

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Supplementary Table 1. Electrocautery																			
Author	Yr	ERBT [^] (n)	Modality	Design	cTURBT control group?	Age (Avg)	Male %	Feasibility	Max. tumor size	Extraction	Anesthesia	Obturator reflex	Bladder perforation	Significant bleeding*	Muscularis propria identified in specimen?	pTa	pT1	≥pT2	
Lodde ¹⁵	2003	37	Monopolar (flat loop)	Prosp.	No	64.7	86.5% (32/37)	All	2.5 cm	Syringe	Mixed	NR	2.7% (1/37)	None	100% (37/37)	82.25% (51/62)*	17.8% (11/62)	0	
Ukai ⁵	2010	97	Energy NR (bent loop)	Prosp.	No	71.2	85.5% (83/97)	Unclear (some mixed technique)	5.5 cm [^]	NR	Spinal	NR	None (0/97)	None	82.5% (80/97)	30.9% (30/97)	60.8% (59/97)	7.21% (7/97)	
Upadhyay ²⁶	2012	21	Monopolar (bent loop)	Prosp., non-ran	Yes	NR	NR	All	<3 cm	NR	General for lateral wall; otherwise spinal	NR	None (0/21)	0	95.2% (20/21)	57.15% (12/21)	28.6% (6/21)	14.3% (3/21)	
Upadhyay control n=25						–	–	–	–	–	–	–	4% (1/25)	0	60% (15/25)	48% (12/25)	32% (8/25)	20% (5/25)	
RoB: in general = Moderate; Re-recurrence = N/A																			
Statistical significance						–	–	–	–	–	–	–	NS	–	<0.001	NS	NS	NS	
Sureka ³²	2014	21	Monopolar (bent loop)	Prosp., non-ran	Yes	52.6	NR	All	4 cm [^]	Grasping forceps via nephroscope for large	NR	NR	NR	NR	All, but excluded if muscle not present	57.14% (12/21)	42.8% (9/21)	0	
Sureka control n = 24						55	NR	–	–	–	NR	NR	NR	NR	All, but excluded if muscle not present	54.16% (13/24)	45.8% (11/24)	0	
RoB: in general = Moderate; Re-recurrence = Serious																			
Statistical significance						–	–	–	–	–	–	–	–	–	–	–	–	–	–
Kramer ⁴² (monopolar arm)	2015	91	Monopolar	Prosp.	No	69	78% (71/91)	26.3% of electro-	<5 cm [^]	Forceps (occasionally specimen)	NR	1.09% (1/91)	NR	3.9% (6/156)	96.2% (150/156)	54.9% (50/91)	36.3% (33/91)	8.8% (8/91)	

