effective in reducing the incidence of paraplegia as a complication of TEVAR and in bringing the timing of TEVAR intervention from the acute phase to the subacute phase.

Keywords

Aortic Dissection, Paraplegia, Cerebrospinal Drainage, TEVAR

1. Background

Paraplegia is one of the most serious complications of acute aortic dissection. It is said to occur in 2% - 4% of cases, and is more common in type A dissection [1] [2]. Treatment after complications is difficult and the prognosis is poor [3].

In recent years, the frequency of thoracic endovascular aortic repair (TEVAR) for type B dissection in the subacute stage has increased due to its excellent remote outcome. In addition, it is said that it is safer to perform the intervention

in the subacute phase than in the acute phase immediately after the onset of dissection. In the present report, we describe a case of complete paraplegia associated with acute type B aortic dissection that was treated by cerebrospinal fluid drainage (CSFD), followed by TEVAR for entry closure in the subacute phase after aortic dissection worsened, without recurrence of paraplegia.

Informed consent was obtained from the patient and permission was obtained to submit this case for publication.

2. Case Presentation

Case: 50-year-old male.

Complaint: Sudden chest and back pain.

History: Hypertension (untreated).

Clinical history:

Patient called for emergency medical assistance due to sudden chest and back pain while driving.

Present condition at the time of arrival: Clear consciousness. Blood pressure 250/166 mmHg, pulse 90/min. No pain or cold sensation was noted in the lower extremities. Bilateral femoral and popliteal arteries were well pulsatile. No motor or sensory disturbance in the lower extremities.

Blood test findings on arrival: white blood cell count 10,900/μl, D-dimer 6.7 μg/ml, Lactate 3.5 mg/dl.

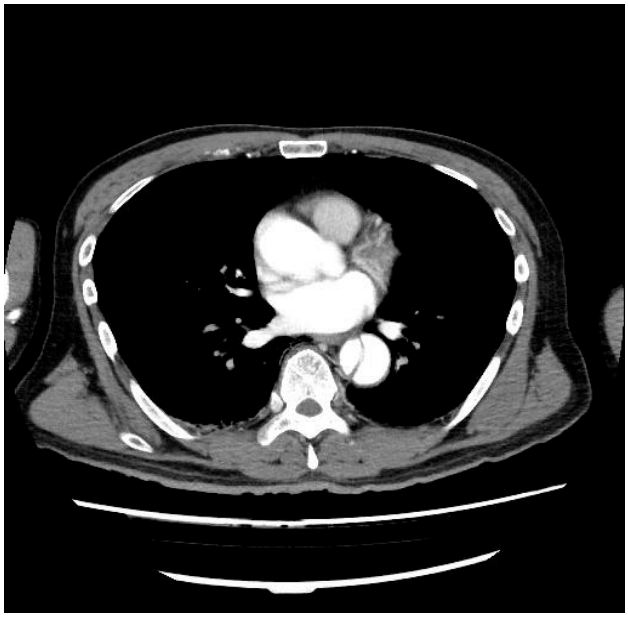
Contrast CT: Contrast CT shows communicating acute type B aortic dissection from the distal arch to the aortic branch (**Figure 1(a)**). The celiac artery and left renal artery were bifurcated from false lumen (**Figure 1(b)**).

Post-hospitalization course:

