

THE OCCURRENCE OF POST-OPERATIVE URINARY RETENTION IN LOW RISK PATIENTS AT AN ACADEMIC HOSPITAL

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degree

of

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DECLARATION

I, Adèle van der Walt, declare that this thesis is my own work. It is being submitted for the degree of Master of Medicine in the branch of Anaesthesiology in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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Signature of candidate

Signed at: University of the Witwatersrand, Johannesburg

.....

Date

ABSTRACT

BACKGROUND: Post-operative urinary retention (POUR) is a post-operative complication that can lead to patient dissatisfaction. Ultrasound monitoring of bladder volume can improve patient satisfaction by early diagnosis of POUR, therefore limiting the amount of distress experienced by patients and preventing adverse effects from prolonged bladder overdistention. Unfortunately ultrasound is currently not readily available for this purpose at CHBAH. There was a perception that as much as 30% of post-operative adult patients at Chris Hani Baragwanath Academic Hospital (CHBAH) considered to be at low risk of POUR do develop urinary retention. No research has been done to assess the occurrence of POUR at CHBAH.

OBJECTIVES: The primary objective of this study was to describe the occurrence of POUR in low risk patients following elective surgical procedures. The secondary objectives were to determine if the occurrence of POUR was influenced by the type of anaesthetic, the age of the patient and the gender of the patient. We also described the medications administered in our study sample in the peri-operative period.

METHOD: A prospective, contextual, descriptive study design was used. Adult patients for elective surgery in orthopaedic, general surgery, ear nose and throat (ENT), maxillo-facial, plastic or ophthalmology who were considered to be at low risk for POUR and consented to participate were included. The participants received a general anaesthetic, neuraxial anaesthetic or both. In this study a convenience sampling method was used. The researcher approached patients preoperatively to inform them about the study and obtain consent, and again 12 – 24 hours following surgery to collect data. Data was captured on a data capture sheet.

In consultation with a biostatistician a sample size of 150 participants was calculated using the program nQuery Advisor.

Data was captured onto a Microsoft Excel spread sheet for analysis. Descriptive statistics were used to summarise the participants' information.

RESULTS: The study included 156 participants. In this study only one participant had POUR therefore the occurrence of POUR was 0.64%. The volume of urine drained on catheterisation in this participant was 2000 ml. This study could not determine whether the occurrence of POUR was influenced by the type of

anaesthetic, the age or the gender of the patient. Systemic opioids were used in the peri-operative period in 99.25% of patients who received a general anaesthetic and 95.24% of patients who received neuraxial anaesthesia. Non-steroidal anti-inflammatory drugs (NSAIDs) were administered in 88.46% of all the participants in the peri-operative period. Of the participants who received a general anaesthetic atropine was used in 44.03%, β -agonists in 10.45% and α -agonists in 11.94% of patients.

CONCLUSION:

The occurrence of POUR in low risk patients at CHBAH is low. The volume of urine drained at catheterisation in the participant who had POUR is alarming. This study could not determine whether POUR was influenced by age, gender or type of anaesthetic. Multimodal analgesia is commonly prescribed in the peri-operative period at CHBAH.

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CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 Introduction

This chapter will serve as an overview of the study and include the following: an introduction and background, problem statement, aims and objectives, research assumptions, demarcation of the study field, ethical considerations pertaining to the study, research methodology, the significance of the study, validity and reliability of this study.

1.2 Background

Post-operative urinary retention (POUR) can cause significant discomfort and distress to the patient. Apart from the negative impact on patient satisfaction it may cause acute or long term motility abnormalities of the bladder, delayed discharge and increased cost of patient care due to catheterisation, treatment of urinary tract infection and prolonged hospital stay. (1-7)

The occurrence of POUR varies widely in the literature and has been documented to range from <1% to >50%. This wide variation may be attributed to the various definitions used in studies. There is no standardised time to voiding or urine volume for the diagnosis of POUR to be made. The definitions for POUR used in the literature were often at the researchers own discretion. (1, 4, 8-10) No literature pertaining to the occurrence of POUR in South Africa could be identified.

Several factors may contribute to POUR. Although increasing age is associated with POUR (4, 10-14), a higher incidence of POUR in men older than 50 years (10, 12) may be attributed to common prostate pathology especially benign prostate hyperplasia (BPH) (8, 15). A history of lower urinary tract

pathology or abnormal voiding is considered to be a risk factor for POUR (8, 10, 12, 16, 17). POUR is a well-known documented complication of neuraxial blocks (4, 11, 18-20) but the contribution of systemic medication used during general anaesthesia and analgesia is not well documented. The increased amount of intravenous fluid and opioid use during prolonged anaesthesia and surgery are thought to contribute to the higher incidence of POUR documented (4, 14). Different ladder sizes and bladder capacities among patients of different ethnic groups may also play a role (5).

Surgeries considered to be high risk for POUR include: inguinal hernia repair, anorectal, perineal, and emergency surgery (1, 10, 11, 14, 18). Procedures involving manipulation of the bladder or instrumentation of the lower urinary tract may cause inflammation and edema predisposing patients to POUR (15).

The diagnosis of POUR can be made by clinical recognition, catheterisation or ultrasound. Clinical recognition of POUR is not reliable and depend on the skills and experience of the nursing staff (1). Palpation and percussion of the lower abdomen may be very uncomfortable or painful to the patient in the post-operative period and a full bladder may easily be missed especially in the obese or elderly (2). It has been documented that patients with POUR may not be aware of a full bladder after neuraxial block or general anaesthesia (1, 4) and patients who are able to void spontaneously may have a significant residual volume (1, 20), therefore a high index of suspicion should be maintained.

Diagnosis of POUR by catheterisation is invasive and embarrassing to the patient (6). Unnecessary catheterisation should be avoided as it predisposes patients to urinary tract infections, trauma, urethral strictures and prolonged hospital stay (17). No consensus has been reached whether in-out or indwelling urinary catheters are more beneficial (6, 15).

Urinary catheterisation is not without risk. Reinforcement of non-invasive management of POUR and the administration of an α -adrenergic antagonist or cholinergic medication may aid voiding and prevent unnecessary catheterisation (2, 10, 15, 21, 22).

Ultrasound has a high sensitivity and specificity for the diagnosis of POUR. It is a non-invasive and cost-effective measuring tool that have gained popularity (5, 9, 18, 23). It has been suggested that ultrasound should be used routinely in the post-operative period to monitor patients at high risk of POUR to facilitate early diagnosis (1, 4, 11). Unfortunately the initial cost to obtain ultrasound is expensive and it is not readily available in all hospitals.

Awareness of POUR and its adverse effects may prompt health care providers to identify patients at risk and implement prevention strategies such as multimodal analgesia, careful consideration of the type of anaesthetic and medication used, encourage voiding prior to surgery and judicious fluid administration (1, 11, 15, 19, 24, 25).

The occurrence of POUR at CHBAH had never been documented to our knowledge. It was possible that urinary retention was only recognised once patients experience discomfort, pain or other adverse effects of bladder distension especially the patient at low risk of POUR that may not be monitored as closely as the patient at high risk. Patient satisfaction is not routinely documented and a high occurrence among patients at low risk of POUR may increase awareness of POUR and indicate the need for a management protocol to be developed for post-operative care at CHBAH with the available resources.

1.3 Problem statement

Urinary retention is a commonly underdiagnosed post-operative complication that results in patient discomfort and possible permanent damage to the lower urinary tract. Reliable early detection of POUR is possible with an ultrasound of the bladder. This method of detecting a full bladder is not readily available for post-operative patients at CHBAH.

There was a perception that as much as 30% of post-operative adult patients at Chris Hani Baragwanath Academic Hospital (CHBAH) considered to be at low risk of POUR do develop urinary retention. Patients known to be at high risk of POUR are usually monitored closely and POUR can be diagnosed timeously. Voiding may not be considered to be as important as other monitored parameters in the patient at low risk of POUR and may predispose patients to late diagnosis in the post-operative wards. As the occurrence of POUR at CHBAH was unknown the researcher was approached to conduct the study.

1.4 Aim

The aim of this study was to describe the occurrence of POUR in adult patients at low risk of POUR who presented for elective surgical procedures at CHBAH and to determine if this was influenced by age, gender or type of anaesthetic received.

1.5 Objectives

The primary objective of this study was to describe the occurrence of POUR in low risk patients following elective surgical procedures.

The secondary objectives of this study were to:

- determine if the occurrence of POUR was influenced by:
 - the type of anaesthetic
 - the age of the patient
 - the gender of the patient
- describe the medications administered in the peri-operative period.

1.6 Research assumptions and definitions

The following definitions were used in this study:

Adult: any patient 18 years or older.

Post-operative urinary retention (POUR): is the inability to empty the bladder without non-invasive or invasive interventions in the post-operative period.

Post-operative period: the post-operative period was considered to start from arrival in the recovery room to 24 hours after the end of anaesthesia.

High risk of POUR: patients considered to be at high risk of POUR included patients who had anorectal surgery, inguinal hernia repair, pelvic or abdominal surgery, previous surgery to the urinary tract, patients with a history of abnormal voiding or known prostate pathology, urinary tract infection in the seven days prior to surgery or previous POUR.

Low risk of POUR: if none of the above factors were evident patients were considered to be at low risk of POUR.

Non-invasive management of POUR: this referred to interventions done by nursing staff that encouraged voiding but which excluded catheterisation.

Invasive management of POUR: referred to catheterisation which may have been in-out or indwelling.

Occurrence: the term occurrence is used in this study as the biostatistician consulted was of the opinion that although the sample size was appropriate for the study, it was not adequate to describe the prevalence of POUR from epidemiological perspective. However, incidence and prevalence will be used in the discussion of the literature when used by the authors.

1.7 Demarcation of study field

The study was conducted in the post-operative wards of the CHBAH in the following surgical disciplines: orthopaedic; general surgery; ear nose and throat (ENT); maxillo-facial, plastics and ophthalmology. CHBAH is a 3 200 bed tertiary hospital in Soweto affiliated to the University of the Witwatersrand, Johannesburg (26). Annually more than 43 657 surgeries are performed in the J.D. Allen theatre complexes of the hospital (27).

1.8 Ethical considerations

Permission to conduct the study was sought from the relevant authorities.

Patients were invited to take part in the study. An information letter (Appendix A) was given to those who agreed to participate and informed written consent (Appendix B) was obtained. Anonymity and confidentiality of participants was maintained.

The study was conducted according to the principles of the Declaration of Helsinki (28) and the South African Good Clinical Practice Guidelines (29).

1.9 Research methodology

1.9.1 Research design

A prospective, contextual, descriptive study design was used.

1.9.2 Study population

The population for this study was adult patients in the post-operative wards who were at low risk for POUR and received either general anaesthesia or a neuraxial block during their elective surgical procedure.

1.9.3 Study sample

In consultation with a biostatistician a sample size of 150 participants was calculated using the program nQuery Advisor. In this study a convenience sampling method was used. Inclusion and exclusion criteria were used to select participants suitable for the study.

1.9.4 Data collection

Potential participants from the specified surgical disciplines were identified from the theatre booking lists in the CHBAH J.D. Allen Theatre Complex the day before surgery or on the day of surgery but before the patient arrived in theatre from the ward.

The participants were approached in their respective wards before surgery. An information letter (Appendix A) was given to each patient and the researcher explained the purpose of the study. If the patient agreed to participate in the study, written informed consent (Appendix B) was obtained.

The researcher approached participants 12 – 24 hours following surgery. Data collected from the participants was captured on a data capture sheet (Appendix C).

1.9.5 Data analysis

Data was captured onto a Microsoft Excel spread sheet for analysis. Descriptive statistics were used to summarise the participants' information.

1.10 Significance of the study

A strong association has been documented between patient dissatisfaction and post-operative complications including post-operative urinary retention (POUR). Prevention and early management of post-operative complications may lead to an improvement in quality of care and patient satisfaction.

(30)

The occurrence of POUR at the CHBAH was unknown. If this study demonstrated a significant proportion of the patients at low risk for POUR presenting for surgery at CHBAH were catheterised, it would improve awareness of POUR. Patient comfort and safety may then be improved by early intervention in low risk patients.

1.11 Validity and reliability of study

Measures were put in place to ensure the validity and reliability of the study.

1.12 Project outline

This report includes the following chapters:

- Chapter 1: Overview of the study
- Chapter 2: Literature review
- Chapter 3: Research methodology
- Chapter 4: Results and discussion
- Chapter 5: Summary, limitations, recommendations and conclusion.

1.13 Summary

In this chapter a brief overview was given on the study that was done and included an introduction and background, problem statement, aims and objectives, research assumptions, demarcation of the study field, ethical considerations pertaining to the study, research methodology, the significance of the study, validity and reliability and a project outline.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter will review the literature concerning POUR. It includes patient satisfaction and safety, the definition of POUR, an overview of the applicable anatomy, physiology and pharmacophysiology, the occurrence of POUR, the pathophysiology involved in urinary retention, risk factors associated with POUR, the diagnosis of POUR and management options for POUR.

2.2 Patient satisfaction and safety

Patient satisfaction is a complex entity and incorporates the patient's values, perceptions, attitude, culture and emotions. The patient judges care against a standard of care expected. When a discrepancy exists between the patient's expectations and the actual care received, dissatisfaction may be the consequence. (31) Providing adequate information to patients may bridge this gap and result in improved patient satisfaction. (32)

A strong association has been documented between patient dissatisfaction and post-operative complications including post-operative urinary retention (POUR). Prevention and early management of post-operative complications may lead to an improvement in quality of care and patient satisfaction. (30) The care provided when a post-operative complication is present may have greater impact on patient satisfaction than the complication itself (32).

Literature on factors associated with patient dissatisfaction is limited globally and the research available may not be generalisable to other populations and health care settings. To our knowledge no research has been conducted in the South African population to assess patient satisfaction and the influence of POUR.

2.3 Definition of post-operative urinary retention (POUR)

Urinary retention is defined as the inability to completely or partially empty the bladder (33).

The normal bladder capacity is considered to be 400-600 ml for an average adult without pathology of the lower urinary system (3, 4, 6). The possibility that bladder sizes may differ among ethnic groups (5, 34) may contribute to the wide range.

Different types of bladder capacity are described in the literature namely anaesthetic bladder capacity, functional bladder capacity and cystometric bladder capacity. Anaesthetic bladder capacity refers to the volume of fluid that can be introduced into the bladder during a cystoscopic procedure while a patient is under anaesthesia. Compared to the other types of bladder capacity, the volume that can be infused into the bladder is much greater. Functional bladder capacity is the volume of urine in the bladder prior to voluntary voiding and is based on the volumes of urine recorded in a diary by the patient. There tends to be great variation among individuals because the decision to voluntarily void is influenced by multiple factors. Cystometric bladder capacity refers to the volume in the bladder at the end of a filling cystometrogram. (34)

2.4 Overview of anatomy, physiology and pharmacophysiology

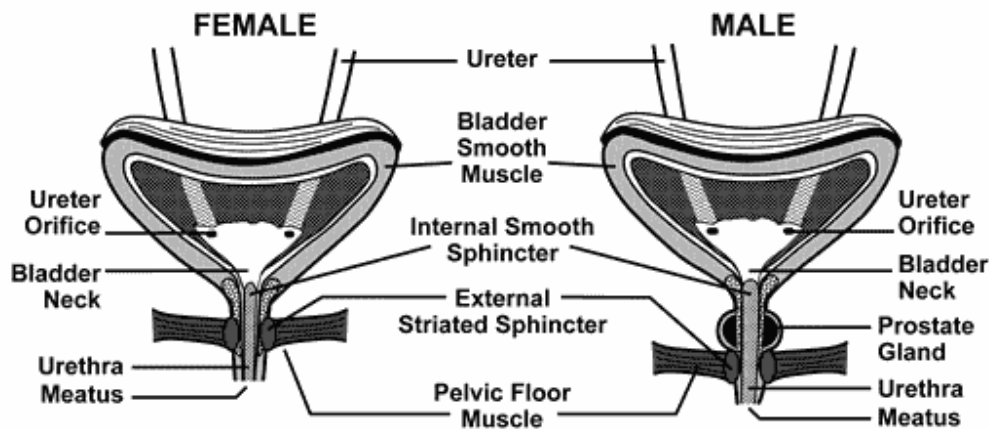
2.4.1 Brief overview of anatomy and physiology of the lower urinary tract

The main functions of the bladder are to store and excrete urine. The bladder wall is very compliant, therefore, significant volumes of urine can be stored (3).