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Kramer ⁴² (bipolar arm)	2015	65	Bipolar	Prosp.	No	65.5	83% (54/65)	cautery switched to cTURBT	<5 cm^	bag)	NR	None 0/65	NR			50.7% (33/65)	44.62% (29/65)	4.61% (3/65)
Hurle ²⁷	2016	74	Energy NR (Collins loop)	Prosp.	No	71	78.4% (58/74)	0.97% (1/103 tumors) converted	3 cm	Ellik (laparoscopic graspers via nephroscope for large)	NR	1.35% (1/74)	1.35% (1/74)	0	100% (74/74)	72.3% (47/65)	41.5% (27/65)	X
Zhang ²⁸	2017	40	Monopolar (Loop)	Retro.	Yes	60.65	87.5% (35/40)	Combination technique for large	>3 cm	Ellik	GA	22.5% (9/40)	5% (2/40)	0	100% (40/40)	37.5% (15/40)	62.5% (25/40)	None
Zhang control n= 50						60.8	76% (38/50)	-	-	-	GA	4% (2/50)	8% (4/50)	0	54% (27/50) in specimen (base cold cup biopsies separately)	54% (27/50)	46% (23/50)	None
RoB: in general = Moderate; Re-recurrence = Serious																		
Statistical significance						-	-	-	-	-	-	p=0.867	p=0.689	0	p<0.01	-	-	None
Balan ¹⁹	2018	45	Bipolar (plasma button + loop)	RCT	Yes	64.7	NR	All	<3 cm	NR	NR	11.1% (5/45)	NR	NR; mean Hb drop 0.28g/dL	100%	53.3% (24/45)	46.7% (21/45)	None
Balan control n = 45 (monopolar cTURBT)						66.1	-	-	-	-	-	4.4% (2/45)	NR	NR; mean Hb drop 0.76g/dL	100%	51.1% (23/45)	48.9% (22/45)	None
RoB: in general = Some concerns; Re recurrence = Some concerns																		
Statistical significance						-	-	-	-	-	-	p<0.05	-	p<0.05	No difference	-	-	-
Zhang ²⁰	2018	82	Bipolar (plasma button)	Observ., unclear	No	58.4	74.4% (61/82)	NR	<4 cm	Ellik	NR	None	None	None	100%	26	51	5
Huang ³⁹	2020	12	Monopolar (loop)	Prosp., non-ran	Yes	NR	75% (9/12)	All	<3 cm	NR	NR	NR	NR	NR	NR	6/12	6/12	None
Huang control n= 9						NR	77.8%	-	-	-	-	-	-	-	-	6/9	3/9	None

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

RoB: in general = Moderate; Re-recurrence = Serious							(7/9)											
Statistical significance						-	-	-	-	-	-	-	-	-	-	-	-	-
Yang ¹⁶	2020	26	Monopolar	Retro.	No	62.39	80.7% (21/26)	All	<3 cm	Ellik, occasionally forceps	Spinal + Epidural	23% (6/26)	3.8% (1/26)	NR	88.5% (23/26)	42.3% (11/26)	57.7% (15/26)	X
Bangash ²⁹	2020	41	Monopolar (Collins knife)	Prosp. Non-Ran	Yes	58.46	82.9% (34/41)	NR	<3 cm	NR	NR	NR	None (0/41)	7.3% (3/41) hematuria	100%	48.8% (20/41)	51.2% (21/41)	46.3% (19/41)
Bangash control n = 41						58.59	-	-	-	-	-	-	NR	9.75% (4/41)	56.1% (23/41)	46.3% (19/41)	53.7% (22/41)	None
RoB: in general = Moderate; Re-recurrence = Moderate																		
Statistical significance						-	-	-	-	-	-	-	-	0.68	<0.001	NS	NS	None
Miyake ⁴¹	2020	12	Bipolar (flat loop)	Prosp. Non-Ran	Yes	76.5	91.67% (11/12)	All	<2.5 cm	Grasping forceps	General or spinal	NR	8.34% (1/12)	NR	100% (12/12)	83.34% (10/12)	16.7% (2/12)	None
Miyake control n=28						74.6	89.3% (25/28)	-	-	-	-	NR	0	NR	NR	21/28	7/28	None
RoB: in general = Moderate; Re-recurrence = Moderate-Serious																		
Statistical significance						-	-	-	-	-	-	-	NS	-	-	-	-	-
Eissa ¹³	2020	50	Monopolar (bent loop)	Retro.	No	72.26	80% (40/50)	All but this was ERBT cohort	2 cm	Forceps or Ellik	General	NR	4% (2/50)	None	90% (45/50)	28% (14/50)	72% (36/50)	X
Hameed ¹⁸	2021	23	Zedd Excision Scissors	Prosp.	No	64	69.6 (16/23)	NR	2.6 cm	3-pronged grasper or Ellik	NR	0	0	0	91% (21/23)	35% (8/23)	57% (13/23)	9% (2/23)
Yanagisawa ²¹	2021	140	Bipolar (needle electrode)	Prosp. Non-Ran	No	72	75% (105/140)	All, but en bloc cohort studied	<3 cm	Biopsy forceps	NR	0 (n=67 lateral)	0.71% (1/140)	1.42% (2/140)	90%	66% (93/140)	34% (47/140)	X
Teoh ⁴⁰	2021	135	Mixed mono/b	Prosp. Non-Ran	Not intention-	71.3	71.1% (96/135)	94.3% <1cm	6 cm (80%	NR	NR	NR	0	5.1% (5/99)	80.8%	65%**	17.2%**	X