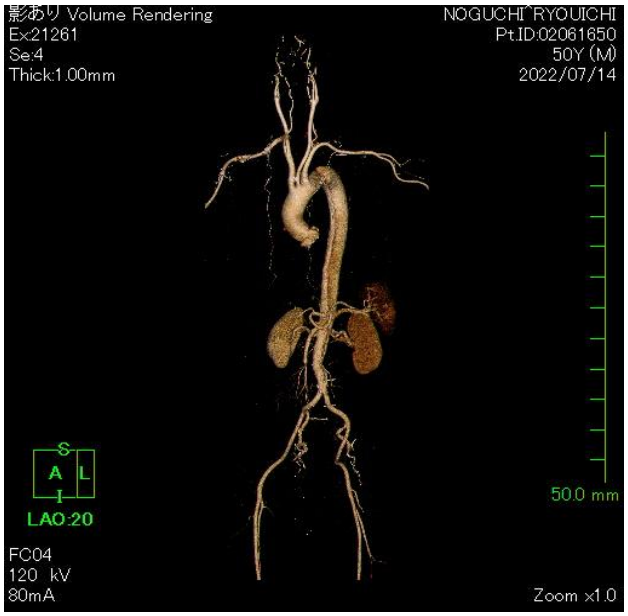
After admission, the patient was treated in the ICU with antihypertensive and sedation therapy according to acute type B dissection. There was no difference in blood pressure in both upper extremities, and systolic blood pressure was generally controlled between 110 - 120 mmHg. Both femoral arteries were well palpable, and blood pressure in both lower extremities did not differ between right and left, and systolic blood pressure was generally 120 - 130 mmHg. There were no complaints of chest and back pain.

On the evening of the third day after the onset of the dissection, manual muscle testing (MMT) levels decreased by 5 to 4, and symptoms of paraplegia appeared in both lower extremities. CT imaging showed no obvious worsening of the aortic dissection.

Steroids were first administered, and the patient improved to MMT 5. However, the next morning, although there was no change in blood pressure or worsening of the dissection on CT, he still had incomplete paraplegia in both lower extremities up to MMT3. Emergency TEVAR was considered, but TEVAR intervention in the acute phase of aortic dissection was feared to worsen the dissection itself and paraplegia, so a CSFD was placed on day 4 of the onset of dissection. The paraplegia improved 2 hours after CSFD implantation.



(a)



(b)

Figure 1. (a) and (b) preoperative computed tomography.

Thereafter, although his lower limb mobility was fine, worsening of ULP was detected. Since the patient was entering a subacute phase in which TEVAR could be performed relatively safely, we decided to perform TEVAR intervention in this case.

Operative findings:

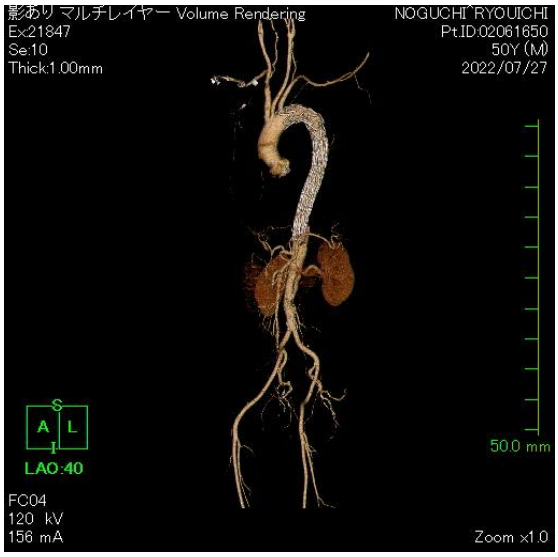
Percutaneous thoracic endovascular aortic repair (P-TEVAR) was performed from just below the left subclavian artery to just above the celiac artery on day 14 of acute aortic dissection and day 12 after paraplegia occurred. To prevent vascular injury, the stent graft diameter was selected to be about 90% - 95% of the

aortic diameter. No problematic endoleak was observed on final contrast. There were no surgical complications such as retrograde type A dissection (RTAD) orstent-induced new entry (SINE). The operative time was 44 minutes.

Postoperative course:

The patient woke up well after the surgery. Fortunately, no recurrence of paraplegia was observed. The blood pressure was maintained at a mean pressure of 80 mmHg. The highest postoperative CPK value was 158 IU/l, which was within the normal range, suggesting that there was no muscle damage due to lower extremity ischemia. Postoperative CT showed good stent graft expansion and enlargement of the true lumen (**Figure 2(a)** and **Figure 2(b)**). He was discharged home 14 days after surgery.

(a)



(b)

Figure 2. (a) and (b) postoperative computed tomography. Stent graft and the true lumen were well expanded.