The bladder consists mainly of smooth muscle, collagen and elastin (3). The smooth muscle of the bladder consists of three layers which are arranged in longitudinal, circular and spiral bundles. The circular muscle is referred to as the detrusor muscle. (35) In order to maintain the capacity of the bladder, the smooth muscle of the bladder is maintained at a steady tone. Various factors may influence bladder tone including autonomic activity, hormones, local metabolites, temperature, response to stretch and locally secreted agents (e.g. nitric oxide). (3) The smooth muscle of the bladder has an intrinsic ability to contract when stretch receptors in the bladder wall are stimulated. Under normal conditions, the threshold for bladder contraction initiated by neural stimulation is lower than that for the smooth muscle itself. The intrinsic ability of the smooth muscle to contract has no function in normal bladder emptying, but in pathological conditions affecting nerve supply to the bladder, may result in various motility disorders of the bladder. (3, 35)

The internal sphincter (Figure 1) is formed by the smooth muscle of the bladder that extends to surround the upper part of the urethra. The control of the internal sphincter is involuntary. In the female, the internal urethral sphincter is tonically contracted to prevent leaking of urine. The role of the internal sphincter in the male is to prevent reflux of semen during ejaculation. It has no role during micturition. The sympathetic nervous system causes bladder contraction during ejaculation, thus preventing reflux of semen into the bladder. The external sphincter is formed by the pelvic floor muscles. In contrast to the internal sphincter, the external sphincter consists of skeletal muscles and is under voluntary control (Figure 1). Micturition can be delayed by the learned ability to keep the external urethral sphincter contracted. (3, 35)

Figure 2.1 The Lower Urinary Tract (36)



Regular peristalsis in the ureters facilitate filling of the bladder at a slow rate (35). With reference to Laplace's law, the tension in the bladder wall during filling is directly proportional to the intravesical pressure and the size of the bladder. The intravesical pressure remains relatively constant during filling due to the compliance of the bladder wall. An increase in the intravesical pressure occurs when bladder capacity is reached. The tension in the bladder wall increases as the bladder expands, and increases even further when bladder capacity is reached. The sensation of a full bladder is experienced when increased tension in the bladder wall activates bladder afferent nerves. The first urge to void in an average adult is experienced at a bladder volume of 150 ml (3, 4, 6, 21, 35), whereas a marked sense of fullness of the bladder is experienced at a volume of 300-400 ml (3, 4, 6, 21, 35, 37)

2.4.2 The nervous system and micturition

Voiding is triggered by reflex activity, but is subject to voluntary facilitation or inhibition. Sustained synchronous contraction of the smooth muscle of the bladder is required for effective voiding. (3, 35)

Control of the lower urinary tract is achieved by complex interaction of different components of the nervous system. Excretion of urine requires coordinated smooth muscle activity of the bladder and urethra. (3, 35) To achieve this coordination, reflex pathways in the brain and spinal cord function as on-off switching circuits, with various feedback mechanisms. (3)

Parasympathetic supply to the bladder arises at the sacral level of the spinal cord (S2, S3, S4). Activation of the parasympathetic nerves results in detrusor muscle contraction and relaxation of the urethra (3, 35). The effects of the parasympathetic nervous system on the lower urinary tract are achieved by acetylcholine release from neurons, nitric oxide release (inhibitory transmitter) and removal of excitatory stimulation (3). Efferent fibres of the parasympathetic supply of the lower urinary tract travel in the pelvic nerves. The parasympathetic nervous system plays a vital role in micturition. When the parasympathetic nerve supply to the lower urinary tract is removed, the bladder becomes distended and hypotonic. (3, 35)

Sympathetic nerve supply arises from the thoracolumbar spinal cord (T10-L3) (3, 38) . Postganglionic fibres travel through the hypogastric nerve to the detrusor muscle and the internal urethral sphincter. In contrast to parasympathetic activation, the sympathetic nervous system plays no role in micturition. Stimulation inhibits bladder contraction and excites the bladder outlet and urethra. (3, 35)

The external urethral sphincter is excited by the pudendal nerves (S2, S3, S4), which contains sacral somatic pathways. The somatic afferent pathways can inhibit voiding by activation of afferents from various sites. (3, 35)

The micturition reflex is initiated by activation of stretch receptors located in the bladder wall. Micturition can be involuntary or voluntary. The afferent and efferent fibres of the micturition reflex travel in the pelvic nerves, and integration takes place in the sacral spinal cord. At bladder volumes of more than 150 ml in a normal adult, the stretch receptors in the bladder wall are stimulated. This results in activation of the afferent pathways. Impulses travel through the afferent fibres in the pelvic nerves to the sacral spinal cord. The parasympathetic pathway to the lower urinary tract is stimulated and the sympathetic pathway is inhibited. (3, 35) The threshold of the voiding reflex can be altered by facilitatory centres in the pons and posterior hypothalamus, or inhibitory centres in the midbrain. Voluntary control is achieved by suppressing the micturition reflex through connections between the frontal cortex, the hypothalamus, the paracentral lobule and the brainstem. With pathological conditions involving these connections, inhibition of the micturition reflex is lost and voiding occurs involuntarily. Voluntary relaxation of the external urethral sphincter is achieved by inhibition of the somatic motor neurons. Bladder contraction during voiding is intensified by positive feedback loops involving central mechanisms. These central mechanisms are stimulated by reflexes which are initiated by the stretch receptors. (3)

2.4.3 The role of the urothelium

The urothelium has similar properties to nociceptors and mechanoreceptors. In response to mechanical and chemical stimulation, the urothelial cells can release nitric oxide (NO), adenosine triphosphate (ATP) and Substance P which can have excitatory or inhibitory actions on the afferent nerves that are in close proximity or in the urothelium. (3) The role of NO in the urothelium still needs to be investigated. NO is released especially during inflammation (3). ATP is released in response to stretch and activate suburothelial bladder afferents (3).

Prostaglandins released from the urothelium have two possible functions, regulation of detrusor muscle activity and cytoprotection of the urothelium (3). Prostaglandin synthesis increases during inflammation, trauma and overdistension of the bladder (39).

Muscarinic receptors are abundant in the urothelium. The urothelium constantly releases a basal amount of acetylcholine resulting in modulation of afferent nerve and smooth muscle activity. The basal release of acetylcholine increases with stretch and aging. (3)

2.4.4 Pharmacophysiology

In order to understand the influences of various medications on the lower urinary system an overview of pharmacophysiology will follow.

2.4.4.1 Peripheral pharmacophysiology

Muscarinic mechanisms

In the lower urinary tract, muscarinic receptors are located in the bladder itself and prejunctionally on cholinergic nerve terminals in the bladder. Stimulation of the muscarinic receptors in the bladder result in an increase in intracellular calcium, which leads to detrusor contraction. Calcium ions move across the

membrane through nifedipine-sensitive L-type calcium channels, thus nifedipine, a calcium channel blocker, can suppress muscarinic-mediated detrusor contraction. The muscarinic receptors are also involved in an amplification mechanism to ensure complete emptying of the bladder. Nicotinic transmission is modulated in the central nervous system by inhibitory and facilitatory muscarinic receptors. Studies done on mice indicated a possible gender difference in the micturition mechanism. Atropine, an anticholinergic drug, can completely abolish the contractile responses of the detrusor muscle. (3)

Purinergetic mechanisms

ATP acts on two families of purinergetic receptors, an ion channel family and a G protein-coupled receptor family. In the human bladder, the ion channel receptors predominate. These ion channel receptors may upregulate in bladder obstruction. Adenosine may depress bladder contraction stimulated by parasympathetic activity. (3)

Adrenergic mechanisms

B-Adrenergic mechanisms

The human detrusor muscle has β_2 - and β_3 -receptors. Stimulation of these receptors causes accumulation of cyclic AMP (cAMP) which results in direct detrusor relaxation. It is mainly the β_3 -receptors that are responsible for the relaxation of the detrusor muscle. (3)

α -Adrenergic mechanisms

In the normal bladder α -adrenergic stimulation is not prominent. In pathologic conditions the density of the α -adrenergic receptors may increase (3).

α -Adrenergic mechanisms play an important role in urethral tone and intraurethral pressure. Resting urethral tone is maintained mainly by α_1 -receptors. The urethra has α_1 - and α_2 -receptors with the α_1 -receptors being more prominent. α -Agonists will increase intraurethral pressure and promote urine storage, while α -antagonists will promote the release of urine. (3)

Nitric Oxide (NO)

NO induced relaxation of smooth muscle is due to increased cyclic guanosine monophosphate (cGMP). NO is considered to be an inhibitory neurotransmitter and result in relaxation of urethral smooth

muscle. NO may have NMDA-receptor dependent effects. At spinal level, NO has an excitatory effect on the micturition reflex. Locally on the bladder, NO is considered to have an inhibitory effect. This is mediated by modulation of bladder afferent activity. Studies in rats implicated possible gender differences in parasympathetic and NO-mediated pathways in the human urethra. (3)

Afferent neuropeptides

Noxious stimulation result in the release of various peptides from the C-fibre bladder afferents. These peptides contribute to the inflammatory response in the bladder and may alter smooth muscle activity. The peptides also act as transmitters at the afferent terminals in the spinal cord. (3)

Stimulation of tachykinin (small peptides) receptors in the spinal cord, activate the opioid mechanisms. The micturition reflex can be inhibited by the activation of opioid mechanisms in the spinal cord. (3)

Prostanoids

Prostaglandins and thromboxanes are manufactured throughout the lower urinary tract and are involved in contractility, inflammation and neurotransmission. Prostaglandins are considered to have a modulatory role, some by affecting neural release of transmitters and others by inhibiting acetylcholinesterase. Indomethacin inhibits prostaglandin synthesis. (3)

2.4.4.2 Central pharmacophysiology

Spinal cord

Spinal reflex pathways involved in control of the bladder and sphincter functions use the glutamatergic transmitter mechanisms namely N-methyl-D-aspartate (NMDA) and α -amino-3-hydroxy-5-methylisoxazole-4-propionate (AMPA). Glutamate plays a role as an excitatory transmitter in the afferent limb of the micturition pathway. (3)

In the spinal cord, α -adrenoceptors can mediate inhibitory or excitatory effects on the lower urinary tract. The afferent pathways of the micturition reflex receive inhibitory input from noradrenergic systems, while the efferent pathways of the micturition reflex receive excitatory input from

noradrenergic systems. Lumbar sympathetic outflow is controlled by α 1-excitatory and α 2-inhibitory mechanisms. (3)

The reflex pathways in the spinal cord are inhibited by opioid peptides. In the spinal cord of the cat inhibition of reflex bladder activity is mediated by δ -receptors while inhibition of sphincter activity is mediated by κ -receptors. In the rat, inhibition of the bladder is mediated by δ - and μ -receptors.

Pontine micturition centre and supraspinal

Glutamate, Gamma-aminobutyric acid (GABA), Dopamine, serotonin as well as cholinergic mechanisms are involved in the pontine micturition centre and supraspinal pathways. μ - and δ -receptors mediate opioid inhibitory effects and increase bladder capacity. These effects can be blocked by naloxone. Naloxone in itself facilitates the micturition reflex. (3)

2.4.4.3 Medication implicated in post-operative urinary retention (POUR)

Literature on medication that may affect the lower urinary tract is limited. A brief overview on the mechanism of action and the possible effects on the lower urinary tract of various medication commonly used peri-operatively will follow.

Anticholinergics

Mechanism of action: competitive antagonists of muscarinic receptors, therefore a reduced response to cholinergic stimulation. (3, 40)

Effects on the lower urinary system: The anticholinergics may decrease bladder tone and increase the tone of the sphincter, thus patients who receive these medications may be at a higher risk for POUR. (15, 40-42) Examples of commonly used anticholinergics in anaesthetic practice are atropine and glycopyrrolate.

Other medications with anticholinergic effects

- Antipsychotic agents e.g. phenothiazines, thioxanthenes
- Antidepressants e. g. tricyclic antidepressants, tetracyclic antidepressants
- Antiarrhythmic agents (class I) e. g. disopyramide, flecainide
- Antispasmodic agents e. g. hyoscine butylbromide
- Antiparkinsonian agents e. g. biperiden, dextenamine, amantadine
- H₁-receptor antagonist e. g. first generation: diphenhydramine, promethazine and second generation: loratadine
- Inhaled anticholinergics e. g. ipratropium. (42, 43)

Calcium antagonists

Mechanism of action: bind to calcium channels, therefore it prevent the calcium influx which would normally lead to muscle contraction (40).

Effects on the lower urinary tract: direct smooth muscle relaxation and decreased contractility of smooth muscle (3, 42), may also have anticholinergic properties (3). Examples are diltiazem, nifedipine and verapamil.

Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

Mechanism of action: selective or non-selective inhibition of the enzyme(s) which catalyze the synthesis of prostaglandin from arachnidonic acid, namely cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2). (40)

Effects on the lower urinary system: may promote relaxation of the bladder and decreases inherent activity of the bladder smooth muscle (3). The highest risk for acute urinary retention associated with NSAIDs, are among first time users of NSAIDs or patients who use the highest recommended dose (39, 42). An example is Flurbiprofen.

β-Adrenergic agonists

Mechanism of action: Selective or non-selective stimulation of β-receptors (40).

Effects on lower urinary system: Sympathetic stimulation through β -receptors result in bladder relaxation (3). Examples are Isoproterenol (non-selective) and Terbutaline (selective β_2)

α -Adrenergic agonists

Mechanism of action: Selective or non-selective stimulation of α -receptors (40).

Effects on the lower urinary system: Increase urethral tone (3, 42) by binding to the $\alpha_{1A/D}$ -receptors (42). Examples are phenylephrine (α_1 -selective) and clonidine (α_2 -selective)

Some medications commonly used in anaesthesia have both α - and β -agonist effects e.g. Ephedrine, Adrenaline (40).

Table 2.1 General anaesthetic agents

General Anaesthetic Agents	Mechanism of Action
Propofol	Interact with GABA _A receptor. (40)
Etomidate	Relative selective action on GABA _A receptor (40)
Benzodiazepines	Enhance the affinity of GABA receptors for GABA.(40)
Barbiturates	Bind to GABA receptor. Decrease rate of dissociation of GABA from the GABA receptor. Also have effects at glutamate receptors, adenosine receptors and nicotinic acetylcholine receptors. (40)
Ketamine	Noncompetitive binding to the NMDA receptors. May also have effects on the opioid receptors, monoaminergic receptors, muscarinic receptors, voltage-sensitive sodium and L-type calcium channels. Weak action on GABA _A receptors. (40)

Effects of general anaesthetic agents on the lower urinary tract: Fan (8) suggested that general anaesthetic agents cause dysfunction of the autonomic nervous system which results in bladder function abnormalities. Benzodiazepines may either be a causative or preventive factor related to urinary retention. The mechanisms are believed to be related to muscle relaxation or anxiolytic and skeletal muscle relaxation respectively. (42) Clinical evidence of the effects on the lower urinary tract of the general anaesthetic agents are limited. When considering the normal physiology of micturition and the receptors involved in the mechanism of action of these agents, there is clearly a possibility of an increased risk for abnormal voiding.

Opioids

Mechanism of action: Agonist activity at opioid receptors. Receptors may be central, with receptors mainly pre- and postsynaptically in the brainstem and the spinal cord, or peripherally on various tissues. (40)

Effects on lower urinary system: neuraxial administered opioids result in detrusor relaxation and an increase in maximum bladder capacity. The agonistic activity on sacrally located opioid receptors may cause parasympathetic inhibition, which leads to urinary retention. According to Stoelting (40) urinary retention caused by neuraxial opioids is not dose-dependent or related to systemic absorption (40). In contrast, Kuipers et al. (25) stated the abnormal lower urinary tract function after intrathecal morphine and sufentanil was related to the pharmacokinetics of the drug and were dose-dependent (25). Systemically administered morphine and other opioids may decrease parasympathetic tone (41, 42) and lead to an increase detrusor muscle tone and the sphincter tone, contributing to an increased risk of urinary retention (40, 42, 44).

Local anaesthetic agents

Mechanism of action: prevents threshold potential being reached in nerve membranes by blocking sodium channels.

Effects on the lower urinary system: Urinary retention is mainly due to the chemical inhibition of nerve impulses, thereby blocking the normal micturition reflex pathways (40).

