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ORIGINAL ARTICLE

A newly developed porcine training model for transurethral piecemeal and en bloc resection of bladder tumour

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Abstract

Purpose The Asian Urological Surgery Training & Education Group (AUSTEG) has been established to provide training and education to young urologists in Asia. We developed and validated a porcine bladder training model for transurethral resection of bladder tumour (TURBT).

Methods Urology residents and specialists were invited to test the training model. They were asked to complete a pre-task questionnaire, to perform piecemeal and en bloc resection of 'bladder tumours' within the training model, and to complete a post-task questionnaire afterwards. Their performances were assessed by faculty members of the AUSTEG. For the face validity, a pre-task questionnaire consisting of six statements on TURBT and the training model were set. For the content validity, a post-task questionnaire consisting of 14 items on the details of the training model were set. For the construct validity, a Global Rating Scale was used to assess the participants' performances. The participants were stratified into two groups (junior surgeons and senior surgeons groups) according to their duration of urology training.

Results For the pre-task questionnaire, a mean score of ≥ 4.0 out of 5.0 was achieved in 5 out of 6 statements. For the post-task questionnaire, a mean score of ≥ 4.5 out of 5.0 was achieved in every item. For the Global Rating Scale, the senior surgeons group had higher scores than the junior surgeons group in 8 out of 11 items as well as the total score.

Conclusion A porcine TURBT training model has been developed, and its face, content and construct validity has been established.

Keywords Bladder cancer · Bladder tumour · Training model · Education · TURBT · En bloc resection

Abbreviations

AUSTEG	Asian Urological Surgery Training & Education Group
TURBT	Transurethral resection of bladder tumour

Introduction

The Asian Urological Surgery Training & Education Group (AUSTEG) has been established since November 2015 with the faculty consisting of expert urologists from more than ten Asian regions. By organizing series of training courses,

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we nurture young urologists in Asia with knowledge and skills on various urological procedures. Hands-on training is important and realistic training models are needed for our participants to polish their surgical skills.

Transurethral resection of bladder tumour (TURBT) is one of the commonest urological procedures performed in our clinical practice. Conventionally, TURBT is performed in a piecemeal manner. Although the procedure is straightforward, it is difficult to ensure a good quality resection [1]. The experience of a surgeon has been shown to be associated with the treatment outcomes of bladder cancer following TURBT [2, 3]. In recent years, there has also been growing interest in en bloc resection of bladder tumour [4, 5]. In principle, en bloc resection is the ideal way to resect a bladder tumour. However, being a relatively new surgical technique, the opportunity to practise in training model becomes especially important to ensure a safe and proper resection in real-life clinical setting.

The AUSTEG has recently developed a porcine training model for TURBT. We believe it is an easy-to-build and low-cost training model which can be generalized for training purposes worldwide. We hereby present on how we build the training model and the results regarding its face, content and construct validity.

Methods

Preparation of the TURBT training model

A porcine training model for TURBT has been developed. Ex vivo porcine bladders were used for this training model. An anterior cystostomy was made near the bladder neck region (Fig. 1a). The endoluminal surface of the bladder was then everted inside out. Bladder mucosa was picked up with forceps and tied with sutures to create a 'bladder tumour' as a target for subsequent resection. Different sizes and clusters of 'bladder tumours' could be created at different locations of the bladder (Fig. 1b). The bladder was then reverted back to its normal position. The anterior cystostomy was closed with sutures to ensure water tightness. A training box was prepared and an entry site for the insertion of resectoscope was created (Fig. 1c). The bladder was put inside the training box and the urethra was brought through the entry site from inside out (Fig. 1d). Any excessive length of the urethra could be excised. A resectoscope could then be inserted into the porcine bladder via the urethra (Fig. 1e) for resection of the 'bladder tumours' (Fig. 1f). The bladder was wrapped around with a piece of cloth. The weight of the cloth could stabilize the bladder upon distension. A coloured cloth could be used to provide a visual feedback endoscopically when the bladder wall becomes too thin during resection. In case the bladder got perforated during resection, additional sutures could be applied and resection could be performed in other sites of the bladder. An endoscopic view of the resection bed inside the porcine bladder is shown in Fig. 2.

Face, content and construct validity

We invited urology residents and specialists to test the TURBT training model in three occasions, namely the AUSTEG Lower Urinary Tract Surgery Training Course which was held in Panyu (China) in May 2017, the 15th Urological Association of Asia Congress which was held in Hong Kong in August 2017, and another AUSTEG Lower Urinary Tract Surgery Training Course which was held in Hong Kong in November 2017.