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

			ipolar (loop)		to-treat (cases converted to cTURBT included)		5)	82.2% 1.01–2 cm 75% 2.01–3 cm 29.6% > 3cm	≤3 cm)									
Yasui ⁴⁶	2021	61	Bipolar	Retro.	No	76	83.6% (51/61)	NR (ERBT cohort)	<3 cm majority. >3 cm cTURBT of exophytic and ERBT of base.	NR	NR	NR	NR	NR	NR	X	100% (61) – selected. Stratified pT1 a,b,c	X
Poletajew ⁴³	2021	153	Mixed (predominantly monopolar) Collins knife or resection loop	Prosp. Non-Ran	Yes	68	76.5% (117/153)	“very scarce, ” exclude from analyses	≤4 cm	NR	NR	NR	NR	NR	91.3% (126/138) (propensity score matched)	61.4% (94/153)*	24.8% (38/153)*	3.9% (6/153)**
Poletajew control n=274						69.5	73.4% (201/274)	–	–	–	–	–	–	–	68.8% (95/138)	46% (126/274)	21.1% (58/274)	11.7% (32/274)
RoB: in general = Moderate; Re-recurrence = Serious																		
Statistical significance						NS	NS	–	–	–	–	–	–	–	p<0.001	–	–	–

^Larger tumors were divided prior to extraction however (3cm cut off for Kramer). *Each individual lesion analysed rather than each patient hence bigger denominator. ~Lower rates of obturator reflex activation, however breakdown of lateral wall location unclear. **Remainder T0. ^^Additional papers by same author referenced but not tabulated as patient cohorts overlapping. Non-ran: non-randomized; NR: not reported; observ: observational; prosp: prospective; RCT: randomized controlled trial; RoB: risk of bias; X: excluded.

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Supplementary Table 2. Laser ERBT																			
Author	Laser	Yr	ERBT^n	Study design	cTURBT control group?	Age (avg)	Male %	Laser parameters	Feasibility	Max tumor size	Extraction	Anesthesia	Obturator reflex	Bladder perforation	Significant bleeding*	Muscularis propria identified in specimen?	pTa	pT1	≥pT2
Holmium laser																			
Kramer ⁴²	Holmium arm	2015	50	Prosp.	No	62.2	72% (36/50)	1-2 J 15-30Hz	98% (49/50)*	<4 cm	Specimen retrieval bags in some	NR	0	NR	2% (1/50)*	50/50 (100%)	58% (29/50)	42% (21/50)	0
Maheshwari ²²	Holmium	2020	67	Retro.	No	57.8	77.6% (52/67)	550 u 1-2 J 40-50 Hz	All	4 cm^	Ellik	General or regional	0	0	5.97% (4/67)	57/67 (85%)	82% (55/67)	17.9% (12/67)	X
Hashem ⁴	Holmium	2020	50	RCT	Yes	60.4	74% (37/50)	1-2J 10-15Hz 10-30W	All	<5 cm	Cold-crown loop	NR	0	0	0	98% (49/50)	4.5% (2/50)	95.5% (42/50)	4% (2/50)
Hashem control n = 50						61.1	78% (39/50)	-	-	-	-	-	24% (12/50)	12% (6/50)	6% (3/50)	62% (31/50)	6.1% (3/50)	93.9% (46/50)	0
RoB: in general = Low; Re-recurrence = Some concerns																			
Statistical significance						-	-	-	-	-	-	-	<0.001	-	NS	<0.001	NS	NS	NS
GreenLight laser																			
He ³⁵	GreenLight (KTP) front-firing	2014	45	Retro.	No	57.8	NR	0.6 J 50 Hz (30 W)	All, but wire loop coagulation required in 1	3 cm	Ellik	Continuous epidural	0	0	Irrigation n=1 Hb mean 1.1g/dL decrease	100% (45/45)	60% (27/45)	33.4% (15/45)	6.67% (3/45)
Chen ³⁴	GreenLight 6 F side-firing	2016	83	Prosp.	Yes	63.43	72.3% (60/83)	120-160 W (cut) 30-50 W (coag)	NR	3 cm	Ellik	Continuous epidural	0	0	NR (less Hb drop with LASER 0.87 vs. 1g/dL)	NR	84.3% (70/83)	15.6% (13/83)	0
Chen control n = 75						65.31	68% (51/75)	-	-	-	-	-	12% (9/75)	2.67% (2/75)		NR	85.3% (64/75)	14.7% (11/75)	0
RoB: in general = Low-moderate; Re-recurrence = Moderate																			
Statistical significance						-	-	-	-	-	-	-	0.001	NS	-	-	-	-	-
Cheng ³⁶	GreenLight front-firing	2017	34	Retro.	Yes	59.41	82.4% (28/34)	120 W	NR	3 cm	Ellik	Spinal / Epidural	0	NR	NR	97% (33/34)	41.2% (14/34)	16 (47.06%)	4 (11.76%)