2.5 Occurrence of POUR

The occurrence of POUR in the literature varies widely. One of the most striking factors contributing to this is the various definitions and diagnostic criteria used in the studies. Multiple factors may also influence the occurrence of post-operative urinary retention. The risk factors are controversial (1, 4, 8, 11, 18, 19, 24, 37) and will be discussed later. Studies done were not standardised and therefore it is difficult to compare results. The occurrence is documented between <1 to >50% (1, 4, 7-10, 42, 45, 46). The variety of occurrences documented will be illustrated with reference to the various definitions used for POUR and other factors which may influence occurrence.

Stallard (41) defined urinary retention as an inability to void >12 hours after induction of anaesthesia and >500 ml of urine drained at first catheterisation. Patients were also diagnosed with POUR if they complained of painful urinary retention or when the bladder was palpable. The incidence of POUR in this study was 6%. (41)

Tammela (10) documented an incidence of 3.8% in a study where the diagnosis of POUR were made when patients have not voided several hours after the end of surgery and the patient experienced discomfort due to a full bladder or had a palpable bladder. The number of hours post-operative was not specified. Non-invasive measures were attempted before catheterisation which was not done in the study by Stallard (41). (10)

In a study by Bhattacharya (19) patients were catheterised if they did not pass urine within three hours post-operatively or when they complained of urinary retention. The incidence of POUR in this study for the group of patients who received spinal anaesthesia was 16%. The incidence may be falsely high since only three hours was allowed for patients to void post-operatively. Pavlin (18) documented that unnecessary catheterisations would have been 50% if patients were expected to void within two to three hours instead of catheterisation at bladder volumes of >600ml measured with an ultrasound associated with an inability to void (18).

Time alone is a poor indicator of urinary retention. When time is used as a diagnostic criteria, there may be an under- or overdiagnosis of POUR. Tammela (10) documented the time from end of surgery to the time of first catheterisation. At the time when patients were catheterised they had bladder volumes

exceeding the normal bladder capacity and some even had overflow incontinence (10), possibly indicating a late diagnosis of urinary retention.

The ultrasound diagnosis of urinary retention is progressively gaining popularity. Since the range for normal bladder capacity is wide, there are inconsistencies with the volumes used as cut-off points for the ultrasound diagnosis of urinary retention. Therefore, the criteria to diagnose urinary retention based on ultrasound findings needs to be clearly defined.

Pavlin (1), Keita (14) and Kreutziger (13) used the same diagnostic criteria for POUR. In these studies POUR was diagnosed when a bladder volume of >600 ml on ultrasound was associated with an inability to void. The incidence of POUR was documented as 0.5% in patients at low risk, 5% in patients at high risk and 25% re-retention after in-out catheterisation in the study by Pavlin (1). Keita (14) did not distinguish low risk or high risk groups and included patients who had orthopaedic, vascular, thoracic, abdominal and urologic surgery. Keita (14) allowed the patients with a bladder volume of > 600 ml 30 minutes of privacy in which they attempted to void spontaneously. The patients were allowed to sit but not stand during the 30 minutes. The incidence documented was 16% from the total study sample. (14) Kreutziger (13) investigated 2% prilocaine as a possible intrathecal local anaesthetic for ambulatory surgery and the incidence was documented to be 23%.

A study by Hansen (11) allowed patients with a bladder volume ≥ 400 ml to attempt to void spontaneously within 1 hour before catheterisation was done. The incidence of POUR was 10.7% but this study excluded patients at increased risk for POUR including those with epidural analgesia post-operatively, abdominal surgery, hip and knee arthroplasty. (11)

Feliciano (6) defined POUR as a bladder volume of >500 ml on ultrasound associated with an inability to void within 30 minutes. He reported an incidence of 44.1% but his study sample consisted only of patients who had spinal anaesthesia. (6)

2.6 Pathophysiology involved in urinary retention

Several pathophysiological processes may be involved in the development of POUR. Often more than one pathophysiological process contributes to POUR.

2.6.1 Medication and anaesthetic technique

The medication thought to affect the lower urinary tract and possibly contribute to POUR was discussed above. During a general or neuraxial anaesthesia a variety of the medications thought to contribute to POUR may be used. Not only the medications, but also the mode of delivery and anaesthetic technique may play a significant role in POUR.

After spinal anaesthesia, urodynamic changes may last for hours. Even when motor block have regressed completely, urodynamic changes may persist. The duration of urodynamic changes depend on the physicochemical properties of the local anaesthetic used. (24)

Detrusor block lasts significantly longer after spinal anaesthesia with bupivacaine when compared to lignocaine. Bladder volumes accumulated during the time of detrusor block after spinal anaesthesia with bupivacaine, were significantly higher than the measured cystometric capacity of the bladder before spinal anaesthesia. The urge to void after spinal anaesthesia disappears quickly, and spontaneous voiding is only regained once the sensory level has regressed to S3. (24)

Unilateral spinal anaesthesia may theoretically have a decreased incidence of POUR since pathways controlling bladder contraction will be affected only partially (47). In a study done by Voelckel (47), there was no statistically significant difference between patients who received a unilateral spinal anaesthesia compared to patients who received bilateral spinal anaesthesia for knee surgery. The incidence of POUR was 30% and 35% for the two groups respectively. (47) An explanation may be that uncoordinated contraction may result in bulging of the compliant areas of the bladder that are not contracting (3).

Selective pudendal nerve block may be an appropriate alternative to spinal anaesthesia for haemorrhoidectomy. The incidence of urinary retention after haemorrhoidectomy with pudendal block was significantly decreased (15).

2.6.2 Inflammatory and infective

Urinary retention may result from edema of the lower urinary tract or inflammation around the sacral nerves (15). This may explain the increased incidence of POUR after pelvic surgery.

2.6.3 Neurologic

Any disruption of the neurologic pathways involved in micturition may lead to abnormal voiding (15). Local anaesthetic agents injected either intrathecally or as an epidural may interrupt these pathways chemically. Pathology involving the neurologic pathways or disrupting normal neurological physiology like stroke, multiple sclerosis, neuropathy and spinal pathology may also cause abnormal voiding (10, 15, 48, 49).

2.6.4 Obstructive

A history of abnormal voiding preoperatively is a predisposing factor to POUR (10). Benign prostatic hyperplasia (BPH) is the most common obstructive cause of the lower urinary tract (15) and has been shown to be significantly associated with POUR (8, 13). Two mechanisms cause bladder outlet obstruction in BPH: 1. the enlarged prostate impinges on the urethra 2. increased α -adrenergic tone. Other possible causes of abnormal voiding include previous surgery or trauma on the pelvis or lower urinary tract, previous prostatitis and previous urinary tract infection (10). In the female, pregnancy and prolapse of the bladder, uterus or rectum may cause obstruction. Pelvic masses and intravesical hematoma are also possibilities. (15)

2.6.5 Other

Reflex of the bladder sphincter may be caused by pain, anxiety, bladder manipulation and catheterisation. (9, 10)

2.7 Risk factors associated with POUR

Multiple studies have been conducted with the aim to identify risk factors which predispose patients to the development of post-operative urinary retention (4, 6, 10-14). Early identification of patients at risk could prevent bladder overdistension.

2.7.1 Age

A correlation between the incidence of POUR and increasing age was shown in multiple studies, with patients 50 years and older at increased risk (4, 10-14, 50). Lamonerie (4) documented an odds ratio of 2.11 with multivariate analysis for patients older than 60 years (95% confidence interval 1.01-4.38)(4) whereas Hansen (11) documented an odds ratio of 1.53 for patients older than 50 years. The association of POUR and age may be due to degenerative changes in the bladder and pathologies commonly seen with increasing age (10). In a recent study, a higher incidence was evident in females <40 years with an odds ratio of 6,125 when compared to women between 40-60 years (13). This can possibly be attributed to increased sympathetic tone as suggested by Tammela (10).

2.7.2 Gender

Gender difference related to the incidence of POUR is controversial. Some studies showed the incidence of POUR to be higher in men (10, 12, 45, 46, 51), while others showed no significant difference between

men and women (4, 11, 14). In a study where patients received spinal anaesthesia with 2% prilocaine, female gender was identified as a predisposing factor for POUR with an odds ratio of 4.36 (95% confidence interval 1.48-12.87) in comparison to men. In this study the mean age of the participants was 46 years (13), therefore increased sympathetic tone in the younger women may have contributed to this finding (10). BPH and other gender specific pathology may be implicated in the studies with a significant difference (8).

2.7.3 Type of surgery

An association between the incidence of POUR and major surgery (14), perineal surgery (1, 50), inguinal hernia repair (18), emergency surgery (10, 11), thoracotomies, hip and knee arthroplasties (10, 52) and laparotomies (10) have been documented. POUR is the most common complication after anorectal surgery. The mechanism is unclear and may be multifactorial including decreased sensation, pain, increased sympathetic activity and outflow obstruction due to edema. (50) Lamonerie (4) did not find any correlation between type of surgery and the incidence of POUR in a study population who had various types of surgery including thoracic, vascular, abdominal, orthopaedic or ear nose and throat (ENT) surgery (4). Gynaecological surgery was not associated with an increased risk for POUR. The bladder is often drained with in-out catheterisation during gynaecological surgery which may contribute to this finding. (1)

2.7.4 Duration of surgery and anaesthesia

A duration of surgery more than one to two hours has been associated with POUR (4, 14). An odds ratio of 3.03 (95% confidence interval 1.39-6.61) was documented for surgery > 2 hours (4). The association between the incidence of POUR and the duration of anaesthesia is controversial (11, 14, 37). Hansen (11) documented an odds ratio of 1.88 (p 0.032) for anaesthesia of > 2 hours. Higher volumes of intravenous fluids and dosages of opioids in longer surgery may play a role (4).

2.7.5 Anaesthetic technique and duration of anaesthesia

Urinary retention is a well known complication of spinal and epidural anaesthesia secondary to changes in sensation and a blocked micturition reflex (4, 11, 18-20, 50). A delay in voiding after spinal or epidural anaesthesia of 213 minutes has been documented (18). An odds ratio of >3 was documented in more than one study for POUR in patients who had spinal anaesthesia (4, 11). In a study comparing spinal anaesthesia and paravertebral block, the incidence of POUR in the group that received paravertebral block was 0% while the group that had spinal anaesthesia had an incidence of 16% (19).

2.7.6 Intravenous fluids

In several studies the amount of fluid administration did not increase the incidence of urinary retention in patients at low risk for POUR (1, 13). Other studies showed a correlation between high amounts of intravenous fluid and POUR (14, 37) especially after spinal anaesthesia (24). Multiple factors may influence the result such as pre-operative fluid balance, renal function and volume of blood loss. (13)

Tammela (10) identified intravenous fluid as a predisposing factor for POUR. This study included all patients who were diagnosed with POUR over a period of one year. The study sample included patients with various possible risk factors including neurologic disease, elderly, history of abnormal voiding and patients who received medications with effects on the lower urinary tract. Bleeding in 79.3% of patients was less than 500 ml and patients received a total amount of intraoperative fluids of 4000 ml or less. (10) The contribution of intraoperative fluid to POUR reported by Tammela (10) may be due to excessive fluid administration. Pavlin (1) suggested excessive fluid administration in an attempt to overcome the delay of voiding after surgery increases the risk of POUR where bladder function may be abnormal .

2.7.7 Medications

The medications with possible effects on the lower urinary tract have been discussed above. A discussion of results of several studies will follow.

Opioids

Kumar (53) documented the mean morphine requirements post-operatively to be a predictive factor of POUR ($p=0.035$).

A study showed the incidence of urinary retention associated with patient controlled analgesia (PCA) was 38.7% which was comparable to epidural analgesia where the incidence was 49.4%. In both these groups the incidence of retention decreased significantly ($p<0.05$) to 4.84% and 5.6% respectively after the PCA and the epidural was stopped. (8)

Intrathecal administered opioids may cause a dose-dependent decrease in detrusor contractility and a decreased sensation to void. The duration of the effects may be dependent on the pharmacokinetics and the dose of the opioid used. Kuipers et al. (25) did urodynamic evaluations before and every hour after administration of intrathecal morphine and sufentanil to evaluate the effects on the lower urinary tract. Recovery after intrathecal sufentanil was faster than morphine and the duration of the effects were thought to be dependent on the pharmacokinetics and the dose of the opioid used. (25) This is in contrast to Stoelting (40) who stated urinary retention related to opioid use is not dose-dependent or related to systemic absorption. Patients may have a high residual volume after spontaneous voiding due to abnormal bladder function caused by the opioids. (25)

The adverse effects of opioids, including POUR, can be reversed by naloxone and methylnaltrexone. Methylnaltrexone has the added advantage of not reversing the analgesic effect of opioids. (44)

Local anaesthetic agents

The physicochemical properties of local anaesthetics play a role in the incidence of POUR. Longer acting local anaesthetics have been associated with an increased incidence of POUR when administered intrathecally (24, 37, 50).

Other

Anticholinergics, sympathimimetics, β -blockers, α -sympatholytics, clonidine/methyldopa and calcium channel blockers were mentioned in an article by Tammela as possible contributing agents to post-operative urinary retention (10). The anticholinergic, atropine, was identified as an independent risk factor of POUR by Dreijer (43). In other studies anticholinergic and opioid dosages were also associated with increased post-void residual volume (1). In contrast, Kreutziger (13) found no correlation between POUR and ephedrine, analgesia, atropine and midazolam in a pilot study with a study sample of 86 patients. Literature on the effects of these medications on the lower urinary system is limited.

2.7.8 Comorbidities

Patients with previous stroke, cerebral palsy, multiple sclerosis, alcohol or diabetic neuropathy and spine fractures may have abnormal voiding and should be documented preoperatively (10). Diabetes mellitus is a common comorbidity and has been associated with POUR in several studies (43, 46, 51). The prevalence of bladder dysfunction is 43 – 87% and 25% in type 1 and type 2 diabetes mellitus respectively. Bladder dysfunction is due to a decrease in bladder sensation which lead to increased bladder capacity and overdistention of the bladder, decreased bladder contractility and increased residual volume. This abnormal functioning of the bladder may be asymptomatic despite the abnormality demonstrated on investigations. (49) Other comorbidities shown to be predictive of POUR include renal failure and psychiatric illnesses e. g. depression and psychosis not otherwise specified (46). Antidepressant and antipsychotic agents may play a role in the development of POUR as discussed earlier. (42, 46)

2.7.9 Previous history of abnormal voiding

Patients with BPH (8, 10), prostate cancer, previous damage to the lower urinary tract or a history of POUR are at increased risk for POUR (10). Undiagnosed BPH may contribute to POUR (8). The use of a urinary tract symptom questionnaire to predict POUR may be useful (12, 16, 17, 52). The International

Prostate Symptom Severity Score (IPSS), a validated score developed by the American Urological Association used to quantify the severity of outflow obstruction in men (12, 17), was used in a study to determine predictability of POUR based on the score (12, 17). The overall scores obtained from the IPSS and comparable questionnaires in patients who had POUR were higher than the patients who could void spontaneously. A study by Cronin (17) suggested IPSS to be a reliable tool to predict POUR while the score was found not to be statistically significant in the study by Sarasin. (12, 17)

2.7.10 Bladder volume

A correlation has been documented by several studies between urinary retention and patients who did not void prior to transport to theatre or who have bladder volumes of more than 100-270 ml before induction of anaesthesia (11, 14, 20). Patients who void before transport to theatre may still have significant bladder volumes at the time of induction of anaesthesia. In a study where patients voided before being transported to theatre three patients had bladder distention before induction of anaesthesia. Two of these patients had bladder volumes prior to induction of >500ml. (54)

An association between bladder volume at the end of surgery or on admission to the post anaesthesia care unit (PACU) have also been documented in several studies (1, 6, 14, 47). A bladder volume of more than 300 ml at the end of knee arthroplasty has a 6.5 times higher risk of POUR (20). A study by Feliciano (6) identified a strong association between the bladder volume on admission to the PACU and POUR. In this study 50% of patients admitted to the PACU had bladder volumes of more than 500 ml and 90% of these patients were unable to void and required catheterisation. (6) This correlates with the study by Voelckel (47) who identified a bladder volume of more than 300 ml immediately post-operative as a strong indicator of POUR (47).

2.7.11 Mobilisation

The inability to mobilise post-operatively predisposes patients to POUR (10, 13). In a study 20.2% of patients with POUR were not able to sit or stand post-operatively and most of these patients only

voided spontaneously once they were able to stand (10). The association between immobilisation and POUR have been documented in several studies (10, 13, 41)

2.8 Diagnosis

The diagnosis of POUR is most commonly made by three possible methods: clinical examination, catheterisation and ultrasound.

