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Pacemaker and transurethral procedures of prostate and bladder tumours: experiences at the Department of Urology, Medical University of Warsaw

Rozrusznik serca a zabiegi przezcewkowe. Doświadczenia Kliniki Urologii Ogólnej, Onkologicznej i Czynnościowej Warszawskiego Uniwersytetu Medycznego

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Abstract

We have analysed the course of surgery in 146 patients with pacemakers who underwent transurethral resection of a prostate or bladder tumour at the Department of Urology in the five years 2014 to 2018 inclusive. In the study group, spinal anaesthesia was performed in 48 patients (32.9%) and general anaesthesia in 98 patients (67.1%). The average time of surgery was 71.8 minutes. Bipolar electroresections were performed in six patients and unipolar in 140 patients. Electrocardiography (ECG) monitoring and pulse oximetry evaluation were used continuously and for up to four hours after the procedure, and resting 12-lead ECG was performed before and immediately after surgery. Pacemaker control was performed before and after the procedure in the pacemaker control office. No case of significant cardiac pacemaker disturbance was observed. Transurethral electroresection of bladder and prostate tumours in patients with implanted pacemakers where guidelines and recommendations were adhered to were not associated with the occurrence of pacemaker complications.

Key words: pacemaker, transurethral procedures, TURP, TURBT

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Introduction

Both experimental studies and observations collected during diathermy procedures in patients with pacemakers have suggested that in cases of transurethral prescriptive prostate resection (TURP) and transurethral resection of bladder tumours (TURBT) disturbed pacemaker functioning may occur and is associated with a subsequent slowdown of heart function, arrhythmia, asystole, and even ventricular fibrillation [1–8]. For this reason, patients with pacemakers require adequate preparation before, during and after surgery, as well as adherence to peri-operative procedures to prevent undesirable complications [9, 10].

The aim of this study was to analyse 146 patients with pacemakers undergoing endoscopic procedures who were treated at the Urology Department in 2014–2018 to assess the safety of treatment in this group of patients.

Materials and methods

Between 2014 and 2018, transurethral procedures (TURP and TURBT) were performed in 2,787 patients in the

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Table 1. Demographics of patients undergoing transurethral surgery

Total transurethral procedures 2014–2018 (five years)	2,787	Percentage (%)
TURP	578	20.7
TURBT	2,209	79.3
Women	652	23.4
Men	2,135	76.6
Patients with pacemakers (total)	146	5.23
Subarachnoid anaesthesia	1,927	69.15
General anaesthesia	860	30.85
Average age of patients (years)	71	

TURP — transurethral prescriptive prostate resection; TURBT — transurethral resection of bladder tumours

Table 2. Demographics of patients with pacemakers undergoing transurethral surgery

Total number of pacemakers	146	Percentage (%)
Women	35	23.97
Men	111	76.03
Subarachnoid anaesthesia	48	32.9
General anaesthesia	98	67.1
Average age of patients (years)	71.42	
Average duration of treatment (minutes)	71.8	

Table 3. Types of cardiac pacing for patients undergoing transurethral procedures

Stimulation type	Percentage of patients (%)
VVI	13.85
AAI	18.46
DDDR	67.69

Urology Department (652 women and 2,135 men). The mean age of patients was 71 years (Table 1).

The 146 TURP and TURBT procedures in patients with implanted cardiac pacemakers were analysed. This represented 5.23% of all transurethral resections performed at the Department during that time (Tables 2, 3).

Anaesthesia used

Regional, subarachnoid anaesthesia is the gold standard anaesthetic management for this type of procedure. If there is a contraindication for subarachnoid anaesthesia, general anaesthesia is used.

Subarachnoid anaesthesia was performed in 1,927 (69.15%) and general anaesthesia in 860 (30.85%) patients. In the study group, subarachnoid anaesthesia was performed in 48 patients (32.9%), and general anaesthesia in 98 patients (67.1%); details are presented in Table 2.

Electrocardiography (ECG) monitoring and pulse oximetry evaluation were used continuously during the procedures and for up to four hours after the procedure. 12-lead resting ECG was routinely performed before and immediately after the procedure. Each patient was monitored for pacemaker function before and after the procedure in the pacing room.

Transurethral electroresection procedures for both bladder tumours (TURBT) and prostate (TURP) were performed as unipolar or bipolar procedures (in saline).