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Cheng control n =30						63.1	90%	–	–	–	–	–	10	NR	NR	80%	43.33	50%	6.7%
RoB: in general = Moderate; Re-recurrence = NA						3	(27/30)									(24/30)	%	(15/30)	(2/30)
Statistical significance						–	–	–	–	–	–	–	p<0.001	–	–	p=0.04	NS	NS	NS
Liang ⁵²	GreenLight (KTP) front-firing	2019	88	Retro.	Yes	58	88.6%	0.6 J 50 Hz (30 W)	NR	NR	NR	NR	NR	NR	NR	30.7%	33%	67%	0
Liang control n= 70						–	–	–	–	–	–	–	–	–	–	11.4%	47.1%	52.9%	0
RoB: in general = Low; Re-recurrence = N/A						–	–	–	–	–	–	–	–	–	–	(8/70)	(33/70)	(37/70)	–
Statistical significance						–	–	–	–	–	–	–	–	–	–	Significant	NS	NS	–
Fan ³⁰	GreenLight Front firing	2021	116	RCT	Yes	60	83.2%	532nm 0.6J x 50Hz (30W)	Appears all	<3 cm	Via sheath /resection loop/Endobag	NR	0	0	NR (less EBL with Laser)	89.7%	78.5%	21.5%	X
Fan control n = 117						57	74%	–	–	–	–	–	7.7%	0.9%	–	71.8%	88.9%	11.1%	–
RoB: in general = Some concerns; Re-recurrence = Some concerns						–	(87/117)	–	–	–	–	–	(9/117)	(1/117)	–	(84/117)	(104/117)	(13/117)	–
Statistical significance						NS	–	–	–	–	–	–	0.002	NS	–	<0.005	0.031	–	–
Thulium laser																			
Muto ²³	Thulium-YAG	2014	55	Prosp.	No	68	89%	800 nm 30 W continuous wave (20 W pulsed-wave for coag)	All	4.5 cm ^	Grasper	Epidural	0	0	0	100%	56.4%	32.7%	10.9%
							(49/55)									(55/55)	(31/55)	(18/55)	(6/55)
Kramer ⁴²	Thulium arm	2015	15	Prosp.	No	69.4	80%	550 u 5–15 W	*	<4 cm ^	Specimen retrieval bags in some	NR	0	NR	*	100%	66.7%	33.3%	0
							(12/15)									(15/15)	(10/15)	(5/15)	
Migliari ⁴⁸	Thulium	2015	58	Prosp., non-ran (retro control)	Yes	71	70.7%	Continuous wave 30 W. 1470 nm diode for coagulation at	NR	4.5 cm	Via sheath with loop	Spinal	0	0	0	100%	56.4%	32.7%	10.9%
							(41/58)									(58/58)	(30/58)	(23/58)	(5/58)