2.8.1 Clinical recognition of urinary retention

Urinary retention can easily be missed when relying on clinical assessment alone. Clinical recognition of bladder distension includes the patient complaining of discomfort or pain in the lower abdomen associated with an inability to void, hypertension in the absence of pain or chronic hypertension, and a palpable bladder above the pubic symphysis. (6, 9)

Patients might be unaware of bladder distension in the post-operative period due to an obtunded state (53), decreased sensation related to opioid administration (25) or neuraxial anaesthesia resulting in decreased sensation and a blocked micturition reflex (4, 11, 18-20, 50). Patients may therefore be unable to alert nursing staff (53) in the post-operative period. In a study by Pavlin (1), patients with a bladder volume of > 500 ml, only 50% recognised a feeling of bladder fullness (1). This was similar to a study by Lamonerie (4), where 44% of patients had a bladder volume of >500 ml on ultrasound when they were otherwise ready for discharge from the PACU. Only 46% of the patients with a bladder volumes >500 ml experienced a feeling of a full bladder. (4)

Palpation and percussion of the lower abdomen may cause significant discomfort and pain to the patient with a full bladder, especially to the patient with an abdominal wound. Guarding and obesity are two factors which limit palpation of the bladder. The fat distribution in the elderly are more on the abdomen which may contribute to late recognition of bladder distension (9). In elderly patients the

adverse effects of bladder distension may be more detrimental since there is already decreased blood flow, degeneration of bladder innervation and decreased muscle activity. (2, 53)

The recognition of urinary retention based on clinical assessment is unreliable (23). The diagnosis of POUR by nurses, based on the history of the amount of fluid administered and patient examination, corresponded with only 54% of diagnosis made by ultrasound. In this study urinary retention was defined as a volume of > 600 ml on ultrasound measurement associated with an inability to void. (1) Warner et al (9) recognised a significant difference in the incidence of urinary retention when the diagnosis was made with ultrasound (bladder volume >400ml considered to prompt further action), compared to the detection based on clinical examination. The incidence was 19.4% and 1.4% respectively. This indicated the need for an improved bladder protocol in their PACU. The protocol used at that time guided the need for bladder palpation, and took into consideration blood loss, intravenous fluids, time patient has not voided (6 hours or more), theatre time of more than 4 hours, and elevated blood pressure without a history of hypertension and no pain. (9)

2.8.2 Catheterisation

Catheterisation has been used for several years to diagnose urinary retention. It has the added benefit of simultaneous relieve of urinary retention but it is not without risk. Compared to ultrasound, catheterisation is invasive. Patients are predisposed to possible infection, trauma, urethral stricture and a prolonged hospital stay (17). The associated embarrassment and discomfort may decrease patient satisfaction (6). It is also a time-consuming task for staff and has cost implications (5, 6, 20, 23).

2.8.3 Ultrasound

Ultrasound is a more effective means of making the diagnosis of urinary retention than manual palpation (9, 23) with almost no discomfort to the patient (9, 20, 55). The routine use of ultrasound in the post-operative period to aid early diagnosis of urinary retention, especially in high risk patients, has

been suggested in various studies (1, 4, 11, 13, 23). Some centres use ultrasound routinely in their PACU (6, 13).

The literature available pertaining to post-operative urinary retention and ultrasound measurement of bladder volume used a wide range of volumes at which intervention was considered. The bladder volumes in these studies ranged from 300 ml – 600 ml. (1, 5, 8, 11)

Ultrasound is a non-invasive, cost-effective and accurate assessment tool. The reliability and accuracy of ultrasound has been demonstrated in previous studies (5, 9, 13, 18, 23, 55). The mean difference in urine volume estimated by ultrasound compared to the immediate volume drained with a catheter was 21.5 ml and 54 ml in two separate studies (18, 23). Rosseland (23) conducted a study to establish the reliability of ultrasound. The mean volume of urine measured by ultrasound was 21.5 ml less than that drained with immediate catheterisation (95% confidence interval -147ml and +104 ml). (23) In the other study the correlation coefficient was 0.89 over a range of volumes of 180-1100 ml indicating the volume drained with catheterisation correlated well with the volume measured by ultrasound (18).

Lee et al (5) demonstrated the benefit of an ultrasound programme guiding the decision for catheterisation. Unnecessary catheterisation in this study was considered to be a urine volume of <300 ml drained immediately after catheter insertion in a patient who did not void for a period of time (time not specified) or <100 ml residual volume after spontaneous voiding. Without ultrasound the rates of unnecessary catheterisations were 35.3%. There was a significant reduction in urinary tract infection rates of 59.94% six months after the implementation of the ultrasound programme in their neurosurgical ward (5).

Monitoring of bladder volume with ultrasound during the post-operative period has been advocated, especially in patients who have had spinal anaesthesia, anaesthesia and surgery time more than two hours, anorectal surgery, hernia repair, emergency surgery and the elderly. (1, 4, 11, 18, 20, 23) Limiting factors to ultrasound are the initial cost to purchase, training of staff and the questionable accuracy of ultrasound when the pelvic anatomy is abnormal. (9) Portable ultrasound devices (e. g. BladderScan BVI 2000™, BladderScan BVI 2500™, BladderScan BVI 3000™) were introduced and have proven to be easy to use (55) with minimal training required. It allows an assessment of bladder volume by the press of a button and does not require interpretation of an ultrasound image. The volume of the bladder is displayed on a LCD screen. (56) Further studies are needed to assess the accuracy of these devices when bladder anatomy is abnormal (55).

In the longterm, the implementation of a bladder programme monitoring patients' bladder volumes post-operatively may be more cost-effective (9). The use of ultrasound may reduce unnecessary catheterisations (5, 55), the rates of urinary tract infections (5) and other adverse effects from bladder overdistention. The cost implicated for treatment of a urinary tract infection secondary to catheterisation includes medication and a prolonged hospital stay (5).

2.9 Adverse effects of bladder overdistension

Bladder overdistension may decrease patient satisfaction, cause abnormal voiding, recurrent or persistent urinary tract infections and reflux. It also increases cost of patient care when treatment of the associated adverse effects is considered (6, 46).

Bladder overdistension may cause significant discomfort and pain to the patient. The patient may present with hypertension or hypotension, dysrhythmias, vomiting, restlessness and confusion. (4, 6, 23) This impacts negatively on patient satisfaction (6).

Prolonged stretching of the bladder is thought to result in loss of elastic and contractile ability of the bladder, a decrease of cholinergic receptors in the bladder wall and irreversible damage to the motor nerves and postjunctional membrane (1, 2). It may also result in ischemia, vesicourethral reflux and bacteria entering into venous and lymphatic systems. Consequently, patients may require prolonged hospital stay. (5, 53)

During bladder distension the blood vessels may be stretched to such a degree, that the blood flow to the bladder is decreased. Intramural tension is the principle determinant of blood flow to the bladder. Intravesical pressure increases significantly with overdistension of the bladder, leading to increased wall tension. Ischaemic injury may cause decreased bladder compliance, decreased ability of the bladder to contract, patchy denervation of the bladder wall and a change in the micturition threshold. (3) Motility disorders of the bladder are often seen after prolonged overdistension of the bladder (3-5) which may be the result of structural and functional abnormalities (18). Transient bladder distension with volumes of between 500-1000 ml may not be harmful if detected and managed within one to two hours (18). The adverse effects of bladder overdistension may be more pronounced in the elderly due to age-related decreased blood flow to the bladder wall and degeneration of the innervation of the bladder (2, 53).

In 1985, Tammela (2) investigated possible predisposing factors to prolonged abnormal voiding after bladder distension. At that time, there was no literature available that investigated possible contributing factors. The factors that were identified in this study included the amount of intravenous fluid, urine volume at first urinary retention and increasing age. Limitations of this study were that of the total patients catheterised, only 8% were catheterised within six hours from the end of surgery, 50.5% of patients were only catheterised more than 12 hours post-operatively and included patients who had overflow incontinence. The first urine volume drained in 37% of the patients was more than 1000 ml. (2) The patients in this study probably had prolonged bladder overdistension which will explain the high incidence of prolonged abnormal voiding of 61%. In contrast, patients who had bladder volumes of more than 900 ml in a study by Pavlin (18), none had abnormal voiding. This may be due to earlier recognition and drainage (18).

Patients who had bladder overdistension should be questioned post-operatively about new urinary tract symptoms including frequency, nocturia, hesitancy, urgency, weak stream, dysuria, incontinence, enuresis and an inability to empty bladder to identify patients with adverse effects secondary to high bladder volumes. (1)

Even when patients void spontaneously in the post-operative period, they may have a significantly high residual urine volume which may be close to the normal bladder capacity (1, 20). The residual volume is higher in patient considered to be at high risk of POUR including patients who had anorectal surgery, inguinal hernia repair or a history of urinary retention. The patient with a high residual volume is at increased risk for bladder overdistension . (1)

Bladder distension and residual urine volume predispose patients to acute recurrent and chronic urinary tract infections, reflux and overflow incontinence (5, 53). Normally the oblique passage of the ureters through the layers of smooth muscle of the bladder provides sufficient closure of the ureters to prevent reflux of urine. There are no sphincters in the ureters. (3) Bladder overdistension may change the adequacy of this mechanism resulting in reflux of urine.

Prolonged stay in PACU or in the ward has implications for resources and costs (6). Urinary retention is one of the most frequent contributors to delayed discharge from the PACU (7). 80% of patients with a retention urine volume of >750 ml required a prolonged hospital stay of 8.6 ± 5.1 days in males and 6.25 ± 2.6 days in females (2).

Patients required to void prior to discharge may prolong recovery time even in patients who do not have POUR (6, 7). The ability to void as a prerequisite for discharge is being reconsidered. It may cause unnecessary prolonged discharge time in patients at low risk of urinary retention. Mulroy (37) suggested that patients at low risk for urinary retention who had spinal or epidural anaesthesia with short acting agents may be discharged prior to voiding, provided they are reliable and have access to a medical facility. When this is considered, patients should be educated on when to seek medical help. The discharge time was significantly shorter. The safety of this practice still needs to be investigated. (37)

2.10 Management options for POUR

2.10.1 Prevention

Identifying the patient at risk for POUR prior to surgery and implementation of a monitoring protocol may decrease the incidence of POUR. It may be beneficial to limit contributing factors where possible in all patients presenting for surgery. (5, 6, 20, 23, 42, 53) Various contributing factors may increase the risk of POUR. A high index of suspicion should be maintained especially in patients with a history of symptoms of the lower urinary tract. (53)

An adequate voiding history should be obtained from all patients booked for surgery. Patients who have abnormal voiding should consult an urologist for appropriate intervention before elective surgery. All patients booked for emergency surgery with abnormal voiding should be catheterised preoperatively. (10)

When choosing an anaesthetic technique, the possibility of POUR as a complication should be considered especially in patients who have other risk factors.

Paravertebral block is an alternative to spinal anaesthesia for inguinal hernia repair. The side-effects associated with paravertebral block are significantly less than spinal anaesthesia, including urinary retention. It is an easy block to learn and it provides adequate post-operative analgesia which lasts on average 1-3 hours longer than spinal anaesthesia. The bilateral motor block associated with spinal anaesthesia limits mobilisation of patients post-operatively. Conversely, patients who received a

paravertebral block are able to mobilise early. Further studies need to be conducted to compare unilateral spinal with paravertebral block. (19)

Although the literature is limited regarding the association between medications and POUR, the choice of medications used should also be taken into account. A multimodal approach to post-operative pain may decrease the incidence of POUR. NSAID use should be promoted while opioids should be limited to the lowest effective dose. (15, 42).

Short acting local anaesthetics for spinal or epidural anaesthesia have a lower risk of POUR. Urodynamic assessment was used in healthy young adult men to evaluate the effects of intrathecal opioids on bladder function. Recovery of normal detrusor function after intrathecal sufentanil was faster compared to morphine which can be explained by the pharmacokinetics. Duration and intensity of suppression of detrusor muscle function and sensation to urge was dose-dependent. (25) It may be beneficial to use shorter acting opioids and local anaesthetic agents intrathecally (24, 25).

Although the contribution of peri-operative fluid to urinary retention is controversial, the administration should be individualised and guided by blood loss and hemodynamic status. Excessive intravenous fluid is associated with higher residual bladder volumes post-operatively which may predispose patients to bladder distension (1). Hansen (11) suggested patients should void before they are transported to theatre. There was a strong association between lack of preoperative void and a post-operative bladder volume of > 400 ml which predisposed patients to urinary retention. (11)

Ultrasound monitoring in the post-operative period may facilitate early detection of POUR. (20, 23, 47) Patients are often unaware of a residual bladder volume after spontaneous voiding in the post-operative period. Studies showed that 61% of patients with a bladder volume of >600 ml did not experience urgency to void or discomfort post-operatively. (1) Patients should be monitored with ultrasound even after spontaneous voiding to detect a significant residual volume (1, 20). A significant residual volume should prompt health care providers to monitor the patient closely in the post-operative period. Luger (20) suggested the bladder should be drained with in-out catheterisation in theatre if the patient's bladder volume is > 300 ml at the end of surgery. If the volume is < 300 ml they should be monitored with hourly ultrasound measurements of bladder volume. (20)

2.10.2 Non-invasive interventions

When urinary retention is suspected or diagnosed, non-invasive measures can be instituted to promote micturition. These measures include:

1. Encourage the patient to attempt to void
2. Provide a quiet, relaxed environment
3. Audible running water in the patient's room
4. Place the patient's hand in warm water, or allow the patient to take a hot bath
5. Encourage early sitting, standing or ambulation
6. Minimize post-operative discomfort
7. Instruct on specific time interval in which the patient should void before non-conservative management is considered. (10, 21, 41) In a study by Stallard (41) > 50% of patients with POUR voided after implementation of non-invasive measures.

Kamphuis (24) suggested encouraging patients to void with abdominal strain when their bladders are full and if the patients are still unable to void after conservative measures, a single in-out catheterisation may be considered (24).

Whether threshold values have been documented for bladder volumes at different periods of time post-operatively to indicate if spontaneous voiding after spinal will be possible or not, is not known. (20). The mean time to void after spinal anaesthesia in patients for arthroscopic knee surgery was 238 ± 15 min (20) compared to a mean time to void in patients who had non-pelvic surgery of 75 minutes (1).

2.10.3 Pharmacological management

Pain can cause significant sympathetic activity and contribute to POUR (9). When considering medication for the treatment for POUR, the first consideration should be adequate pain relief. Analgesia should be multimodal and opioid use should be limited if possible (15, 41, 42, 46).

Selius (15) mentions that prazosin, an α -receptor antagonist, has been documented in the literature to decrease post-operative urinary retention in men. The mechanism by which the α -adrenergic antagonists are thought to promote micturition, is by relieving the increased sympathetic activity associated with bladder overdistension (2, 10, 42, 48).

β -adrenergic agonists may also be beneficial and dopaminergic agonists may produce near complete emptying of the bladder (48), but literature on these medications and the effects on bladder function are limited.

Carbachol, a cholinergic drug, have been used to promote micturition before catheterisation (10, 48) although a study have shown it to be ineffective in prevention of prolonged micturition problems (2). Tammela (2) considered the ineffectiveness to be either due to decreased blood flow to the bladder and nerve denervation as a result of bladder overdistension or the doses given were too low (2).

2.10.4 Role of catheterisation

In the 1980's, catheterisation was considered to be more of a concern than bladder overdistension. Patients were encouraged to void and fluid was restricted. A study conducted by Tammela (2) to investigate post-operative micturition problems suggested that catheters should not be inserted routinely, but the decision should be individualised, and patients who had a retention volume of > 500 ml, should remain catheterised for a few days in order for the bladder to regain normal function, or patients should be catheterised again as needed to prevent re-retention. (2)

There is consensus that catheters should only be inserted when indicated and for the shortest duration possible (53, 57). The question as to whether in-out catheterisation or indwelling catheterisation is more

beneficial has not been resolved. A bladder volume of > 500 ml on admission to PACU was strongly associated with POUR in univariate analysis in a study by Feliciano (6). In-out catheterisation in high risk patients at the end of surgery or on admission to the PACU has been suggested (6, 15).