TURBT (bladder tumour removal) procedures were generally performed using unipolar electrocoagulation. The loop of the resectoscope inserted into the urethra was the active electrode, and the passive electrode plate was glued to the patient's thigh or buttock. There was a current flow between electrodes, and the highest impedance occurred on the active electrode, which resulted in a rise in temperature enabling tissue separation or coagulation. Unipolar electroresection procedures were performed in non-electrolyte solutions so that the current flowed through the patient's tissues between the active electrode (the loop) and the passive one (the plate).

During bipolar electroresection, mainly used for prostate adenomas resection, current flow occurred between two elements of the loop, or between the loop and the tip of the resectoscope jacket, causing evaporation of the solution and the formation of a high-temperature plasma

in which a constant current flow occurred. The temperature generated during cutting was lower than during traditional resection, resulting in less thermal damage to surrounding tissues. By using saline as a flushing fluid, the risk of a post-resection syndrome (TUR syndrome) was practically eliminated.

Results

In the studied group of patients with pacemakers, the majority (67.1%) were operated under general anaesthesia, while in 32.9% subarachnoid anaesthesia was used. The average duration of the procedure was 71.8 minutes. The number of treatments in individual years is shown in Table 4. Details of the treatments are given in Tables 4 and 5.

Only in four cases was the pacemaker deactivated with a magnet being used during the operation.

No patient had a cardiac pacing disorder. In the outpatient control of patients after surgery, there was no case of damage to the pacing system.

Discussion

The spectacular progress in cardiology observed since the mid-twentieth century, and the significant extension of life in people with cardiovascular diseases, have resulted in a large increase in the number of patients with implanted cardiac stimulation systems.

The cardiac pacing system consists of a battery-containing pacemaker, a system that analyses the heart rhythm, a system that activates stimulation when necessary, a system that generates electrical impulses, and electrodes that connect the pacemaker to the heart muscle.

Currently, both single and dual cavity pacemakers are used for permanent cardiac pacing. The site of stimulation is usually the right ventricle and right atrium. Stimulants are marked with a letter code. These letters mean:

- pacing site (A — atrium, V — ventricle, D — both cavities);
- potential reading location (A, V, D);
- pacemaker response method (I — braking, T — triggering, D — both types)
- the ability to adapt the stimulation rate to exercise (O — none, R — rhythm modification)

In clinical practice, two-chamber stimulation types are most commonly used: AAI (R), VVI (R), VDD, DDD (R), and two-chamber stimulation (CRT, cardiac resynchronisation therapy) that involves synchronous stimulation of the right and left ventricles.

With VVI pacing (right ventricle electrode, ventricular control and pacing), there is a lack of synchronisation

Table 4. Data on transurethral resection of the prostate (TURP) broken down by year

Year	TURP	Pacemaker	Unipolar	Bipolar	Time		
					Min	Max	Mean
2014	97	11	10	1	50	120	74.54
2015	73	5	5	0	40	120	78
2016	107	4	4	0	60	170	105
2017	148	7	7	0	65	100	75
2018	153	5	4	1	45	90	72
Total	578	32					

min — minimum; max — maximum

Table 5. Data on transurethral resection of bladder tumours (TURBT) broken down by year

Year	TURBT	Pacemaker	Unipolar	Bipolar	Time		
					Min	Max	Mean
2014	448	23	23	0	20	95	54.56
2015	388	17	17	0	35	160	56.17
2016	498	27	26	1	20	130	62.59
2017	452	22	21	1	23	130	59.54
2018	423	25	23	2	35	185	71.2
Total	2,209	114					

min — minimum; max — maximum

between an atrial and ventricular contraction, which is a non-physiological phenomenon.

Since Senning's first human pacemaker implantation in 1958, millions of people have benefited from this treatment. At the same time, progress has also been made in the diagnosis and treatment of urological diseases. Patients with implanted pacing systems have wider access to interventions on the urinary system using current techniques, which can potentially risk damage to the pacing system [11].

Transurethral procedures *i.e.* prostate resection (TURP) and bladder tumour resection (TURBT), are very common urological procedures [3–5].

Transurethral electroresection (TURP) used in the treatment of tumours and prostatic hyperplasia, involves the application of a current to the tissues to achieve the effect of cutting, coagulation and fulguration to achieve haemostasis. In urology, uni- and bi-polar techniques with repeated applications of high-intensity current — often above 100 V — are used. During the procedure, it is important to position the so-called passive electrode as far away from the cardiac pacing system as possible, *e.g.* on the buttock, which reduces the effect of current on the stimulator [12, 13].