3. Discussion

It has been reported that the frequency of spinal cord disorders complicating acute aortic dissection is 2% - 4%, and is relatively common in type A dissection [1] [2]. Although this is a relatively rare complication, it is a serious complication considering the fact that once it develops and the symptoms are fixed, ADL is greatly reduced.

Therefore, early treatment is desirable. Untreated hypertension is a risk factor for the development of aortic dissection. However, the association between untreated hypertension and the development of paraplegia is unknown. There are various mechanisms of spinal cord injury associated with aortic dissection, but the main ones are withdrawal and compression of the intercostal and lumbar arteries due to dissection, and decreased direct perfusion due to decreased true-lumen blood flow caused by dynamic occlusion in the high aorta [4] [5]. Primary entry closure with stent grafting may be an effective treatment from the viewpoint of increasing true lumen perfusion and decreasing false lumen pressure. In fact, when type A dissection is complicated by paraplegia, entry closure by open chest surgery is performed to save the patient's life, and this alone often improves paraplegia, and if not, CSFD implantation is often considered afterward [6]. However, when acute type B dissection is complicated by paraplegia, stent grafting is often preferred over open chest surgery, but TEVAR intervention in the acute phase is generally not recommended due to the risk of more serious complications such as RTAD. Another treatment for paraplegia is to maintain a high mean blood pressure to increase dorsal luminal blood flow, but this is difficult in acute dissection.

CSFD is also effective for paraplegia associated with aortic dissection. There have been reports of cases of spinal cord injury associated with early thrombo-occlusive type A dissection that resolved with CSFD alone, and spinal cord drainage may be an option depending on the patient's condition.

In a report by Nagano *et al*., an emergency descending entry closure was performed for spinal cord injury associated with type B dissection with good results, and aggressive treatment is recommended. Open thoracotomy is also a method, but it may be more invasive than TEVAR.

In this case, the patient had acute type B dissection complicated by complete paraplegia, and we considered performing TEVAR as a compliant type B dissection as soon as possible, but we were hesitant to perform TEVAR in the acute phase because of complications. The initial placement of the CSFD, in this case, resulted in improvement of paraplegia. Therefore, we were able to wait until the subacute phase, when the vessels were stabilized, to perform TEVAR. Since TEVAR was performed in the subacute phase, it was possible to manage the patient's circulation with an average blood pressure of about 85 after the procedure. This may have contributed to the prevention of recurrence of paraplegia.

When paraplegia develops after acute type B dissection, as in this case, TEVAR intervention in the acute phase may be considered for entry closure and main-

tenance of blood pressure control, but if the CSFD is placed first and paraplegia is improved, it may be better to wait until the subacute phase to perform TEVAR to prevent TEVAR-related complications. It was thought that effective use of CSFD can delay TEVAR intervention to the subacute phase when the intima is stabilized, thereby reducing the complication rate of TEVAR.

4. Conclusion

The initial placement of CSFD was effective in reducing the incidence of paraplegia as a complication of TEVAR and in bringing the timing of TEVAR intervention from the acute phase to the subacute phase.

Conflicts of Interest

There is no stipulated COI for all authors of this paper.

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Anaesthetic Management and Challenges for Carotid Body Tumour Excision in a Young Nigerian: A Case Report and Review of Literature

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Abstract

Background: Carotid body tumours (CBTs) are rare tumours that arise from chemoreceptor cells at the bifurcation of carotid artery. Excision of CBT poses several anesthetic challenges and may be complicated with marked intraoperative hemodynamic instability and turbulent postoperative recovery. Attention to details and a meticulous anesthetic plan are essential for successful anesthetic management. **Aim:** To present anaesthetic management and challenges for carotid body tumour excision in a young Nigerian. **Case Presentation:** A 26-year-old man presented with left sided slow growing neck tumour. The tumour was completely excised with no anaesthetic or surgical complication. Histology and immunohistochemistry of the excised tumour confirmed paraganglioma. He was discharged fifteenth post-operative day. **Conclusion:** General anesthesia is the preferred technique. The basic elements of anesthetic management are protection of hemodynamic stability and maintenance of cerebral perfusion pressure (CPP).