In a prospective randomized trial where urinary retention was defined as the need for catheterisation in the presence of a palpable bladder and inability to void or a bladder volume on ultrasound of >500 ml, there was no significant difference between in-out catheterisation when needed and indwelling catheterisation for 24 hours with regard to re-retention, infection rates and length of hospitalisation. Patients received only a single dose of parenteral antibiotics at induction of anaesthesia. They recommended in-out catheterisation because indwelling catheter had no additional benefit. (50)

Catheterisation in the post-operative period may be more challenging due to wound dressings, post-operative pain, sedation and lack of mobility of the patient. These difficulties may compromise the ideal aseptic technique used during catheterisation (8).

Urinary tract infections are the most common nosocomial infections, in which 80% are associated with urinary catheters (5, 57). Studies have shown that urinary tract infection rates decrease when unnecessary catheterisations are avoided (5, 18).

The risk of acquiring a urinary tract infection is estimated to be 3-7% for each day a patient has an indwelling catheter in situ. The most important risk factor being the duration of catheterisation. (57) Kumar (53) stated, with reference to previous studies done, there is no significant increased risk of urinary tract infection with indwelling catheter for 48 hours or less compared to in-out catheterisation (53). Catheterisation should be limited to absolute indications after other methods of management have been considered, and the catheter should be removed as soon as possible. Routine use of antibiotics as prophylaxis is not recommended. (57)

Catheterisation and urinary tract infections may be associated with deep wound sepsis in patients who had hip and knee arthroplasty, possibly through haematogenous spread (8, 53, 58). In order to minimise the risk of deep wound sepsis, the following suggestions regarding catheterisation were made: strict aseptic technique, avoid multiple catheter insertions, keep the duration of catheterisation as short as possible and antibiotic cover when a catheter is inserted in a patient at increased risk for deep wound sepsis e.g. elderly, obese, higher ASA scores (58).

Bladder ultrasound may be cost-effective in that there is decreased risk of trauma, decreased iatrogenic infection and decrease nursing time. (9, 18, 23)

2.11 Summary

This chapter contained a literature review on POUR. It included patient satisfaction and safety, the definition of POUR, an overview of the applicable anatomy, physiology and pharmacophysiology, the occurrence of POUR, the pathophysiology involved in urinary retention, risk factors associated with POUR, the diagnosis of POUR and management options for POUR.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter the problem statement, aims and objectives, ethical considerations, research methodology and validity and reliability will be discussed in detail.

3.2 Problem statement

Urinary retention is a common underdiagnosed post-operative complication that results in patient discomfort and possible permanent damage to the lower urinary tract. Reliable early detection of POUR is possible with an ultrasound of the bladder. This method of detecting a full bladder is not readily available for post-operative patients at CHBAH.

There was a perception that a number of post-operative adult patients at Chris Hani Baragwanath Academic Hospital (CHBAH) considered to be at low risk of POUR did develop urinary retention. Patients known to be at high risk of POUR are usually monitored closely and POUR can be diagnosed timeously. Voiding may not be considered to be as important as other monitored parameters in the patient at low risk of POUR and may predispose patients to late diagnosis in the post-operative wards. The occurrence of POUR at CHBAH was unknown.

3.3 Aim

The aim of this study was to describe the occurrence of POUR in adult patients at low risk of POUR who presented for elective surgical procedures at CHBAH and to determine if this was influenced by age, gender or type of anaesthetic received.

3.4 Objectives

The primary objective of this study was to describe the occurrence of POUR in low risk patients following elective surgical procedures.

The secondary objectives of this study were to:

- determine if the occurrence of POUR was influenced by:
 - the type of anaesthetic
 - the age of the patient
 - the gender of the patient
- describe the medications administered in the peri-operative period.

3.5 Ethical considerations

Approval to conduct this study was received from the Post Graduate Committee (Appendix D) and the Human Research Ethics Committee (Medical) (Appendix E) of the University of the Witwatersrand and the Chief Executive Officer (Appendix F) of CHBAH.

The proposed project was discussed with the various heads of the surgery departments and the nursing managers of the different post-operative wards and verbal consent was obtained from these parties.

Participants were invited to take part in the study. The study was explained to all potential participants identified by the researcher. An information letter (Appendix A) was given to those who agreed to participate, and written informed consent was obtained. A translator was available to assist participants who did not understand English, however translation was not necessary. No identifying information was recorded on the data collection sheets and the lists of participants' names were kept in a separate file thereby ensuring anonymity. Confidentiality was maintained as only the researcher and the supervisors had access to the raw data. Data will be securely stored for six years following the completion of this study.

If the researcher identified a participant with POUR the nursing staff and the treating doctor would have been notified.

The study was conducted according to the principles of the Declaration of Helsinki (28) and the South African Good Clinical Practice Guidelines (29).

3.6 Research methodology

3.6.1 Research design

A prospective, contextual, descriptive study design was used.

In prospective studies, data about a presumed cause are first collected before the effect or outcome is measured. The variables being measured occurred during the study (59), as in this study.

A contextual study is conducted within a specific location where a problem is identified (59). This study was done at CHBAH.

A descriptive study is a study in which phenomena are described or the relationship between variables are examined and no attempt is made to determine cause-and-effect relationships, nor is any intervention made (59, 60). It is merely to obtain more information within a particular field (60). This study was descriptive as it described the occurrence of POUR in patients who presented for surgery at CHBAH and were at low risk for POUR.

3.6.2 Study population

The population for this study was adult patients in the post-operative wards who were at low risk for POUR and received either general anaesthesia or a neuraxial block during their elective surgical procedure.

3.6.3 Study sample

Sample size

In consultation with a biostatistician a sample size of 150 participants was calculated using the program nQuery Advisor. When the sample size is 150, a two-sided 95.0% confidence interval for a single proportion using the large sample normal approximation will extend 0.069 from the observed proportion for an expected proportion of 0.250. (61)

From a sample size of 150 patients it could be expected that 25% would have POUR to an accuracy of 7% with 95% confidence.

Sampling method

A convenience sampling method is a non-probability sampling procedure. It involves the selection of the most readily available patient for the study. (59) In this study readily available participants were invited to participate in the study during office hours until the sample size was realised.

Inclusion and exclusion criteria

The following inclusion and exclusion criteria were used.

Inclusion criteria:

- elective surgical patients who were at low risk for POUR in the following surgical disciplines: orthopaedics, general surgery ,ENT, maxillo-facial, plastics and ophthalmology
- inpatients who were admitted to CHBAH for a minimum of 24 hours post-operatively
- patients 18 years and older
- patients who gave consent to take part in the study.

Exclusion criteria:

- Patients with a previous history of POUR or any urinary tract related problems including:
 - nocturia
 - frequency
 - urgency
 - hesitancy
 - incontinence
 - weak stream
 - dysuria
 - known BPH or other prostate pathology
 - urinary tract infection within the last week
- known diagnosis of renal dysfunction
- indwelling urinary catheter in situ
- catheterisation (in-out or indwelling) during the surgical procedure
- no intravenous fluid administered peri-operatively
- hyperglycemia
- diuretic use
- surgery considered to be high risk for POUR including: pelvic surgery, anorectal surgery, inguinal hernia repair, spine surgery, neurosurgery
- known neurologic pathology
- continuous epidural anaesthesia or analgesia

3.6.4 Data collection

Potential participants from the specified surgical disciplines were identified from the theatre booking lists in the CHBAH J.D. Allen Theatre Complex the day before surgery or on the day of surgery but before the patient arrived in theatre from the ward.

The participants were approached in their respective wards before surgery. An information letter (Appendix A) was given to each participant and the researcher explained the purpose of the study and

what the participant may expect. The participants were given an opportunity to ask the researcher questions about the study. If the participant agreed to participate in the study, written informed consent (Appendix B) was obtained.

The researcher approached the participants 12 – 24 hours following surgery and collected the following information from the participants, the anaesthetic record and the participants' files using the data capture sheet (Appendix C). The following data was collected:

- age
- gender
- type of surgery
- length of procedure
- type of anaesthetic
- ability to void spontaneously or catheterised since admission to the ward following surgery
- non-invasive interventions done by the nursing staff if the patient was not able to void spontaneously
- if the patient was catheterised, document the volume and whether in-out or indwelling catheterisation was done
- amount of peri-operative fluids administered
- medications received peri-operatively.

If the participant had not voided spontaneously and no successful intervention had been done at the time the researcher approached the participant post-operatively, the researcher would inform the nursing staff of the respective ward and the treating doctor.

3.6.5 Data analysis

Data was captured onto a Microsoft Excel spread sheet and analysed using the statistical program STATISTICA 10.0. Frequencies and percentages were used to describe the variables in the study.

3.7 Validity and reliability of study

“Validity indicates whether the conclusions of the study are justified based on the design and interpretation” and “reliability represents the consistency of the measure achieved” (62).

Validity and reliability of this study was ensured by:

- using an appropriate study design
- determining the sample size in consultation with a biostatistician
- having stringent inclusion and exclusion criteria
- the researcher being the only data collector
- using a standardised participant data collection sheet
- selecting participants from a number of different disciplines to ensure a representative sample.

3.8 Summary

In this chapter the problem statement, aim, objectives, ethical considerations, research methodology and the validity and reliability of this study were presented. In the following chapter the results are presented and discussed.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter the results and a discussion of the results are presented. The results are presented according to the research objectives. The results are rounded off to two decimal places and therefore totals might not add to 100%.

The primary objective of this study was to describe the occurrence of POUR in low risk patients following elective surgical procedures.

The secondary objectives of this study were to:

- determine if the occurrence of POUR was influenced by:
 - the type of anaesthetic
 - the age of the patient
 - the gender of the patient
- describe the medications administered in the peri-operative period.

4.2 Results

4.2.1 Sample realisation

Data was collected from December 2013 to February 2014. During this three month period, 362 patients were identified from the theatre booking lists as potential participants. From these potential participants, 156 patients were included. The reasons for exclusion of the 206 patients are shown in Table 4.1.

Table 4.1 Exclusion criteria met by potential participants

Exclusion criteria	No. of patients	Percentage %
Diuretic use	45	21.8%
Patients not in the ward preoperatively	42	20.4%
Surgery cancelled	35	17.0%
Communication difficulty	22	10.7%
Neurological fallout eg. Stroke, spinal pathology	14	6.8%
Catheterisation pre- or intraoperatively	10	4.9%
Patient refusal	6	2.9%
Hyperglycemia	6	2.9%
Surgery done with local anaesthesia only	5	2.4%
Both diuretic use and hyperglycemia	4	1.9%
Incontinence	2	1.0%
Early discharge	2	1.0%
Previous POUR	2	1.0%
Urgency	2	1.0%
Renal failure	2	1.0%
Urinary tract infection	2	1.0%
Weak stream	1	1.0%
Hesitancy	1	1.0%
Both hesitancy and dysuria	1	0.5%
Both incontinence and dysuria	1	0.5%
Incomplete data	1	0.5%
TOTAL	206	101.2%

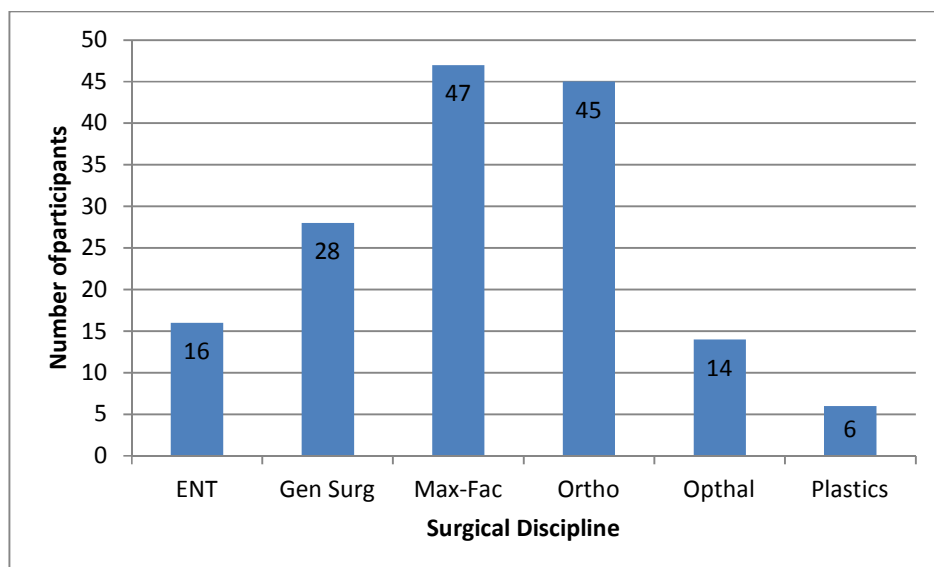
4.2.2 Demographic characteristics of the study sample

The study sample included 59.6% (n=93) males and 40.4% (n=63) females, with a mean age of 36.7 years (SD 11.84077). The age range was between 18 and 69 years.

The majority of participants had general anaesthesia 85.9% (n=134). The remainder had neuraxial anaesthesia 13.5% (n=21) and one participant, 0.6%, had both general and neuraxial anaesthesia.

The surgical disciplines included maxillo-facial (30.1%, n=47), orthopaedic (28.9%, n=45), general surgery (18.0%, n=28), ENT (10.3%, n=16), ophthalmic (9.0%, n=14) and plastic (3.9%, n=6) surgery. The surgical disciplines are shown in Figure 4.1.

Figure 4.1 Number of participants in each surgical discipline included in this study



The length of surgery ranged between 20 to 250 minutes with the mean length of surgery of 99.27 minutes (SD 51.12).

The mean volume of intravenous fluid administered was 947.8 ml (SD 502.8). On 64.7% (n=101) of participants' anaesthetic charts intravenous fluid volume was recorded as either a 1000 or 2000 ml, and

no intravenous fluid volume was documented on 9.0% (n=14) of participants' anaesthetic charts.

4.2.2 Primary objective: to describe the occurrence of POUR in low risk patients following elective surgical procedures.

Only one participant (0.6%) from the study sample was not able to void spontaneously in the post-operative period. The non-invasive techniques used by the nursing staff included encouraging this participant to void spontaneously, running tap water, easing discomfort and giving an intravenous fluid bolus. A retention volume of 2000 ml was recorded when an indwelling catheter was inserted.

4.2.3 Secondary objective: to determine if the occurrence of POUR was influenced by the type of anaesthetic and describe the medications administered in the peri-operative period.

The results of this study could not determine if the occurrence of POUR was influenced by the type of anaesthetic. The one participant (0.6%) who did have POUR had general surgery and received a general anaesthetic. She received opioids, propofol and atropine during the peri-operative period. The anaesthetic management of this participant who developed POUR was not significantly different from the other participants who also received a general anaesthetic.

See Table 4.2, 4.3 and 4.4 for the use of medications in the peri-operative period in our study.

Table 4.2 The use of systemic opioids in the peri-operative period.

	TOTAL		GENERAL ANAESTHESIA		NEURAXIAL ANAESTHESIA		BOTH GENERAL & NEURAXIAL ANAESTHESIA	
NO. OF PARTICIPANTS PER ANAESTHETIC TECHNIQUE	156 (100%)		134 (85.9%)		21 (13.5%)		1 (0.6%)	
SYSTEMIC OPIOIDS USE								
	NO.	%	NO.	%	NO.	%	NO.	%
INTRAOPERATIVE SYSTEMIC OPIOIDS	66	42.3%	65	48.5%	1	4.8%	0	0%
POST-OPERATIVE SYSTEMIC OPIOIDS	19	12.1%	3	2.24%	15	71.4%	1	100%
BOTH INTRA- & POST-OPERATIVE OPIOIDS	68	43.5%	65	48.5%	3	14.2%	0	0%
NO SYSTEMIC OPIOIDS	3	1.9%	1	0.75%	2	9.5%	0	0%
TOTAL % OF PARTICIPANTS RECEIVED OPIOIDS PERI-OPERATIVELY	153	98.0%	133	99.2%	19	90.4%	1	100%
NEURAXIAL OPIOID USE								
NEURAXIAL OPIOID	16	10.2%	Not applicable		15	71.4%	1	100%

Two of the patients (9.5%) who had neuraxial anaesthesia (13.5%, n=21) did not receive any systemic opioids. In the group of patients who received neuraxial opioid and local anaesthetic (71.4%, n=15), one patient (6.7%) received systemic opioids both in theatre and in the post-operative ward and 80% (n=12) received systemic opioids in the post-operative ward only. Two patients (13.3%) received no systemic opioids in the peri-operative period. From the other group of patients who received only local anaesthetic neuraxially and no neuraxial opioid (28.6%, n=6), one patient (16.7%) received systemic opioids in the intra-operatively period only, three patients (50%) received systemic opioids in the

postoperative period only and two patients (33.3%) received systemic opioids in both the intra- and post-operative periods.

