ELECTRICAL RESISTANCE AND CURRENT LEAKAGE OF APPLIANCES FOR TRANSURETHRAL RESECTION

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Urethral stricture following transurethral resection of the prostate (TUR-P) is closely related to the electrical resistance and current leakage of appliances. Electrical resistance and leakage were therefore investigated in 7 old bipolar loops, 3 new bipolar loops (①, ② and ③) used for TUR-P, 2 new bipolar loops (④ and ⑤) for TUR-bladder tumor (TUR-Bt), and 4 new monopolar loops (⑥ through ⑨) for TUR-P. Two of the 7 old bipolar loops were found to be positive and 5 negative for current leakage. The 2 positive loops had resistances of 4.4 and 17 ohm (Ω). Before use, the electrical resistance of the 5 new bipolar loops (① to ⑤) ranged from 0.5 to 0.6Ω. The resistance of loop ① was less than 5Ω after the sixth use, and that of loop ③ was 2.8Ω after the fifth use. By contrast, loop ② exhibited resistance of 115Ω after the third use. The average operation time for loops ①, ② and ③ were 66, 64 and 62 minutes. Loop ④ showed resistance of 14Ω after the third use, and loop ⑤ 1Ω even after the sixth use. Furthermore, none of the 5 loops showed current leakage. On the other hand, all 4 monopolar loops (⑥ through ⑨) exhibited current leakage after the first use, and showed relatively high electrical resistance. These findings demonstrate the necessity of timely replacement of bipolar loops and the exchange of monopolar loops after the first use.

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Key words: Electrical resistance, Current leakage, Appliances, Transurethral resection

INTRODUCTION

We encountered postoperative urethral stricture in 6 out of 128 patients (4.7%) following transurethral resection of the prostate (TUR-P). However, it was observed at a much higher frequency, in 5 out of 8 patients (62.5%), in a shorter period. We evaluated the patients with and without stricture, but found no difference in the operation time, the resected prostatic weight, or the catheter retention period[1]. However, electrical checking of the cord, loop, sheath, telescope, and electrosurgical unit used in TUR-P revealed abnormalities in the loops and cords. In particular, when 4 cords were connected to a loop used sereral times, wide variations in resistance (15,000, 1,150,000, 1.3, and 0.9 ohm (Ω)) were observed[2]. The electrical resistance was extremely high in cords used for several years, and the parts of the cords causing the high resistance were generally at the connections.

We examined the electrical resistance and the current leakage of old loops, and checked the changes occuring with the passage of time for new loops.

MATERIALS AND METHODS

The current leakage of bipolar loops and the sheaths used at the Department of Urology of Nagaoka Red Cross Hospital was checked using a testing device, and the electrical resistance of the loops was determined using a Fluke 73 multimeter. The testing device consisted of a transistor generator, which generated a high voltage of 3,000 to 6,000 volt (V), and indicated current leakage from the sheaths or loops by a continuous audible signal.

Three new bipolar loops (①, ② and ③)

were also tested, and the number and length of the TUR-P procedure, the resected prostatic weight, the changes in electrical resistance, and the development of current leakage were assessed (Fig. 1). Similarly, a comparative study was performed with 2 new bipolar loops (④ and ⑤) used for the transurethral resection of a bladder tumor (TUR-Bt). Since the connection of the Storz electrode has recently been changed from bipolar to monopolar, we also examined 4 new monopolar loops (⑥, ⑦, ⑧ and ⑨) for TUR-P.

RESULTS

Seven bipolar loops, the length and frequency of use of which were unknown, were checked for current leakage. Two loops were found to be positive, and 5 were negative for leakage. The electrical resistances of these loops were 0.4, 0.3, 0.3, 0.2, and 0.8 Ω in the negative loops, while the values were 4.4 and 17 Ω in the positive loops. After the loop with a 17 Ω resistance was connected to the electrical cord several times, part of the connection was damaged and the resistance increased to 540 Ω thereafter.