Keywords

Anaesthesia, Carotid Body Tumour, Excision, Complications

1. Introduction

Carotid body tumours (CBTs), also known as chemodectoma or paraganglioma, are rare neuroendocrine tumours [1], which arise from chemoreceptor cells found at the carotid bifurcation. They constitute most head and neck paragangliomas [2] [3]. The tumours are usually benign, slow growing but they could become malignant and invade or exert pressure on the neighboring neurovascular tissues [4].

Although CBT can occur at any age, they are usually found in the fourth and fifth decades of life [5]. The reported rate of incidence of CBT is between 0.06 and 3.3 per 100,000 [6] and has a female preponderance that varies with altitude. At sea level, the male/female ratio is 1.1 to 1.4 but at high altitude, 2000 m above sea level, it is 1 to 8.3 [7].

Three types of CBTs have been identified namely familial, hyperplastic and sporadic.

Familial CBTs are usually found in young patients while hyperplastic CBTs occur in conditions of chronic hypoxia such as chronic obstructive pulmonary disease (COPD), cyanotic heart disease and in high altitude dwellers [8].

Blood supply to carotid body tumour is mainly from the external carotid artery (ECA), however, contributions from the internal carotid artery (ICA), vertebral artery ascending pharyngeal artery and superior thyroid artery have been reported.

Shamblin's classification of CBT is based on its association with the internal carotid artery [9].

In order to prevent possibility of local spread and eventual metastasis, early excision of the tumour is advocated, as is the case with all tumours. Excision of CBT poses anaesthetic challenges which may be complicated with significant morbidity and mortality [10].

2. Case Report

A 26-year-old Nigerian male presented with a left-sided slow growing neck tumour of four years duration. The tumour was painless, soft, non-pulsatile and it was associated with some difficulty in breathing but there was no dysphasia. There is positive family history of CBT.

On examination, hypopigmented scar was observed running along the entire length of the tumour (from previous attempt at excising the tumour). The tumour measured 12 by 10 centimeter in size and it was not warm to touch and it was not attached to overlying skin. A similar but smaller tumour mass was also palpated in the right anterior triangle of the neck. There were no palpable lymph nodes. CT scan showed an avidly enhancing highly vascular masses in the carotid spaces splaying the carotid vessels and indenting the internal jugular veins with associated narrowing of the nasopharyngeal air column (**Figure 1** and **Figure 2**). The left carotid mass was excised whole down to its root at the carotid

Figure 1. Carotid angiography shows the tumor encasing the carotid on the left CT neck showing the carotid body tumor extending to the skull base.

Figure 2. Carotid angiography shows the tumor encasing the carotid on the left CT neck showing the carotid body tumor extending to the skull base.

bifurcation (**Figure 3** and **Figure 4**). The histology (**Figure 5**) and immunohistochemistry of the excised tumour confirmed paraganglioma.

3. Anaesthesia

Routine blood investigations were within normal limits. Recent CT scans and MRI angiography were in keeping with bilateral carotid body tumours. The CT scan revealed an avidly enhanced tumour, highly vascular and with splaying of the internal and external carotid arteries.

Surgical excision of the left CBT under general anesthesia was planned and the patient was admitted to the ward for preoperative review and preparation for surgery.

On the eve of surgery, premedication was commenced with oral diazepam, 5

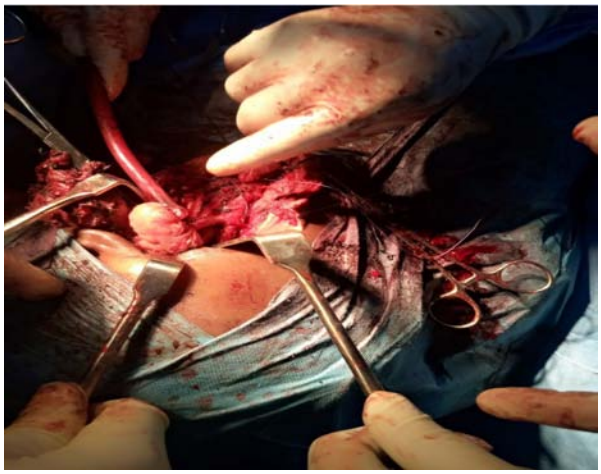

Figure 3. Carotid body tumor completely excised.