Table 4.3 The peri-operative use of medications in the study at CHBAH

Medication	TOTAL		GENERAL ANAESTHESIA		NEURAXIAL ANAESTHESIA	
	TOTAL NO. OF PARTICIPANTS	%	NO.	%	NO.	%
PROPOFOL	132	84.6%	132	98.5%	0	0%
OPIOIDS	153	98.1%	133	99.3%	20	95.2%
BENZODIAZEPINE	22	14.1%	5	3.7%	17	81.0%
KETAMINE	30	19.2%	29	21.6%	1	4.8%
ATROPINE	59	37.8%	59	44.0%	0	0%
β –AGONIST	14	9.0%	14	10.5%	0	0%
α –AGONIST	17	10.9%	16	11.9%	1	4.8%
β –BLOCKER	2	1.3%	2	1.5%	0	0%
CALCIUM CHANNEL BLOCKER	1	0.6%	1	0.8%	0	0%
NSAID	138	88.5%	117	87.3%	21	100%

Table 4.4 The use of NSAIDS in the peri-operative period at CHBAH

NSAID USE	GENERAL ANAESTHESIA		NEURAXIAL ANAESTHESIA	
	NO.	%	NO.	%
TOTALS	117	87.3%	21	100%
INTRAOPERATIVE	4	3.0%	1	4.8%
POST-OPERATIVE	52	38.8%	17	81.0%
BOTH INTRA-AND POST-OPERATIVE	61	45.5%	2	9.5%
NO NSAID USED	0	0%	1	4.8%

4.2.5 Secondary objective: to determine if the occurrence of POUR was influenced by the age of the participant.

The results of this study could not determine if the occurrence of POUR is influenced by age. The one participant who did have POUR was 35 years old. The mean age of the study sample was 36.7 years.

4.2.4 Secondary objective: to determine if the occurrence of POUR was influenced by the gender of the participant.

The results of this study could not determine if the occurrence of POUR is influenced by gender. The one participant who did have POUR was a female. The study sample consisted of 40.4% (n=63) females.

4.3 Discussion

The prevention, early recognition and prompt management of post-operative complications improve patient satisfaction and quality of care (30). Patients presenting for surgery may not be counselled about all the possible complications related to the surgery or anaesthesia especially when the patient is considered to be at low risk for the specific complication. Patient satisfaction is higher in patients that are well informed (32). POUR can have a significant impact on patient satisfaction and the patient's perception of quality of care (6, 30).

POUR can result in significant discomfort, delayed discharge from the PACU, increased cost of patient care, urinary tract infections (6) and acute or long term bladder function abnormalities (1-5). The development of urinary retention can be influenced by a variety of factors. There was a concern that a significant proportion of adult patients presenting for elective surgery at CHBAH developed POUR. The occurrence of POUR at CHBAH was not known. The aim of this study was to describe the occurrence of POUR in adult patients at low risk of POUR who presented for elective surgery at CHBAH and to determine if it was influenced by age, gender or the type of anaesthetic, and to describe the drugs used during the peri-operative period.

Multiple factors are thought to contribute to the development of POUR including increasing age, type of surgery, duration of surgery and anaesthesia, anaesthetic technique, amount of intravenous fluids, medications, comorbidities, previous abnormal voiding and the inability to mobilise. Different types of bladder capacities are described. Anaesthetic bladder capacity is greater than functional or cystometric bladder capacity due to the effects of general or neuraxial anaesthesia (34). This larger capacity of the bladder during anaesthesia can result in bladder overdistention and increase the risk of POUR. In any patient presenting for surgery there will be a variety of factors that are non-modifiable (e. g. age, gender, type of surgery) and factors that will be unavoidable (e.g. anaesthetic technique, immobility). A high index of suspicion should be maintained for POUR in any patient presenting for surgery. In our study potential confounding factors were excluded in order to investigate the occurrence of POUR in a population at low risk and in whom the ability to void may not be monitored as closely in the post-operative period compared to patients at high risk of POUR. It is important to realise that POUR may not be recognised by patients due to sensory fallout after neuraxial anaesthesia or an obtunded state after a general anaesthetic (1, 4).

The occurrence of POUR in this study at CHBAH was found to be 0.6% (n=1). The occurrence of POUR in the literature ranges from <1% to >50% (1, 4, 7-10, 42, 45, 46). This wide variation can be attributed to the lack of a standard definition and a combination of various risk factors. The definitions used in the literature were based on a variety of factors alone or in combination. These factors included patient discomfort, time since operation, bladder volume on ultrasound post-operatively and the amount of urine drained at catheterisation (1, 6, 10, 11, 13, 14, 18, 19, 41). In our study the definition used for POUR was the inability to empty the bladder without non-invasive or invasive interventions in the post-operative period. The diagnosis of POUR in our study depended on the nursing staff or recognition by the participant. Our study did not change usual practice at CHBAH in terms of diagnosing POUR. Many potential risk factors for POUR are recognised and some are controversial. The risk factors include type of surgery, medications, anaesthetic technique, duration of surgery or anaesthesia, age, gender and the amount of intravenous fluids.

The incidence of POUR was 0.8% in patients at low risk of urinary retention in a study done by Pavlin et al (18). In Pavlin's (18) study the definition of POUR was an inability to void at a bladder volume of more than 600 ml measured by ultrasound. The aim of the study was to determine whether monitoring of bladder volume in the recovery room by ultrasound reduced unnecessary bladder catheterisation and prolonged bladder overdistention compared to conventional management. The low risk category included patients who had low risk surgery and received a general anaesthetic, peripheral nerve blocks or local anaesthesia. Low risk surgery excluded hernia repair, anal or pelvic surgery. (18)

A study conducted by Tammela et al. (10) compared well to our study in terms of definition of POUR and when patients were catheterised. In the study by Tammela et al. (10) patients were catheterised when they were still unable to void after non-invasive measures were instituted including encouragement to void, ambulation, non-opiate analgesia and privacy was given to the patient. Catheterisation was performed if the bladder was palpable, the patient had discomfort and pain from bladder distention or several hours had passed since surgery ended. The decision to catheterise a patient was made by the nursing staff based on the above measures. The study demonstrated an incidence of urinary retention of 3.8% compared to an incidence of 0.6% in our study. The higher incidence in the study by Tammela et al. (10) can be attributed to the inclusion of patients with preoperative neurological damage, preoperative abnormal micturition, history of POUR, previous urinary tract surgery, urinary tract infection, raised

serum creatinine levels, enlarged prostate and several surgeries which were excluded in our study including thoracotomies, laparotomies, anal, urologic, vascular, spine, inguinal, endoprosthetic surgeries of hips and knees and emergency surgery. From the patients who had urinary retention, 70% received a general anaesthetic in the study by Tammela et al. (10) Unfortunately this study did not describe the methods and definitions clearly. (10)

Although only one participant in our study had POUR, the volume of urine drained at catheterisation is a concern. Normal bladder capacity for an average adult is considered to be 400-600 ml (3, 4, 6). The participant in our study who had POUR drained 2000 ml at catheterisation after non-invasive measures failed. Bladder overdistention may cause significant discomfort, distress and pain and result in patient dissatisfaction (6, 30). In the post-operative period, patients may often be unaware of an overdistended bladder for several hours due to an obtunded state or decreased sensation from neuraxial anaesthesia or opioids (1, 4, 53). Prolonged bladder overdistention may have deleterious effects including vesico-urethral reflux, urinary tract infection (5, 53) and irreversible damage to nerves and the postjunctional membrane resulting in abnormal voiding (1-5). These effects may be more pronounced in the elderly due to age-related changes in blood flow to the bladder and degenerative changes (2, 53). POUR and its adverse effects contribute to increased cost and a prolonged hospital stay (2, 6, 7). Non-invasive measures might have been attempted for a prolonged period in the participant in our study who had POUR. There is limited literature available on the recommended period that non-invasive measures can be attempted before it is considered to have failed. If bladder volumes were monitored in our study using ultrasound, the participant who had POUR would have been catheterised earlier. This could have prevented the discomfort and pain the participant experienced and improved patient satisfaction. The participant in our study who had POUR was very distressed and even requested to be sent to another hospital. The presence of adverse effects from prolonged bladder overdistension or catheterisation was beyond the scope of this study.

Spinal and epidural anaesthesia are considered to be risk factors for POUR (4, 11, 18-20, 50). A neuraxial block eliminates sensation and blocks the micturition reflex, resulting in urinary retention (40). In this study only 13.5% (n=21) of participants received neuraxial anaesthesia. The anaesthetic technique, medication and volume of intravenous fluid used for each participant was at the discretion of the anaesthesiologist, registrar or medical officer managing the case and was not influenced by the researcher. Considering the added risk of POUR when a patient received a neuraxial block, the

occurrence of POUR found in our study might have been higher if it included more patients who received neuraxial block.

In our study all the participants who received neuraxial anaesthesia (13.5%, n=21) had a spinal anaesthetic with 0.5% bupivacaine, either plain or with dextrose. Of these participants 71.4% (n=15) received a neuraxial opioid mixed with the local anaesthetic. Fentanyl was the only opioid used in neuraxial anaesthesia in our study. Longer acting neuraxial anaesthetics administered intrathecally are associated with a higher occurrence of POUR (24, 37, 50). Neuraxial opioids result in decreased detrusor contractility and sensation to void which may be related to the dose and pharmacokinetics of the opioid used (25, 40). Patients who received intrathecal opioids may have significant residual volume after spontaneous voiding due to abnormal bladder function (25). Measuring residual volume after spontaneous voiding was beyond the scope of our study.

Although the increased sympathetic stimulation associated with inadequate analgesia can lead to POUR (3, 9), POUR can also be attributed to opioid use (40, 41). Systemically administered opioids increase the risk for POUR by inhibition of parasympathetic tone (40), resulting in an increase in detrusor muscle tone and sphincter tone (40, 41). Multimodal analgesia is advocated in the peri-operative period to provide adequate analgesia. Use of the lowest effective dose of opioids are recommended (15). Systemic opioids were used in the peri-operative period in 98.1% (n=153) of all participants. Only 1.3% (n=2) of participants who received a neuraxial anaesthesia and one participant (0.6%) who received a general anaesthetic did not receive any systemic opioids in the peri-operative period in our study. Refer to Table 4.2 for the use of opioids in our study.

The use of NSAIDs may result in detrusor relaxation and decreased bladder smooth muscle activity (3). NSAIDs were administered in 88.5% (n=138) of participants in the peri-operative period. Of these participants, 3.2% (n=5) received NSAIDs intraoperatively, 44.9% (n=70) in the post-operative period only and 40.4% (n=63) participants received NSAIDs both intra- and post-operatively (Refer to Table 4.4).

Opioids are commonly prescribed in the post-operative period together with NSAIDs at CHBAH to provide adequate analgesia. In our study the use of opioids and NSAIDs does not seem to have contributed significantly to the development of POUR. However, in the post-operative wards some

patients did not receive the medications at the dosing intervals as prescribed. There is a possibility that more patients would have developed POUR had they received the prescribed dosages of analgesia at the correct intervals.

Several medications used by anaesthesiologists, other than opioids, are thought to potentially contribute to the development of POUR based on the mechanism of action. These include anticholinergics, calcium channel blockers, NSAIDs, β - and α -agonists, propofol, etomidate, benzodiazepines, barbiturates and ketamine. (3, 8, 15, 40, 41) Refer to table 4.3 for the use of these agents in our study sample. Barbiturates, etomidate and glycopyrrolate were not used in any of the participants in our study.

Atropine was used in 44.0% (n=59) of participants who received a general anaesthetic in our study. Atropine in all of these participants was used to counteract the side-effects of neostigmine used to reverse the non-depolarising muscle relaxants. At the time of data collection there was a shortage of glycopyrrolate which is usually preferred above atropine for this purpose due to the better side-effect profile. Atropine was not used to treat bradycardia in any of the participants in our study. Anticholinergics may contribute to the development of POUR by decreasing bladder tone and increasing sphincter tone (15, 40, 41). Other medications with anticholinergic activity (e. g. hyoscine butylbromide, promethazine, ipratropium) (42, 43) were not used in any of the participants in our study.

The mean age of this study sample was 36.7 years. In this study 12.8% (n=20) of participants were older than 50 years and from this group only 5.8% (n=9) participants were 60 years and older. Various studies identified age as a risk factor to POUR (4, 10-14, 50) and suggested degenerative changes to the bladder, benign prostatic hypertrophy and other pathologies may be responsible for the higher incidence with increasing age (10). In our study, participants with obstructive or irritative urinary symptoms were excluded. In a study by Tammela et al. (10) the incidence of POUR in the older age groups were consistent with other studies suggesting age to be a risk factor. Surprisingly the incidence of POUR among females between the ages of 21-40 years was also high (10). Kreutzinger et al. (13) had a similar results with an OR for urinary retention of 6.125 for females younger than 40 years compared to women between 40-60 years. A high sympathetic tone in females younger than 40 years was thought to play a role (10).

Gender as a risk factor to the development of POUR is controversial. Several studies have shown no significant difference between males and females (4, 11, 14) whereas other studies indicated males (10, 12) or females (13) are at higher risk. In our study the majority of the study sample was male. Only 4.5% (n=7) of male participants were older than 50 years and none of them were older than 60 years. All participants with irritative or obstructive urinary symptoms were excluded in our study. This would have excluded participants with BPH and other urinary tract pathology which were thought to contribute to the higher incidence of POUR in other studies (8). From the females, 21.8% (n=34) were between the age of 21-40 years, 16.7% (n=26) were older than 40 years and 1.3% (n=2) participants were younger than 21 years.

The contribution of the amount of intravenous fluid to the development of POUR is controversial. Several studies stated the amount of intravenous fluid did not increase the incidence of POUR (1, 13), whereas other studies identified an association between POUR and large amounts of intravenous fluid administration (14, 37). Fluid status, including hydration status preoperatively and blood loss intraoperatively, was not assessed in our study. The mean intravenous fluid volume administered was 947.88 ml (SD 502.8). The documentation of intravenous fluid administered intraoperatively may have been done inaccurately. A request was made in the weekly e-mail of the anaesthetic department of CHBAH at commencement of data collection to document the amount of intravenous fluid administered during the intraoperative period accurately and clearly on the anaesthetic chart. Despite the request no intravenous fluid volume was documented on 9.0% (n=14) of participants' anaesthetic charts. A number of anaesthesia providers may have recorded the volume of the vaculitre used and not the actual amount of fluid administered. This is suspected since 64.7% (n=101) of participants had intravenous fluid recorded as either 1000 or 2000 ml. Considering the possibility that anaesthetic providers may have documented the volume of the vaculitre and 9.0% (n=14) of participants had no volume recorded, the recorded volume of intravenous fluid administered to 73.7% (n=115) participants may have been inaccurate. Therefore in this study it is not possible to comment whether fluid administration was excessive or not.

In our study participants were not encouraged to void immediately preoperatively and whether participants voided preoperatively were not documented. Patients who did not void prior to transport to theatre or with bladder volumes of 100-270 ml prior to induction of anaesthesia were associated with POUR in several studies (11, 14, 20). Even when patients void before transport to theatre, they may

have a significant residual volume which can be attributed to pain, immobility and the use of opioids in the preoperative period and even if they do not have a residual volume, they may have distended bladders at the time of induction (54). Bladder volumes of 300-500ml post-operatively were identified as an indicator of POUR (6, 20, 47).

Various studies have identified the inability to mobilise as a predisposing factor for POUR (10, 13, 41). The ability to mobilise post-operatively was not documented in our study.

The use of ultrasound has been advocated by various studies to guide decision making regarding urinary catheterisation (1, 4, 11, 18, 20, 23). Ultrasound measurement of bladder volume is a quick, non-invasive and an accurate manner to diagnose POUR (5, 9, 13, 18, 23) with no or very little discomfort to the patient (9, 20). The use of ultrasound can assist in the early diagnosis of POUR and therefore prevent severe discomfort, pain and other effects of POUR to patients. The limitations related to ultrasound use for the diagnosis of POUR include the initial cost to purchase, training and availability of trained staff (9) and the lack of a standard bladder volume on ultrasound to make the diagnosis of POUR. The bladder volumes used in studies ranged between 300-600ml (1, 5, 8, 11). The BladderScan BVI 3000™ is an ultrasound machine that is easy to use, portable and battery operated. It allows an assessment of bladder volume by the press of a button therefore minimal training is needed to assess bladder volume accurately. It displays the volume of the bladder in millilitres on the LCD screen and no image interpretation is needed. (56) Studies have demonstrated operator and patient satisfaction with these portable ultrasound devices (55). At CHBAH there is no BladderScan BVI 3000™ or a similar easy to use ultrasound machine available. It was also not possible to have a dedicated ultrasound machine available to measure bladder volumes at the time of the study and none of the staff in the anaesthesia department are trained to measure bladder volumes. There is one ultrasound machine available in theatre which is used for peripheral nerve blocks on a daily basis. It is possible that the occurrence of POUR in our study might have been higher if POUR was diagnosed using a bladder volume on ultrasound.