Participants were first invited to watch a demonstration of the TURBT training model. They were then asked to fill in pre-task questionnaires regarding the face validity of the training model (Table 1). Six statements regarding the TURBT procedure and the TURBT training models were set, and participants were asked to comment on each statement using a Likert scale of 1 (Strongly disagree) to 5 (Strongly agree). The results would reflect on the face validity of the TURBT training model.

After completion of the pre-task questionnaires, they were asked to have hands-on experience on the TURBT training model. They were asked to perform both piecemeal and en bloc resection of 'bladder tumours' within the training model using bipolar resection loop electrodes. They were then asked to complete post-task questionnaires regarding the content validity of the training model (Table 2). Fourteen items regarding the details of the TURBT training model were listed, and participants were asked to comment on each item using a Likert scale of 1 (very unrealistic) to 5 (very realistic). The results would reflect on the content validity of the TURBT training model.

While the participants were performing piecemeal and en bloc resection, their performances would be assessed by faculty members of the AUSTEG. A Global Rating Scale for TURBT was constructed and used for the assessment (Table 3). The Global Rating Scale is composed of 11 items, and the faculty would score on each item using a Likert scale of 1–5. For subsequent analysis, the participants would be stratified into two groups, the junior surgeons and senior surgeons groups, according to the mean duration of urology training in the whole cohort. The Global Rating Scale scores of the two groups would then be compared using Mann–Whitney *U* test.

The pre-task questionnaire, post-task questionnaire and Global Rating Scale were developed and reviewed by the faculty members of the AUSTEG. The faculty members were considered expert urologists in Asia, and have the capacity to understand and formulate the essential components of TURBT.