Next, the changes in electrical resistance and current leakage were followed up using 3 new bipolar loops for TUR-P and 2 new bipolar loops for TUR-Bt. Loop ① exhibited a resistance of less than 1 Ω up to the third use and a resistance of 5 Ω or less by the sixth use (Table 1). By contrast, loop ② had a resistance of 2.5 Ω after the first use and this increased to 115 Ω by the third use, after which it was discarded. For loop ③, the resistance was less than 1 Ω up to the third use and 2.8 Ω up to the fifth use. The average resected prostatic weight and the operation time for loops ①, ② and ③ were: 21.0, 28.0, and 20.2 g, and 65.5, 64.0, and 61.8 min., respectively. The resistance of loop ④ was 1.5 Ω at the first use and 13.8 Ω at the third use, showing relatively high resistance values (Table 2). By contrast, loop ⑤ still had a low resistance of 1 Ω even after the sixth use. None of the 5 loops (① through ⑤) showed current leakage.

As for the new monopolar loops, all 4 loops (⑥ through ⑨) exhibited current leakage after the first use (Table 3). The resected prostatic weight and the operation time of the first use were between 16 and

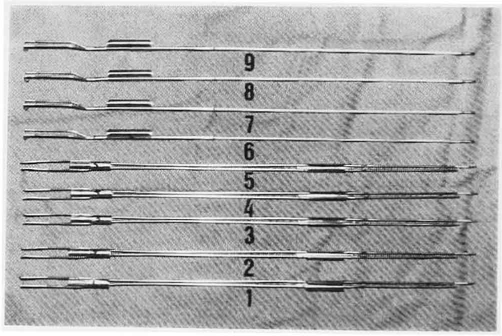

Fig. 1. Bipolar (①~⑤) and monopolar (⑥~⑨) loops

Table 1. Electrical resistance and current leakage of bipolar loops for TUR-P

No. of times used		Before	1	2	3	4	5	6
①	Resistance (Ω)	0.5	0.5	0.5	0.6	2.4	0.7	4.8
	Leakage	(−)	(−)	(−)	(−)	(−)	(−)	(−)
	Resection time (min.)		63	60	75	90	50	55
	Resected weight (gm.)		18	21	23	27	12	25
②	Resistance (Ω)	0.6	2.5	6.1	115			
	Leakage	(−)	(−)	(−)	(−)			
	Resection time (min.)		84	66	42			
	Resected weight (gm.)		48	21	15			
③	Resistance (Ω)	0.6	0.6	0.7	0.9	1.5	2.8	
	Leakage	(−)	(−)	(−)	(−)	(−)	(−)	
	Resection time (min.)		45	68	82	56	58	
	Resected weight (gm.)		12	20	30	18	21	

43 g, and 40 and 70 min. Up to the second use, Loop ⑦ had a resistance of only 3.2 Ω, but loop ⑥, ⑧ and ⑨ had resistances of 13.8, 110, and 33.0 Ω, respectively.

One of the 3 sheaths checked by the testing device, made a continuous buzzing sound, which indicated current leakage, and was discarded.

DISCUSSION.

In general, urethral stricture after TUR-P occurs in 3 to 7% of the patients[3-5]. To prevent this condition, urethral bougienage, steroid ointment, meatotomy, and Otis urethrotome are employed[6]. Postoperative stricture frequently occurs in patients with large adenomas, patients undergoing excessive manipulation, or patients in whom the catheter is retained for an unreasonably long time. In addition, there are cases where urethral damage is caused by excessive warming of the irrigating fluid[7].

Table 3. Electrical resistance and current leakage of monopolar loops for TUR-P

No. of times used		Before	1	2
⑥	Resistance (Ω)	1.0	6.2	13.8
	Leakage	(−)	(+)	(+)
	Resection time (min.)		40	60
	Resected weight (gm.)		16	34
⑦	Resistance (Ω)	0.7	0.9	3.2
	Leakage	(−)	(+)	(+)
	Resection time (min.)		55	50
	Resected weight (gm.)		28	24
⑧	Resistance (Ω)	0.9	23.8	110
	Leakage	(−)	(+)	(+)
	Resection time (min.)		70	55
	Resected weight (gm.)		43	21
⑨	Resistance (Ω)	0.8	6.5	33.0
	Leakage	(−)	(+)	(+)
	Resection time (min.)		60	50
	Resected weight (gm.)		31	23