The findings of our study were not what were expected as the perception was that the occurrence of POUR in low risk patients at CHBAH was at least 25%. The perception that the occurrence of POUR may be high at CHBAH could be contributed to cognitive errors, also referred to as Cognitive Dispositions to Respond (CDR). A number of CDRs exist but two types are applicable in this scenario, Availability CDR

and Base-rate neglect CDR. Availability CDR refer to a situation where a clinician perceives a diagnosis to occur frequently or to be very likely if it readily comes to mind. The clinician's diagnosis or thoughts are influenced by recent situations or experiences. Base-rate neglect refers to increasing or decreasing the true prevalence of a disease. The clinician may not be aware of the CDR influencing his/her thoughts and decisions. (63)

The low occurrence of POUR places this study in the so-called "negative research" category, however, the researcher is of the opinion that the results from this study do contribute to the body of knowledge regarding POUR in low risk surgical patients at CHBAH. Internationally there is a tendency not to analyse or publish negative or non-significant results (64). There are various reasons for not publishing negative research for example:

- the inclination of journals to only publish research with significant positive findings (65, 66),
- pressure to publish in order to get funds for research force researchers into a direction of research where significant positive findings are more likely (66), and
- fear of a bad reputation associated with negative results (65-67)

This reporting and publication bias contributes to an imbalance of information available to clinicians on which they base clinical decisions. Publication of negative results can correct the existing imbalance and add value by encouraging good research practice, direct further research, minimise duplicate work, improved transparency, reveal common flaws in research methods used and improve clinical decision making. (65-70)

Publication of negative research results also forces the researcher and clinicians to re-evaluate personal preconceptions and thought processes. The value of reporting has been increasingly recognised. In recent years several journals were established in which studies with non-significant findings can be published in an attempt to eliminate or minimise the negative attitude toward these studies. These journals include The Journal of Negative Results in Biomedicine, The All Results Journal and The Journal of Articles in Support of the Null Hypothesis. (66, 69)

4.4 Conclusion

The occurrence of POUR in this study was 0.64% (n=1). Possible contributing factors to POUR in this participant were 35 year old female, 2000ml intravenous fluid, and the use of opioids, propofol, atropine and NSAIDs. The volume of urine drained on catheterisation of 2000ml is a concern as this is 3.5-5 times normal bladder capacity. This study could not determine whether the occurrence of POUR was influenced by age or gender.

4.5 Summary

This chapter dealt with the results and discussion of results of the data collected for the research report, according to the primary and secondary objectives of this study. The data presented included the occurrence of POUR in patients at low risk who present for elective surgery, the volume of urine drained on catheterisation, the type of anaesthetic technique, medications administered and whether the occurrence of POUR was influenced by age and gender.

In the final chapter a summary, the limitations, recommendations and conclusions of the study are presented.

CHAPTER FIVE

SUMMARY, LIMITATIONS, RECOMMENDATIONS, CONCLUSION

5.1 Introduction

In this chapter a summary of the study, the limitations, recommendations for clinical practice and further research and a conclusion are presented.

5.2 Summary of the study

5.2.1 The aim of the study

The aim of this study was to describe the occurrence of POUR in adult patients at low risk of POUR who presented for elective surgical procedures at CHBAH and to determine if this was influenced by age, gender or type of anaesthetic received.

5.2.2 Objectives of the study

The primary objective of this study was to describe the occurrence of POUR in low risk patients following elective surgical procedures.

The secondary objectives of this study were to:

- determine if the occurrence of POUR was influenced by:
 - the type of anaesthetic
 - the age of the patient
 - the gender of the patient
- describe the medications administered in the peri-operative period.

5.2.3 Summary of the methodology used in the study

A prospective, contextual, descriptive study design was used. This study described the occurrence of POUR in patients who presented for surgery at CHBAH and were at low risk for POUR.

The population for this study was adult patients in the post-operative wards who were at low risk for POUR and received either general anaesthesia or a neuraxial block during their elective surgical procedure. The patients were booked for elective procedures in orthopaedic, general surgery, ENT, maxillo-facial, plastic and ophthalmology.

In consultation with a biostatistician a sample size of 150 participants was calculated using the program nQuery Advisor. From a sample size of 150 patients we can expect 25% to have POUR to an accuracy of 7% with 95% confidence

In this study a convenience sampling method was used. Readily available participants were invited to participate in the study until the sample size (n=150) was realised.

Potential participants from the specified surgical disciplines were identified from the theatre booking lists in the CHBAH J.D. Allen Theatre Complex the day before surgery or on the day of surgery but before the patient arrived in theatre from the ward.

The participants were approached in their respective wards before surgery. An information letter (Appendix A) was given to each participant and the researcher explained the purpose of the study. If the patient agreed to participate in the study, written informed consent (Appendix B) was obtained from the participant.

The researcher approached participants 12 – 24 hours following surgery and collected the following information from the participant, the anaesthetic record and the participant's file using the data capture sheet (Appendix C):

- age
- gender
- type of surgery
- length of procedure
- type of anaesthetic
- ability to void spontaneously or catheterised since admission to the ward following surgery
- non-invasive interventions done by the nursing staff if the participant was not able to void spontaneously
- if the participant was catheterised, documented volume and whether in-out or indwelling catheterisation was done
- amount of peri-operative fluids administered
- medications received peri-operatively.

Participants were excluded if they had one or more of the following:

- Participants with a previous history of POUR or any urinary tract related problems including:
 - nocturia
 - frequency
 - urgency
 - hesitancy
 - incontinence
 - weak stream
 - dysuria
 - known BPH or other prostate pathology
 - urinary tract infection within the last week
- known diagnosis of renal failure
- indwelling urinary catheter in situ
- catheterisation (in-out or indwelling) during the surgical procedure
- no intravenous fluid administered peri-operatively
- hyperglycemia
- diuretic use
- surgery considered to be high risk for POUR or including pelvic surgery, anorectal surgery, inguinal hernia repair, spine surgery, neurosurgery, arthroplasty
- known neurologic pathology
- continuous epidural anaesthesia or analgesia

A few participants were also excluded due to communication difficulty, refusal to participate, early discharge, cancellation of surgery and no neuraxial or general anaesthetic administered for the participant's procedure.

5.2.4 Main Findings of the study

In our study only one participant (0.64%) from the 156 participants had POUR. This participant was a 35 year old female who had general surgery under general anaesthesia. Opioids, propofol, atropine and

NSAIDs were administered in the peri-operative period. The retention volume drained at catheterisation was 2000 ml after non-invasive measures failed. Our study could not determine whether POUR was influenced by the type of anaesthetic, age or gender. Multimodal analgesia is used at CHBAH in the peri-operative period as evident by the high number of participants who received opioids and NSAIDs.

5.3 Limitations of the study

The potential limitations to this study included the following:

The contextual nature of the study means that the result represent the occurrence of POUR in patients who were at low risk for POUR at CHBAH and may not be generalisable to patients in other settings.

Many other factors influence the occurrence of POUR such as the amount of fluid given peri-operatively, comorbidities, whether the patient voided shortly before surgery commenced and whether the patient was mobilised early or not. Identification of all these factors was, however, beyond the scope of this study.

Participants were recruited at the convenience of the researcher.

The assessment of non-invasive measures done was based on the participant's awareness and understanding of the nurses actions.

There is a possibility that the amount of intravenous fluid received peri-operatively may not be documented accurately. The anaesthetic team at CHBAH was requested to document the amount of intravenous fluid administered accurately and clearly on the anaesthetic chart. Despite this, several anaesthetic records had no volume of intravenous fluid documented. An assessment of the peri-operative hydration status of the participant and documentation of blood loss intra-operative were not done in this study.

Fluid balance of the participants was not assessed.

Documentation of the volume of urine drained at first catheterisation was done by the nurse looking after the participant for the particular shift in the respective ward. It is possible that the nurse did not document the volume of urine accurately.

In this study the residual volume of urine after spontaneous voiding was not measured.

It is beyond the scope of this study to comment on complications evolving from prolonged bladder distension and urinary catheterisation.

It is possible that the occurrence of POUR at CHBAH would have been higher if the study sample consisted of more participants who received neuraxial anaesthesia, ultrasound was used to diagnose POUR or less stringent exclusion criteria was used.

Although the majority of participants received opioids in the post-operative wards, the opioids were not administered as prescribed for all the participants e. g. nursing staff did not adhere to the dosing intervals. It is possible that the occurrence of POUR at CHBAH would have been higher if participants received the opioids as prescribed.

5.4 Recommendations from the study

5.4.1 Recommendations for clinical practice

Many risk factors for POUR are non-modifiable and unavoidable and a high index of suspicion for POUR should be applied to all patients presenting for surgery. A thorough history should be obtained from all patients preoperatively including voiding history.

A definition for POUR should be agreed upon at CHBAH since an internationally recognised definition of POUR does not exist and the diagnosis of POUR depends on the definition used. The definition used at CHBAH will have to be based on clinical recognition or time. A diagnosis based on clinical recognition or time is not ideal but ultrasound for the diagnosis of POUR is currently not readily available at CHBAH.

A protocol for the recognition and appropriate management of POUR is recommended to avoid prolonged bladder overdistention. The participant in our study who had POUR drained 2000 ml on urinary catheterisation after non-invasive management had failed. The protocol should include risk

factors, the time period thought to be appropriate for non-invasive measures, when to catheterise and whether antibiotics are indicated when a patient is catheterised.

5.4.2 Recommendations for further research

The development of a precise unambiguous definition of POUR that is recognised internationally would aid in the development of an evidence-based guideline on prevention and management of POUR. Current literature is difficult to compare due to a variety of definitions used for POUR.

The likelihood of POUR based on the number of risk factors present in a patient could be investigated and possibly incorporated into a protocol. Further research could facilitate the development of a protocol for the prevention, diagnosis and management of POUR.

In our study we used very stringent criteria to investigate the occurrence of POUR in patients at low risk. Another study at CHBAH with less stringent criteria is recommended to describe the occurrence of POUR in patients at higher risk.

The use of ultrasound to diagnose POUR has gained popularity. Unfortunately these devices are not available at CHBAH. When ultrasound becomes more readily available at CHBAH further studies using ultrasound to diagnose POUR is recommended.

Further research to assess patient satisfaction at CHBAH is recommended. This could aid in the identification of areas of improvement and possible further research.

5.5 Conclusion

The occurrence of POUR in patients at low risk at CHBAH is low. This study could not determine whether POUR was influenced by type of anaesthetic, age or gender. Multimodal anaesthesia is commonly used at CHBAH in the peri-operative period.

5.6 Summary

In this chapter a summary of the study, the limitations, recommendations for clinical practice and further research and a conclusion were presented.

REFERENCES

1. Pavlin DJ, Pavlin EG, Fitzgibbon DR, Koerschgen ME, Plitt TM. Management of bladder function after outpatient surgery. *Anesthesiology*. 1999;91(1):42-50. PubMed PMID: 10422927. eng.
2. Tammela T, Kontturi M, Lukkarinen O. Postoperative urinary retention II: micturition problems after the first catheterization *Scandinavian Journal of Urology and Nephrology*. 1986;20:257-60.
3. Yoshimura N, Chancellor MB. *Physiology and pharmacology of the bladder and urethra*: Wein: Campbell-Walsh Urology; 2011.
4. Lamonerie L, Marret E, Deleuze A, Lember N, Dupont M, Bonnet F. Prevalence of postoperative bladder distension and urinary retention detected by ultrasound measurement. *British Journal of Anaesthesiology*. 2004;92(4):544-6. PubMed PMID: 14977795. eng.
5. Lee Y-Y, Tsay W-L, Lou M-F, Dai Y-T. The effectiveness of implementing a bladder ultrasound programme in neurosurgical units. *Journal of Advanced Nursing*. 2007;57(2):192-200.
6. Feliciano T, Montero J, McCarthy M, Priester M. A retrospective, descriptive, exploratory study evaluating incidence of postoperative urinary retention after spinal anesthesia and its effect on PACU discharge. *Journal of PeriAnesthesia Nursing*. 2008;23(6):394-400.
7. Pavlin DJ, Rapp SE, Polissar NL, Malmgren JA, Koerschgen M, Keyes H. Factors affecting discharge time in adult outpatients. *Anesthesia and analgesia*. 1998;87(4):816-26. PubMed PMID: 9768776. eng.
8. Fan CH, Hung HH, Wong KC, Cheung KW, Chiu KH. Should the bladder be catheterised before or after total knee replacement? *Hong Kong Journal of Orthopaedic Surgery*. 2002;6(2):69-75.
9. Warner AJ, Phillips S, Riske K, Haubert M-K, Lash N. Postoperative bladder distention: measurement with bladder ultrasonography. *Journal of PeriAnesthesia Nursing*. 2000;15(1):20-5.
10. Tammela T, Kontturi M, Lukkarinen O. Postoperative urinary retention I: incidence and predisposing factors. *Scandinavian Journal of Urology and Nephrology*. 1986;20:197-201.
11. Hansen BS, Soreide E, Warland AM, Nilsen OB. Risk factors of post-operative urinary retention in hospitalised patients. *Acta anaesthesiologica Scandinavica*. 2011;55(5):545-8. PubMed PMID: 21418152. eng.
12. Sarasin SM, Walton MJ, Singh HP, Clark DI. Can a urinary tract symptom score predict the development of postoperative urinary retention in patients undergoing lower limb arthroplasty under spinal anaesthesia? A prospective study. *Annals of the Royal College of Surgeons of England*. 2006;88(4):394-8. PubMed PMID: 16834862. Pubmed Central PMCID: 1964637. eng.
13. Kreutziger J, Frankenberger B, Luger TJ, Richard S, Zbinden S. Urinary retention after spinal anaesthesia with hyperbaric prilocaine 2% in an ambulatory setting. *British Journal of Anaesthesiology*. 2010;104(5):582-6. PubMed PMID: 20338955. eng.
14. Keita H, Diouf E, Tubach F, Brouwer T, Dahmani S, Mantz J, et al. Predictive factors of early postoperative urinary retention in the postanesthesia care unit *Anesthesia and analgesia*. 2005;101(2):592-6.
15. Selius BA, Subedi R. Urinary retention in adults: diagnosis and initial management. *American family physician*. 2008;77(5):643-50. PubMed PMID: 18350762. eng.
16. Weekes G, Quinlan JF, O'Toole GC, O'Byrne JM. A prospective analysis of the need for urinary catheterisation in the first 24 h post-primary arthroplasty. *European Journal of Orthopaedic Surgery and Traumatology*. 2006;16:330-2.