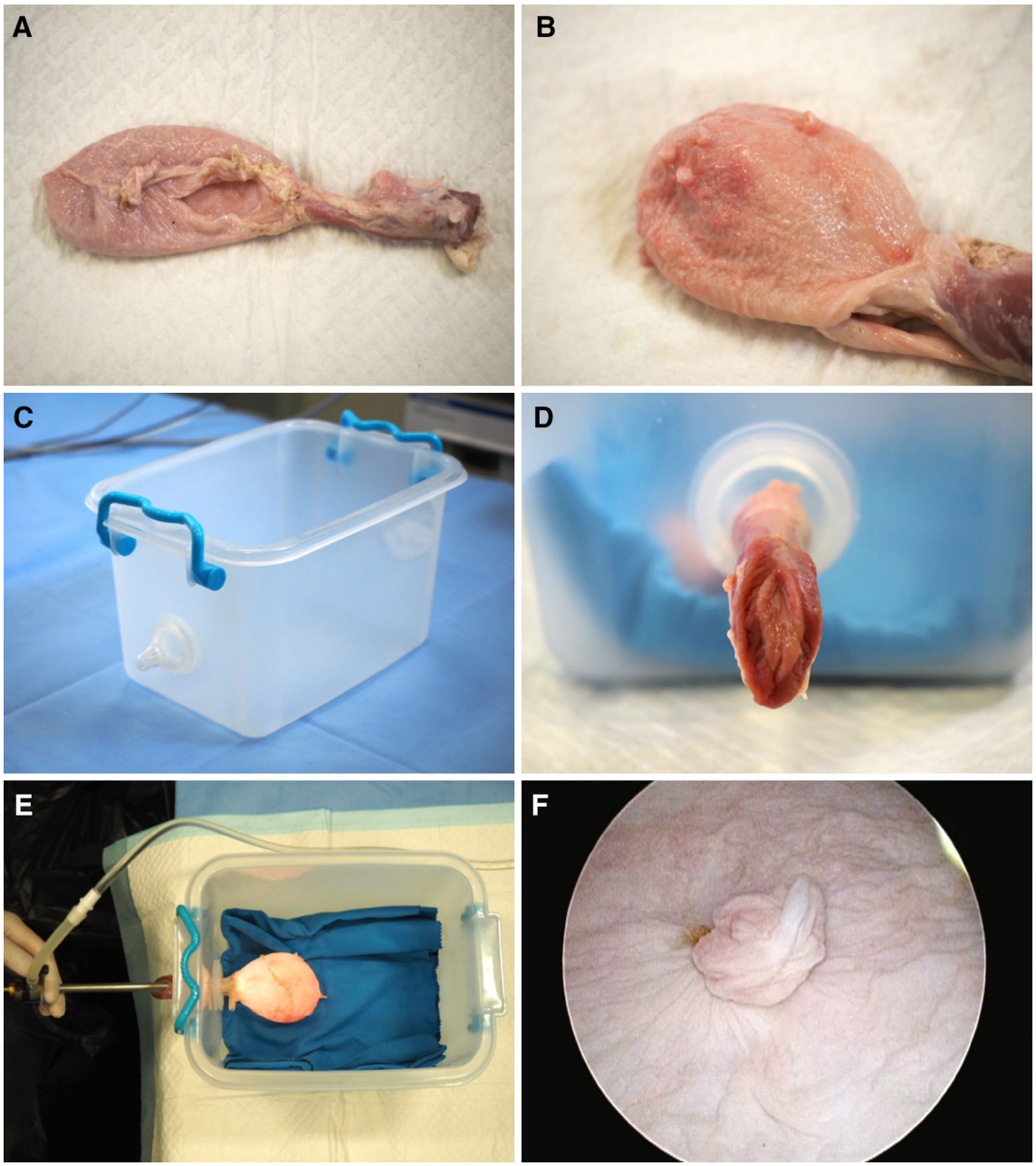

Fig. 1 **a** An ex vivo porcine bladder was used and an anterior cystotomy was made near the bladder neck region. **b** The porcine bladder was everted inside out and 'bladder tumours' were created. **c** A training box was prepared and an entry site for the insertion of resectoscope was created. **d** The porcine bladder was put inside the training box and the urethra was brought through the entry site from inside out. **e** A resectoscope could be inserted into the porcine bladder via the urethra. **f** 'Bladder tumours' could be resected

Results

Overview

A total of 46 urologists participated. Among them, the questionnaires from 6 urologists were found to have missing data and were excluded from subsequent analysis. A total of 40 urologists completed and returned both the pre-task and post-task questionnaires, resulting in a response rate of 87.0%. The mean age of the participants was 31.6 ± 3.1 years. The majority of them were male urologists (95.2%). The participants had a mean duration of urology training of 4.0 ± 2.9 years; 20 had < 4 years of urology training and 20 had ≥ 4 years of urology training.

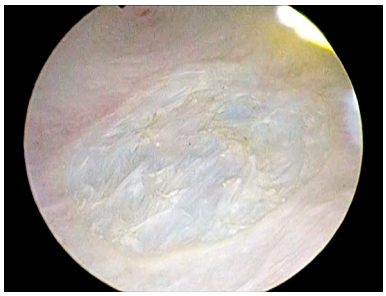

Fig. 2 An endoscopic view of the resection bed inside the porcine bladder

Face validity

For the pre-task questionnaires, the participants were neutral regarding the difficulty of TURBT, be it piecemeal or en bloc resection (mean score of 3.18 ± 0.93). The participants agreed that the most difficult part of the procedure is how to resect the bladder tumour at the correct depth (mean score of 4.13 ± 0.79). The participants agreed that the 'bladder tumour' in the training model is a good target for performing resection (mean score of 4.15 ± 0.70), and the TURBT training model allows piecemeal and en bloc resection that is similar to reality (mean score of 4.08 ± 0.69). Overall, the participants agreed that the TURBT training model is similar to reality (mean score of 4.08 ± 0.76), and it is useful for training purpose (mean score of 4.30 ± 0.65). The results confirmed the face validity of the TURBT training model (Table 4).

Content validity

For the post-task questionnaires, the participants agreed that anatomy and orientation of the training model were very realistic (mean score of 4.63 ± 0.59 and 4.65 ± 0.58). The use of resectoscope and endoscopic view of the 'bladder

Table 1 Pre-task questionnaire on the porcine training model for transurethral resection of bladder tumour

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. TURBT, either piecemeal or en bloc resection, is a difficult procedure	1	2	3	4	5
2. The most difficult part of the procedure is how to resect the bladder tumour at the correct depth	1	2	3	4	5
3. The "bladder tumour" in the TURBT training model is a good target for performing piecemeal and en bloc resection	1	2	3	4	5
4. The TURBT training model allows piecemeal and en bloc resection that is similar to reality	1	2	3	4	5
5. Overall speaking, the TURBT training model is similar to reality	1	2	3	4	5
6. The TURBT training model is useful for training purpose	1	2	3	4	5