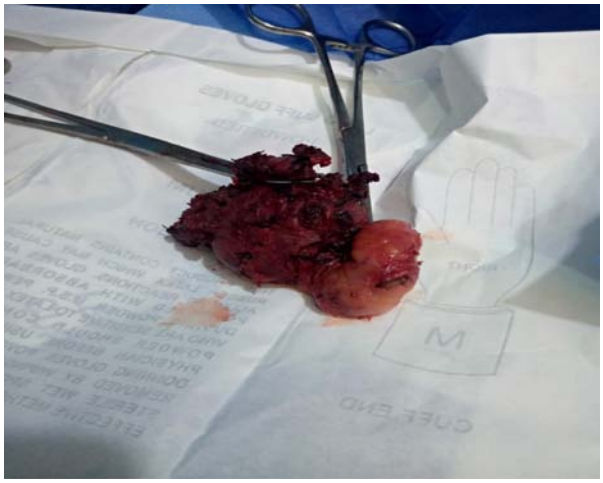

Figure 4. Carotid body tumor completely excised.

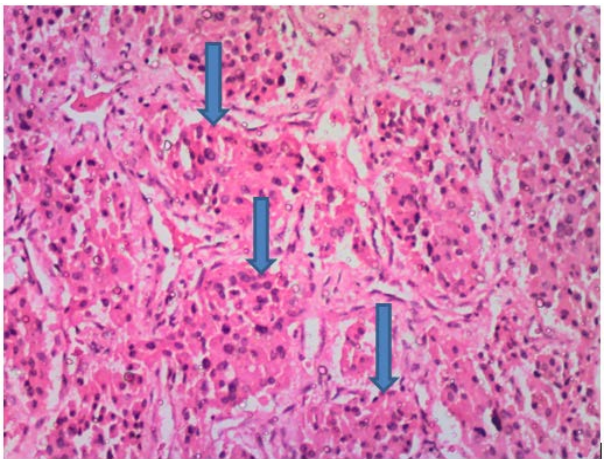

Figure 5. Histological section showing nested packets of mild to moderately pleomorphic tumour cells (arrows) having hyperchromatic central nuclei and moderate eosinophilic, faintly granular cytoplasm consistent with the features of paraganglioma (H & E ×40).

mg, oral ranitidine, 150 mg and oral metoclopramide, 10mg and these were repeated two hours before surgery. The patient was fasted according to the American Society of Anesthesiologists (ASA) fasting guidelines.

Wide bore cannulae (14 G and 18 G), were sited on each upper limb. In the operating theatre, probes of a multinodular monitor including 3-channel electrocardiograph leads were attached to the patient. The baseline vital signs were recorded. Non-invasive blood pressure (NIBP) was 110/80 mmHg, heart rate (HR) was 84 beats per minute and arterial oxygen saturation (SPO_2) was 96 percent, breathing room air. Invasive blood pressure (IBP), central venous pressure (CVP) and somatosensory evoked potential (SSEP) were desired but the equipment and/or the soft-wares for measuring these parameters were not available and were therefore not measured.

Prior to induction of anesthesia, intravenous midazolam, 0.05 mg/kg and intravenous fentanyl, 2 mcg/kg were administered. The patient was pre-oxygenated for 5 minutes. Anesthesia was induced with intravenous propofol 2 mg/kg and oro-tracheal intubation, using reinforced endotracheal tube, 75 mm inner diameter was facilitated with intravenous suxamethonium, 2 mg/kg.