Table 2. Electrical resistance and current leakage of bipolar loops for TUR-Bt

No. of times used		Before	1	2	3	4	5	6
④	Resistance (Ω)	0.5	1.5	1.8	13.8			
	Leakage	(−)	(−)	(−)	(−)			
	Resection time (min.)		62	28	10			
	Resected weight (gm.)		15	7	1↓			
⑤	Resistance (Ω)	0.6	0.6	0.6	0.6	0.6	0.8	1.0
	Leakage	(−)	(−)	(−)	(−)	(−)	(−)	(−)
	Resection time (min.)		20	10	30	20	15	10
	Resected weight (gm.)		1↓	1↓	2	4	2	3

Hammarsten et al.[8] compared 2 groups treated with transurethral siliconised latex catheters and suprapubic siliconised latex catheters, and reported an incidence of postoperative urethral stricture of 17 and 4%, respectively, after a follow-up period of 6 to 24 months. They suggested that the catheter influenced urethral stricture formation.

Flachenecker and Fastenmeier[9 10] suggested the possibility of electrical problems in transurethral surgery. Kay[11] measured the in vivo current leakage during transurethral resection, but did not find a large enough current leakage to cause a clinical problem.

In the present study, the current leakage and the electrical resistance were evaluated in 7 old loops the length and frequency of use of which were unknown. Significant current leakage was detected in 2 of the 7 loops, and this seemed to indicate the possibility of electrical resistance sometimes causing clinical problems.

Five new bipolar and 4 new monopolar loops were tested, and the relationship was assessed between the number of uses, the length of use, and the resected weight on one hand, and the current leakage and electrical resistance on the other hand. In particular, loop ② showed an electrical resistance of more than 100 Ω after only the third use. The difference between this loop and the other two bipolar loops (① and ③) was a relatively long resection time at the first use and a higher prostatic resection weight. However, it would seem to be difficult to estimate the degree of wear of a loop without measuring its electrical resistance. The results of our measurements suggest that loops should be replaced after they have been used three times or before that, and within 180 minutes of use.

The connection of the Storz electrode cord has recently been changed from bipolar to monopolar and is now connected at a position above the manipulation element. This eliminates any risk of contact of the irrigation fluid or blood with the connection between the cord and the loops, which was often found to be a problem in the past. This change might reduce the possibility of problems such as current leakage at the connection, but the 4 new monopolar loops tested demonstrated considerable current leakage after the first use. Although it will increase costs, we recommend exchange of the monopolar loop after each use.

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和文抄録

経尿道的切除術に使用する器具の電気抵抗および漏電について

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経尿道的前立腺切除術後の尿道狭窄は，使用している器具の電気抵抗や漏電とおおいに関係がある．そこで経尿道的前立腺切除術に用いていた7本の古い双極性のループ，3本の新品双極性ループ（①，②，③），経尿道的膀胱腫瘍切除術に用いた2本の新品双極性ループ（④，⑤），および経尿道的前立腺切除術に用いた新品の単極性ループ（⑥，⑦，⑧，⑨）の電気抵抗および漏電について検査してみた．7本の古い双極性ループのうち2本に漏電がみられ，5本は漏電がなかった．漏電のみられた2本の電気抵抗は，4.4 および17オーム（Ω）であった．つぎに新品の双極性ループ5本（① から ⑤）の，使用前の電気抵抗を調べると0.5から 0.6Ω であったが，ループ①は6回使用後も5Ω 以下，ループ③は5回使用でも 2.8Ω だった．これに対しループ②は，2回使用後に 115Ωまで上昇したが，ループ ①，② および③を用いた平均切除時間は，66，64および62分と差がなかった．ループ④は3回使用で 14Ω，ループ⑤は6回使用でも 1Ω以下であったが，これらの5本はいずれも漏電がみられなかった．一方単極性ループの4本（⑥から⑨）は1回使用後に漏電を示すとともに，かなりの電気抵抗がみられた．これらは双極性ループの適切な交換と，単極性ループの1回毎の交換が必要なことを示していた．

（泌尿紀要 **38**：413-417，1992）