During electrocoagulation of both bladder and prostate tumours in patients with implanted cardiac pacemakers, some authors say that a bipolar technique should be used, which significantly reduces the possibility of damage to the pacing system. Electrocoagulation is a unipolar configuration that can significantly interfere with the functioning of the pacing system by pulses that can be received and interpreted as interference, thereby temporarily moving the pacemaker to a constant rhythm. The use of electrocoagulation may block effective stimulation, or temporarily suspend the pacemaker's function. With high coagulation current, the endocardium may be damaged at the electrode anchor (tissue burn), which is associated with the risk of ineffective stimulation [10, 13, 14]. These phenomena can be prevented by reprogramming the pacemaker for the duration of the procedure, *i.e.* setting a lower sensitivity, or switching to the so-called rigid rhythm, or by setting it to trigger mode with a long refractive period. These methods were previously the first choice before the advent of TURP and TURBT. In a few cases, deactivation of the pacemaker (using a magnet) has been used. However, in pacemaker-dependent patients, even a short-term pacemaker pause can cause a serious haemodynamic problem. A pacemaker-dependent patient is defined as one who uses stimulation during more than 40% of evolution per day [5, 7, 15]. Therefore, bipolar electrocoagulation is preferred, which significantly reduces the risk of pacemaker damage. It is also recommended to limit the time of electrical applications to 1–2 s for every 10 s of the time interval [16, 17]. In the case of bladder tumour electroresections, there are dozens of current applications lasting less than 3 s performed. In the case of prostate resections, the number of applications is usually much higher, running into several hundreds and even more than 1,000.

There are strict recommendations regarding perioperative management in patients with pacemakers [11, 18–21]. A patient who is being prepared for the procedure should have a current pacemaker control. Expected battery life should be at least three months. The procedure for using the current application should be described in detail. During the procedure, cardiac function should be monitored continuously by means of ECG recording and pulse oximetry monitoring. Observation after surgery within the hospital ward should last a minimum of 24 hours. In the past, it was recommended to deactivate the pacemaker during the procedure when using unipolar electrocoagulation. According to the current recommendations of scientific societies in the field of electrotherapy, the routine use of a magnet is not recommended. It is necessary to provide equipment for immediate use when needed *i.e.* defibrillation, cardioversion and cardiac pacing. Complete damage to a pacemaker during surgery is extremely rare. Temporary ineffective stimulation or control disorders have been reported. After the procedure, early control of the pacing system should be conducted. In our study, 146 patients with implanted pacemakers did not have damage to the device during or after urological procedures. All patients were referred for control of pacing systems in the early postoperative period, with an average of seven days.

Conclusions

1. Transurethral electroresection of bladder and prostate tumours in patients with implanted cardiac pacemakers are not associated with complications of the pacemaker so long as the principles of management are mantained.
2. Impairment of the pacemaker's work is extremely rare while following rigorous peri-operative recommendations.

Streszczenie

Dokonano analizy przebiegu operacji u 146 pacjentów ze stymulatorami serca, którzy przebyli operacje przezcewkowe resekcji gruczołu krokowego i resekcji guzów pęcherza moczowego w klinice urologii w latach 2014–2018. W badanej grupie znieczulenie podpajęczynówkowe wykonano u 48 pacjentów (32,9%), a ogólne — u 98 (67,1%). Średni czas trwania zabiegu wynosił 71,8 minuty. Zabiegi elektroresekcji bipolarnej wykonano u 6 pacjentów, a elektresekcji monopolarnej — u 140. W czasie zabiegów stosowano monitorowanie elektrokardiograficzne (EKG) oraz ocenę pulsoksymetryczną w sposób ciągły oraz do 4 godzin po zabiegu, 12-odprowadzeniowe EKG spoczynkowe wykonywano przed zabiegiem oraz bezpośrednio po nim. U każdego pacjenta kontrolowano pracę stymulatora przed zabiegiem oraz po nim w pracowni kontroli stymulatorów. W żadnym przypadku nie obserwowano istotnych zaburzeń pracy rozrusznika serca. Zabiegi przezcewkowej elektroresekcji guzów pęcherza moczowego i prostaty u pacjentów z wszczepionymi stymulatorami serca przy zachowaniu zasad postępowania nie wiązały się z wystąpieniem powikłań pracy stymulatora.

Słowa kluczowe: rozrusznik serca, zabiegi przezcewkowe, TURP, TURBT

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