Thereafter, anaesthesia was maintained with isoflurane in oxygen and medical air mixture, intravenous pancuronium 0.08 mg/kg and subsequently in doses of 0.015 mg/kg as required for muscle relaxation and intravenous morphine 0.1 mg/kg for analgesia. Intraoperative blood loss was estimated to be 1.2 litres. Haemodynamic stability was achieved with blood transfusion and intravenous infusion of colloids and crystalloids. Episodes of bradycardia occurred intraoperatively. The bradycardia which occurred during tumour manipulation resolved when the manipulation or handling was discontinued but that which occurred as a result of haemodynamic insufficiency responded well to intravenous atropine and intravenous fluids.

The patient remained relatively stable throughout the course of anesthesia. At the end of surgery, isoflurane was gradually tailed off while the patient breathed 100 percent oxygen. On return of spontaneous breathing, the residual effect of the non-depolarising muscle relaxant, pancuronium, was reversed with intravenous neostigmine 2.5 mg and intravenous glycopyrrolate 0.4 mg.

When the extubation criteria were met, the patient was extubated and he was then transferred to ICU for observation and continued monitoring.

Post-operatively the patient received injections of pentazocine 30 mg twelve hourly and paracetamol infusion whenever there was breakthrough pain. He was discharged to the ward on the third post-operative day in stable clinical condition and finally home on the fifteenth-post-operative day. At discharge, there was complete wound healing.

4. Discussion

The cornerstone of diagnosis and the management of CBT are detailed history, physical examination and radiological studies such as CT scan, MRI and mag-

netic resonance angiography (MRA) [5]. These radiological studies also yield useful information about the composition of the tumour and its relationship with the surrounding tissue and vasculature [10].

Unfortunately in sub-Saharan Africa, CT scan, MRI and MRA are either not accessible or affordable. Ultrasound scan while being readily available is also more affordable and gives some useful information [11].

Differential diagnosis of CBT include medullary thyroid carcinoma, neuroendocrine carcinoma, middle ear adenoma meningioma and schwannoma [12] and these must be ruled out. In some cases, CBTs are active and they secret catecholamines and serotonin. They may also be associated with pheochromocytoma, a tumor of chromaffin cells which secrete nor-adrenaline, adrenaline, and dopamine. Although rare, acute presentation of phaeochromocytoma may include pulmonary oedema, myocardial infarction and cerebrovascular episodes which may occur at any time in the peri-operative period. Mortality can be as high as 90 percent. CBT in this index patient was asymptomatic of inappropriate catecholamine secretions, therefore tests for urinary catecholamines were not done.

Surgical excision of CBT poses several anaesthetic challenges which may increase the risk of perioperative morbidity and mortality. The aims of the anaesthetists include provision of safe anaesthesia, accessible surgical field for the surgeon and good outcome of surgery. All these were achieved by meticulous preoperative review, a good anesthetic plan with attention to details, adept airway management, prevention and proactive management of haemorrhage, including massive hemorrhage and adequate perfusion of brain tissues for optimal delivery of oxygen and nutrients. Maintenance of appropriate cerebral perfusion pressure (CPP) that is, the difference between mean arterial pressure (MAP) and intracranial pressure (ICP) provides the net pressure gradient that drives oxygen to the cerebral tissue. Throughout surgery, MAP was carefully maintained above 65 mmHg as a strategy to prevent ischemia of the brain tissue and stroke.

Hemorrhage is a common complication of CBT excision. Shamblin classification helps to predict the severity of blood loss. Shamblin type I tumor is usually small, localized and can be separated easily from the adjacent carotid arterial wall, while Shamblintype 2 CBT is large and often adherent to the carotid artery which partially encapsulates the tumor and thus increase significantly the risk of hemorrhage and Shamblin type 3, CBTs are closely adherent to the carotid artery and are therefore associated with massive hemorrhage. The complexity of structures in the neck and limited exposure, part of the left sternocleidomastoid muscle, internal jugular vein and cranial nerves X and X11 were resected. Such complications are reported in the literature.