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

(cTURBT electrocautery. Small lesions resected en bloc with loop)							(111/125)							(24/152)	(9/152)	(3/152)	(23 excluded due quality)	(87/152)	(48/152)	
RoB: in general = Moderate; Re-recurrence = Moderate-Serious																				
Statistical significance						NS	NS	-	-	-	-	-	-	<0.001	0.012	0.267**	0.001	NS	NS	-
Yang ²⁵	Thulium	2021	235	Retro.	No cTURBT control	65.7	79.1% (186/235)	NR	98% (249/254 original population)	3cm	Ellik or laparoscopic forceps	Spinal/epidural	0	0	NR	Muscle = Inclusion criterion but appears none of 254 excluded on this basis	81.7% (192/235)	18.3% (43/235)	X	
Other lasers																				
Chen ⁴⁹	2 Micron	2015	71	RCT	Yes	63	76% (54/71)	30 – 50 W	All	4cm	Extractor	Sacral block	0	-	0	NR	60.5% (43/71)	35.2% (25/71)	-	
Chen control n=71						62	71.8% (51/71)	-	-	-	-	-	25.4% (18/71)	0	0	NR	77.5% (55/71)	21.1% (15/71)	-	
RoB: in general = Some concerns; Re recurrence = Some concerns																				
Statistical significance						NS	NS						<0.001	NS	NS	-	-	p=0.047	-	
Severgin ^{a67}	2 Wave length	2018	34	Prosp.	No	NR	82.35% (28/34)	1.9 4um Th 1.5 6um Erb 1.0 J 10 Hz 1.94 um wave length	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Tao ⁵¹	980 nm wave	2020	36	NR	Yes	UK	UK	UK	UK	UK	UK	UK	None (0/36)	None (0/36)	UK	UK	UK	UK	UK	
Tao control n= 48						-	-	-	-	-	-	-	12.5% (6/48)	6.25% (3/48)	-	-	-	-	-	
RoB: in general = Moderate; Re-recurrence = Serious													Apparent (NR)	Apparent (NR)	-	-	-	-	-	
Statistical significance						-	-	-	-	-	-	-								

^aBleeding and conversion in Kramer paper expressed as LASER cohort – unclear if holmium or thulium arm. [^]Some large tumours divided within the bladder prior to extraction. ^{**}Less ‘gross haematuria’ with laser ERBT vs. cTURBT (38.1% vs. 96.7%, p<0.0001) in this study. ‘Significant bleeding’ in table refers to return to theatre. NR: not reported; Non-Ran: non-randomized; observ: observational; prosp: prospective; RCT: randomized controlled trial; RoB: risk of bias; X: excluded.