17. Cronin JJ, Shannon FJ, Bale E, Quinlan W. Prediction of post-operative urinary retention in hip and knee arthroplasty in a male population. *European Journal of Orthopaedic Surgery and Traumatology*. 2007;17:47-50.
18. Pavlin DJ, Pavlin EG, Gunn HC, Taraday JK, Koerschgen ME. Voiding in patients managed with or without ultrasound monitoring of bladder volume after outpatient surgery. *Anesthesia and analgesia*. 1999;89(1):90-7. PubMed PMID: 10389784. eng.
19. Bhattacharya P, Mandal MC, Mukhopadhyay S, Das S, Pal PP, Basu SR. Unilateral paravertebral block: an alternative to conventional spinal anaesthesia for inguinal hernia repair. *Acta anaesthesiologica Scandinavica*. 2010;54:246-51.
20. Luger TJ, Garoscio I, Rehder P, Oberladstatter J, Voelckel W. Management of temporary urinary retention after arthroscopic knee surgery in low-dose spinal anesthesia: development of a simple algorithm. *Archives of orthopaedic and trauma surgery*. 2008;128(6):607-12. PubMed PMID: 17968566. eng.
21. Marley RA, Swanson J. Patient care after discharge from the ambulatory surgical center. *Journal of PeriAnesthesia Nursing*. 2001;16(6):405-6.
22. Durant PA, Yaksh TL. Drug effects on urinary bladder tone during spinal morphine-induced inhibition of the micturition reflex in unanesthetized rats. *Anesthesiology*. 1988 Mar;68(3):325-34. PubMed PMID: 3344988. eng.
23. Rosseland LA, Stubhaug A, Breivik H. Detecting postoperative urinary retention with an ultrasound scanner. *Acta anaesthesiologica Scandinavica*. 2002;46(3):279-82. PubMed PMID: 11939918. eng.
24. Kamphuis ET, Ionescu TI, Kuipers PWG, De Gier J, Van Venrooij GEPM, Boon TA. Recovery of storage and emptying functions of the urinary bladder after spinal anesthesia with lidocaine and with bupivacaine in men. *Anesthesiology*. 1998;88(2):310-6. PubMed PMID: 9477049. eng.
25. Kuipers PW, Kamphuis ET, Van Venrooij GE, Van Roy JP, Ionescu TI, Knappe JT, et al. Intrathecal opioids and lower urinary tract function: A urodynamic evaluation. *Anesthesiology*. 2004;100(6):1497-503.
26. Chris Hani Baragwanath Hospital [2012/06/28]. Available from: www.chrishanibaragwanathhospital.co.za.
27. CHBAH J. D. Allen Theatre annual summary statistics. 2011.
28. WMA Declaration of Helsinki - Ethical principles for medical research involving human subjects: World Medical Association [updated 20082012/06/28]. Available from: <http://www.wma.net/en/30publications/10policies/b3/>.
29. Department of Health. Guidelines for good practice in the conduct of clinical trials with human participants in South Africa. Pretoria: Department of Health; 2006.
30. Myles PS, Williams DL, Hendrata M, Anderson H, Weeks AM. Patient satisfaction after anaesthesia and surgery: results of a prospective survey of 10 811 patients. *British journal of anaesthesia*. 2000;84(1):6-10.
31. Fung D, Cohen MM. Measuring Patient Satisfaction with Anesthesia Care: A Review of Current Methodology. *Anesthesia & Analgesia*. 1998;87(5):1089-98 10.213/00000539-199811000-00020.
32. Caljouw MA, van Beuzekom M, Boer F. Patient's satisfaction with perioperative care: development, validation, and application of a questionnaire. *British journal of anaesthesia*. 2008 May;100(5):637-44. PubMed PMID: 18337271. Epub 2008/03/14. eng.
33. 18 ed. United States of America: F. A.Davis Company; 1997. Taber's Cyclopedic Medical Dictionary; p. 2037.
34. Gray M. Evaluation of bladder filling/storage functions. *Urologic Nursing*. 2011;31(3):149-53.
35. Barret KE, Barman SM, Boitano S, Brooks HL. Ganong's review of medical physiology 23 ed. Weitz M, Brown RY, editors: McGraw-Hill 661-2 p.

36. [2014/06/26]. Available from:
http://www.seekwellness.com/incontinence/how_bladder_works.htm#.
37. Mulroy MF, Salinas FV, Larkin KL, Polissar NL. Ambulatory surgery patients may be discharged before voiding after short-acting spinal and epidural anesthesia. *Anesthesiology*. 2002;97(2):315-9. PubMed PMID: 12151918. eng.
38. Davidson's Principles and Practise of Medicine
20 ed. Boon NA, Colledge NR, Walker BR, Hunter JAA, editors: Churchill Livingstone Elsevier; 2006. 460 p.
39. Verhamme KMC, Dieleman JP, Van Wijk MAM, Van der Lei J, Bosch JLH, Stricker BHC, et al. Nonsteroidal anti-inflammatory drugs and increased risk of acute urinary retention. *Arch Intern Med*. 2005;165:1547-51.
40. Stoelting RK, Hillier SC. Pharmacology and physiology in anesthetic practice. 4 ed. China: Lippincott Williams and Wilkins; 2006.
41. Stallard S, Prescott S. Postoperative urinary retention in general surgical patients. *British Journal of Surgery*. 1988;75:1141-3.
42. Verhamme KMC, Sturkenboom MCJM, Stricker BHC, Bosch R. Drug-induced urinary retention: incidence, management and prevention. *Drug safety*. 2008;31(5):373-88.
43. Dreijer B, Moller MH, Bartholdy J. Post-operative urinary retention in a general surgical population. *Eur J Anaesthesiol*. 2011;28:190-4.
44. Rosow CE, Gomery P, Chen TY, Stefanovich P, Stambler N, Israel R. Reversal of opioid-induced bladder dysfunction by intravenous naloxone and methylnaltrexone. *Clin Pharmacol Ther*. 2007;82(1):48-53.
45. Lingaraj K, Ruben M, Chan YH, Das De S. Identification of risk factors for urinary retention following total knee arthroplasty: a Singapore hospital experience. *Singapore Med J*. 2007;48(3):213-6.
46. Wu AK, Auerbach AD, Aaronson DS. National incidence and outcomes of postoperative urinary retention in the Surgical Care Improvement Project. *The American Journal of Surgery*. 2012;204:167-71.
47. Voelckel WG, Kirchmair L, Rehder P, Garoscio I, Krappinger D, Luger TJ. Unilateral anesthesia does not affect the incidence of urinary retention after low-dose spinal anesthesia for knee surgery. *Anesthesia and analgesia*. 2009;109(3):986-7. PubMed PMID: 19690278. eng.
48. Durant PAC, Lucas PC, Yaksh TL. Micturition in the unanesthetized rat: spinal vs. peripheral pharmacology of the adrenergic system. *The Journal of pharmacology and experimental therapeutics*. 1988;245(2):426-35. PubMed PMID: 3367300. eng.
49. Deli G, Bosnyak E, Pusch G, Komoly S, Feher G. Diabetic Neuropathies: Diagnosis and Management. *Neuroendocrinology*. 2013;98(4):267-80.
50. Lau H, Lam B, Patil NG. Management of postoperative urinary retention: a randomized trial of in-out versus overnight catheterization. *ANZ J Surg*. 2004;74:658-61.
51. Jung HJ, Park J, Kong C, Kim Y, Park J, Kim JB. Postoperative urinary retention following anterior cervical spine surgery for degenerative cervical disc diseases. *Clinics in Orthopedic Surgery*. 2013;5:134-7.
52. Kieffer WKM, Kane TPC. Predicting postoperative urinary retention after lower limb arthroplasty. *Annals of the Royal College of Surgeons of England*. 2012;94:356-8.
53. Kumar P, Mannan K, Chowdhury AM, Kong KC, Pati J. Urinary retention and the role of indwelling catheterization following total knee arthroplasty. *International Braz J Urol*. 2006;32(1):31-4.
54. Joelsson-Alm E, Nyman CR, Lindholm C, Ulfvarson J, Svensen C. Perioperative bladder distention: a prospective study. *Scandinavian Journal of Urology and Nephrology*. 2009;43:58-62.
55. Sparks A, Boyer D, Gambrel A, Lovett M, Johnson J, Richards T, et al. The clinical benefits of the bladder scanner: a research synthesis. *J Nurs Care Qual*. 2004;19(3):188-92.

56. BladderScan BVI 3000 Operator's Manual 2007 [2014/7/10]. Available from: <http://verathon.com/Portals/0/Uploads/ProductMaterials/0900-0383-11-60%20%28BladderScan%20BVI%203000%20Operator%27s%20Manual%29.pdf>.
57. Lo E, Nicolle L, Classen D, Arias KM, Podgorny K, Anderson DJ, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals. *Infection Control and Hospital Epidemiology*. 2008;29:S41-S50.
58. Cumming D, Parker MJ. Urinary catheterisation and deep wound infection after hip fracture surgery. *International orthopaedics*. 2007 Aug;31(4):483-5. PubMed PMID: 16909250. Pubmed Central PMCID: 2267643. Epub 2006/08/16. eng.
59. Brink HI. *Fundamentals of research methodology for health care professionals*. 2 ed. Cape Town: Juta and company ltd; 2006.
60. Burns N, Grove SK. *The practice of nursing research*. 6 ed: Saunders; 2009.
61. Dixon WJ, Massey FJ. *Introduction to statistical analysis*. 4 ed: McGraw-Hill 1983.
62. Botma Y, Greeff M, Mulaudzi FM, Wright SCD. *Research in health sciences*. Cape Town: Pearson education South Africa (Pty) Ltd; 2010.
63. Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. *Academic medicine : journal of the Association of American Medical Colleges*. 2003 Aug;78(8):775-80. PubMed PMID: 12915363. Epub 2003/08/14. eng.
64. Negative results = no results, or contribution to knowledge?. 2013 [2014/07/27]. Available from: <http://forskningsrelaterat.hb.se/2013/10/24/negative-results-no-results-or-contribution-to-knowledge/?lang=en>.
65. Anderson G. No result is worthless: the value of negative results in science 2012 [2014/05/28]. Available from: <http://blogs.biomedcentral.com/bmcblog/2012/10/10/no-result-is-worthless-the-value-of-negative-results-in-science/>.
66. Matosin N, Frank E, Engel M, Lum JS, Newell KA. Negativity towards negative results: a discussion of the disconnect between scientific worth and scientific culture. *Disease Models & Mechanisms*. 2014;7(2):171-3.
67. Gelling L. Negative results have a value. *Nurse Researcher*. 2013 2013/07/01;20(6):3-.
68. Sheehan M. Publishing Negative Research Results Practical Ethics 2008 [2014/06/26]. Available from: <http://blog.practicaethics.ox.ac.uk/2008/09/publishing-negative-research-results/>.
69. Anderson G. Opinion: Publish Negative Results 2013 [2014/6/26]. Available from: <http://www.stemcellpioneers.com/showthread.php?6460-Opinion-Publish-Negative-Results>.
70. Amsen E. Negative results in medical research and clinical trials - an interview with Ben Goldacre 2013 [2014/06/26]. Available from: <http://blog.f1000research.com/2013/06/10/negative-results-in-medical-research-and-clinical-trials-an-interview-with-ben-goldacre/>.

APPENDIX A: PARTICIPANT INFORMATION LETTER

Occurrence of Post-operative Urinary Retention

Hallo,

My name is Adèle van der Walt. I am a medical doctor working at Chris Hani Baragwanath Academic Hospital (CHBAH). I am the doctor who put patients to sleep when they go for an operation. Part of my job is to make sure patients are comfortable and without pain during their operation. I am currently studying at the University of Witwatersrand, to become a specialist in this field. This research will be submitted as part of my MMed degree.

I would like to invite you to participate in a research study. I am looking at how long it takes patient to pass urine after an operation. The study will involve a few questions I will ask you after your operation. The questions will only take a few minutes of your time. I will also need to get information from your file.

If you agree to take part in the study I will ask you to sign a consent form. By signing the consent form you will give me permission to include you in the study.

The study has been approved by the Human Resource Ethics Committee (HREC)(Medical)(M120743) and the Post-Graduate Committee of the University of the Witwatersrand. Furthermore, permission to conduct the study has been obtained from the CHBAH Research Board and the heads of departments involved.

The paper I use to write the information I need for the study will not have your name and it will not be possible to trace it back to you. The information will be kept in a safe place and only I and my supervisors will have access to it. The results published will have no identifying data.

The study offers no benefit to you or any other participants now, but may result in better care in the future.

If you have any questions or concerns regarding this study, you may contact one of the following persons at any time:

Dr. Adèle van der Walt (researcher): 084 485 2301

Prof. Cleaton Jones (Chairman of HREC): (011) 7171234.

Consent to participate in the study is entirely voluntary. Please know that you may withdraw from the study at any time without having to provide a reason. Refusing to participate or withdrawing from the study will not affect your treatment in any way.

Thank you for taking the time to listen to me while I explained my study and to read this letter.

Yours Sincerely,
Adèle van der Walt

APPENDIX B: INFORMED CONSENT

Occurrence of Post-operative Urinary Retention

I, _____ {name} understand the content of the information letter and I have had the opportunity to ask questions which have been answered to my satisfaction. I understand that taking part in this study is voluntary.

I hereby give consent to take part in this study.

{Participant}

{Date}

APPENDIX C: DATA CAPTURE SHEET

Pre-operative:

History of POUR	YES	NO
Nocturia	YES	NO
Frequency	YES	NO
Urgency	YES	NO
Hesitancy	YES	NO
Incontinence	YES	NO
Weak Stream	YES	NO
Dysuria	YES	NO
BPH/Prostate pathology	YES	NO
Urinary Tract Infection within the last week	YES	NO
Renal Failure	YES	NO
Indwelling Urinary Catheter In Situ	YES	NO
Hyperglycaemia	YES	NO
Diuretic use	YES	NO
Surgery Considered to be High Risk for POUR including pelvic surgery, anorectal surgery, inguinal hernia repair, spine surgery, neurosurgery	YES	NO
Neurologic Pathology	YES	NO

Post-operative

Catheterisation intra-operatively (in-out or indwelling)	YES	NOI
Hyperglycaemia	YES	NO
Diuretic use	YES	NO
Continuous Epidural Anaesthesia or Analgesia	YES	NO

1. Demographics

Study number	
--------------	--

Male	
Female	

Age	
-----	--

2. Surgery

ENT	
General surgery	
Maxillo-Facial	
Orthopedic	
Other	

Length of the procedure	Hours	
	Minutes	

Volume of IV fluid received intra-operatively	
---	--

General anaesthesia	
Neuraxial block	

3. Post-operative

Was patient able to void spontaneously?	Yes	
	No	

If no, was any non-invasive intervention undertaken?	Yes	
	No	

If yes indicate intervention(s)	Encouraged to void	
	Audible running water close to the patient	
	Place patient's hand in hot water	
	Allow patient to have a hot bath	
	Encourage patient to sit, stand or early ambulation	
	Minimise post-operative discomfort	
	IV fluid bolus	
	Other	

Was patient catheterised?	Yes	
	No	

If the patient was catheterised was it:	In-out catheterisation	
	Indwelling catheter	

Retention volume drained at catheterisation?	
--	--

4. Classes peri-operative medication received

	Systemic	NAB
Opioids		
Benzodiazepines		
Propofol		
Etomidate		
Ketamine		
Barbiturate		
Anticholinergics		
β -Adrenergic agonists		
α -Adrenergic agonists		
β -Adrenergic antagonists		
Calcium channel antagonist		
NSAIDs		
Local anaesthetic		

APPENDIX D: PERMISSION FROM POST-GRADUATE COMMITTEE



Faculty of Health Sciences
Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172040

Reference: Ms Thokozile Nhlapp
E-mail: thokozile.nhlapp@wits.ac.za

07 January 2011
Person No: 589614
PAG

Dr A Van Der Walt
P O Box 73240
Fairland
2030
South Africa

Dear Dr Van Der Walt

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *Occurrence of post-operative urinary retention in low risk patients at an academic hospital* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

A handwritten signature in black ink, appearing to read 'S Benn'.

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

APPENDIX E: APPROVAL FROM ETHICS COMMITTEE



UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Adele van der Walt

CLEARANCE CERTIFICATE

M120743

PROJECT

Prevalence of Post-Operative Urinary Retention
in Patients at CH Baragwanath Academic
Hospital (CHBAH)

INVESTIGATORS

Dr Adele van der Walt.

DEPARTMENT

Department of Anaesthesiology

DATE CONSIDERED

27/07/2012

DECISION OF THE COMMITTEE*

Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 13/09/2012

CHAIRPERSON
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Ms Juan Scribante

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX F: APPROVAL FROM THE MEDICAL ADVISORY COMMITTEE AT CHBAH



GAUTENG PROVINCE

REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE
CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 15 May 2013

TITLE OF PROJECT: Occurrence of post-operative urinary retention in low risk patients at an academic hospital

UNIVERSITY: Witwatersrand

Principal Investigator: Dr A van der Walt

Department: Anaesthesiology

Supervisor (If relevant): Ms J Scribante

Permission Head Department (where research conducted): Yes

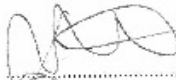
Date of start of proposed study: May 2013

Date of completion of data collection: April 2014

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Hospital. The CTO /management of Chris Hani Baragwanath Hospital is accordingly informed and the study is subject to:-

- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- the Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- the MAC will be informed of any serious adverse events as soon as they occur
- permission is granted for the duration of the Ethics Committee approval.


Recommended
(On behalf of the MAC)
Date: 15 May 2013


Approved/Not Approved
Hospital Management
Date: 17/05/13