Surgical time was prolonged, ten hours compared to the average of 3 hours found in literature. Factors that probably contribute to the prolonged surgical time are rarity of CBT and the consequent limited experience of the surgeon, anesthetist and supporting staff as it relates to tumors of this nature.

Mild hypothermia was beneficial during this surgery because it reduced cerebral metabolic consumption of oxygen, ($CMRO_2$). A decrease of 1˚C body temperature reduces the cerebral metabolic rate by 7 percent and therefore tight control of temperature was required. An attempt towards this goal was achieved by infusing crystalloids at room temperature and monitoring closely the body temperature of the patient.

Hyperventilation causes vasoconstriction of cerebral blood vessels which in turn reduces oxygen delivery to the brain, frequency of ventilation and end-tidal carbon dioxide were also closely monitored.

Administration of anaesthetic agents interferes with intrinsic physiological regulatory mechanism of the body systems. Homeostasis was maintained by infusion of intravenous fluids and drugs and close monitoring of vital signs. Blood loss was carefully estimated and replaced as necessary, while urinary output, a measure of vital organs perfusion was measured hourly Volatile anesthetics in high concentration cause reduction in the tension of vascular smooth muscle, thus resulting in vasodilation and an increase in cerebral blood flow.

Continuous delivery of oxygen and nutrients is essential to prevent irreversible injury to the brain and oxygen and glucose must be available for use by the brain.

Review of literature revealed that carotid bodies were first described by Von Hiller in 1743 as reddish-brown well circumscribed and highly specialized round organs which are in the adventitia of carotid arteries. The organs play an important role in the control of ventilation during hypoxia, hypercapnia and acidosis by their ability to sense partial pressure of oxygen and carbon dioxide in the blood [13].

CBTs arise from these chemoreceptor cells at the bifurcation of the carotid arteries and they represent about 65 percent of head and neck paraganglioma [14]. These rare tumours occur commonly on the right side of the neck in 57 percent of patients, on the left side of the neck in 25 percent and bilaterally in 17 percent of patients and in about 10 percent of this population, the CBTs were malignant [15]. CBTs are generally slow growing and are usually benign. Occasionally they accompany head and neck paraganglioma, malignant tumours of lungs, breast and larynx [16]. Also about 10 percent of cases present with cranial nerve palsy, paralysis of hypoglossal nerve, glosso-pharygeal nerve, recurrent laryngeal nerve, spinal accessory nerve and sometimes the parasympathetic chain is involved. [17].

Surgical excision of CBT under general anesthesia is the preferred choice of management, however continuous cervical block (regional anaesthesia) has been reported [18]. Radiation therapy is reserved for inoperable cases.

Perioperative morbidity may be as high as 20 to 40 percent [19]. Hemorrhage is the most common and most challenging complication; therefore, an adequate level of preparedness must be put in place to manage this complication. Preoperative embolization, a method of reducing blood flow to large tumors, have

been used to reduce the risk of massive hemorrhage and consequently hemodynamic instability.

5. Conclusion

CBT excision requires a high degree of vigilance by the anesthesiologist. Cerebral protection, hemorrhage, hypotension and management of arrhythmias are challenging. Successful anesthetic management depends on detailed history, comprehensive investigation and optimization of the patient, monitoring and prompt management of complications that may occur in the perioperative period.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

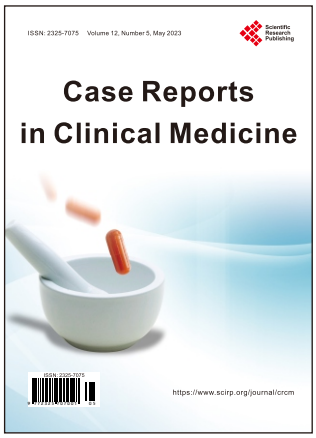
CBT: Carotid body tumour

NIBP: Non invasive blood pressure

IBP: Invasive blood pressure

SSEP: Somatosensory evoked potential

CMR02: Cerebral metabolic rate of oxygen



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