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Supplementary Table 3. Hydrodissection																	
Author	Yr	ERBT ^ (n)	Study design	Control group?	Age (Avg)	Male %	Feasibility	Max tumor Size	Extraction	Anesthesia	Obturator reflex	Bladder perforation	Significant bleeding*	Muscularis propria identified in specimen?	pTa	pT1	≥pT2
Nagele ⁵⁵	2011	5	Prosp.	No	77	80% (4/5)	100% (5/5)	2 cm	Endoscopic bag	NR	NR	None (0/5)	None (0/5)	NR (separate cold cup muscle biopsies taken)	100% (5/5)	0	0
Fritsche ⁵⁶	2011	17	Prosp.	No	NR	NR	17/17 (100%) ~	1.6 cm~	Endoscopic bag	NR	NR	None (0/17)	None (0/17)	All	41.2% (7/17)	29.4% (5/17)	5.9% (1/17)
Cheng ¹⁷	2018	95	Retro.	cTURBT	62.4	70.5% (67/95)	95/95 (100%)	4 cm	Nylon bag	Epidural	2.1% (2/95)	None (0/95)	None (0/95)	NR (separate cold cup muscle biopsies taken)	54.7% (52/95)	45.3% (43/95)	0
Cheng Control n=98					64.4	71.4% (70/98)	-	-	-	-	7.14% (7/98)	2% (2/98)	None (0/98)	NR	55.1% (54/98)	44.9% (44/98)	0
RoB: in general = Moderate; Re-recurrence = NA																	
Statistical significance					-	-	-	-	-	-	p=0.034 for complications overall			-	0.95		
Gakis ³³	2020	56	RCT	cTURBT	66.8	80.4% (45/56)	All - excluded if not	≥3 cm	Mixed	NR	NR	1.8% (1/56)	None (0/56)	77.4% (41/56)	89.3% (50/56)	10.7% (6/56)	0
Gakis Control n=59					70.2	79.7% (47/59)	-	-	Mixed	NR	NR	1.8% (1/56)	1.7% (1/59)	66.7% (36/59)	71.2% (42/59)	28.8% (17/59)	0
RoB: in general = Low; Re-recurrence = Some concerns																	
Statistical significance					-	-	-	-	-	NR	NR	p=1.0	p=0.49	p=0.28	P=0.02		-

^ERBT n = overall patient number. Multiple tumors were excised in some patients. *Significant bleeding as reported by authors or defined as need for transfusion or manual washout postoperatively. ~ 7.5 cm tumor resected but largest extracted en bloc was 1.6 cm. cTURBT: conventional TURBT (using electrocautery in piecemeal fashion). NR: not reported; Non-Ran: non-randomized; observ: observational; prosp: prospective; RCT: randomized controlled trial; RoB: risk of bias; X: excluded.

Croghan SM, et al. En bloc transurethral resection of bladder tumors: A review of current techniques

APPENDIX

Note all references can be found in the main article at cuaj.ca

Supplementary Table 4. Polypectomy snare																	
Author	Yr	ERBT [^] (n)	Study design	cTURBT control group?	Age (avg)	Male %	Feasibility	Max tumor size	Extraction	Anesthesia	Obturator reflex	Bladder perforation	Significant bleeding [^]	Muscularis propria identified in specimen?	pTa	pT1	≥pT2
Maurice ⁵⁷	2012	9	Retro.	No	NR	NR	All (pedunculated selected)	>5 cm	Snare or endoscopic mesh net	NR	None (0/9)	None (0/9)	0	50% polypectomy specimen Cold cup biopsy in addition -> 100%	NR	NR	NR
Adam ⁵⁸	2018	4 (18 lesions)	Prosp.	No	64.2	75% (3/4)	All selected lesions	2.6 cm	Stone basket	General	NR	None (0/4)	0	75% polypectomy specimen (3/4)	25% (1/4)	75% (3/4)	-
Hayashida ⁵⁹	2019	39	Prosp.	Yes	NR	61.5% (24/39)	All selected lesions	6 cm	NR	NR	NR	2.56% (1/39)	None (0/39)	All with en bloc base; not specified for polypectomy specimen	48.7% (19/39)	46.2% (18/39)	5.1% (2/39)
Hayashida control n=31					-	67.7% (21/31)	-	-	-	-	-	None (0/21)	None (0/21)	All; some cautery artefact	51.6% (16/21)	45.2% (14/21)	3.2% (1/21)
RoB: in general = Moderate; Re recurrence = Serious																	
Statistical significance					-	-	-	-	-	-	-	NR	-	-	-	-	-

Adam: Electrosurgical polypectomy snare plus standard TURBT of base. Maurice: Electrosurgical polypectomy snare plus cold cup biopsy base. Hayashida: Electrosurgical polypectomy snare plus en bloc TURBT of base. NR: not reported; RoB: risk of bias.