Table 2 Post-task questionnaire on the porcine training model for transurethral resection of bladder tumour

	Very unrealistic	Unrealistic	Neutral	Realistic	Very realistic
1. Anatomy	1	2	3	4	5
2. Orientation	1	2	3	4	5
3. Use of resectoscope	1	2	3	4	5
4. Endoscopic view of the 'bladder tumour'	1	2	3	4	5
5. Use of foot pedal	1	2	3	4	5
6. Use of electrocautery	1	2	3	4	5
7. Auditory feedback from electrocautery	1	2	3	4	5
8. Piecemeal resection of the 'bladder tumour'	1	2	3	4	5
9. Tactile feedback during piecemeal resection of the 'bladder tumour'	1	2	3	4	5
10. En bloc resection of the 'bladder tumour'	1	2	3	4	5
11. Tactile feedback during en bloc resection of the 'bladder tumour'	1	2	3	4	5
12. Technical feasibility of the model	1	2	3	4	5
13. Utility of the model	1	2	3	4	5
14. Overall opinion	1	2	3	4	5

Table 3 Global Rating Scale for transurethral resection of bladder tumour

Respect for tissue	**1**	**2**	**3**	**4**	**5**
	Frequent use of unnecessary forces causing tissue damage		Some unnecessary forces causing tissue damage		Consistent careful tissue handling
Time and motion	**1**	**2**	**3**	**4**	**5**
	Many unnecessary movements		Some unnecessary movements		Clear economy of motion with maximal efficiency
Hand-eye coordination	**1**	**2**	**3**	**4**	**5**
	Often need to glance back and forth between the monitor and resectoscope		Sometimes need to glance back and forth between the monitor and resectoscope		Never need to glance back and forth between the monitor and resectoscope
Use of foot pedals	**1**	**2**	**3**	**4**	**5**
	Often need to search for the foot pedal		Sometimes need to search for the foot pedal		Never need to search for the foot pedal
Ability to perform piecemeal resection	**1**	**2**	**3**	**4**	**5**
	Unable to perform piecemeal resection		Barely able to perform piecemeal resection		Easily performs piecemeal resection
Ability to perform en bloc resection	**1**	**2**	**3**	**4**	**5**
	Unable to perform en bloc resection		Barely able to perform en bloc resection		Easily performs en bloc resection
Strategy	**1**	**2**	**3**	**4**	**5**
	Frequent interruption between steps		Some interruption between steps		No interruption between steps
Speed	**1**	**2**	**3**	**4**	**5**
	Very slow progress		Fair progress		Very fast progress
Need of assistance	**1**	**2**	**3**	**4**	**5**
	Frequent need of assistance		Sometimes need assistance		Does not need any assistance
Final result	**1**	**2**	**3**	**4**	**5**
	Unable to complete resection, or noted bladder perforation		Barely able to complete resection without perforation		Easily completes resection without bladder perforation
Overall performance	**1**	**2**	**3**	**4**	**5**
	Very poor		Fair		Very good

tumour' were very realistic (mean score of 4.83 ± 0.39 and 4.65 ± 0.53). The use of foot pedal, electrocautery and auditory feedback from electrocautery were very similar to reality (mean score of 4.80 ± 0.41, 4.78 ± 0.42 and 4.73 ± 0.45). The participants agreed that piecemeal resection of 'bladder tumour' and the tactile feedback during piecemeal resection were very realistic (mean score of 4.50 ± 0.64 and 4.58 ± 0.64). The participants agreed that en bloc resection of 'bladder tumour' and the tactile feedback during en bloc resection were very realistic (mean score of 4.73 ± 0.51 and 4.65 ± 0.53). The technical feasibility and the utility of the training model were very similar to reality (mean score of 4.65 ± 0.62 and 4.73 ± 0.51). Overall, the participants agreed that the training model is very realistic (mean score of 4.73 ± 0.45). The results confirmed the content validity of the TURBT training model (Table 4).

Construct validity

A Global Rating Scale for TURBT was used to assess our participants. The participants were divided into two groups,

Table 4 Results of the pre-task and post-task questionnaires

	Mean score ± SD
Pre-task questionnaire	
1. TURBT, either piecemeal or en bloc resection, is a difficult procedure	3.18 ± 0.93
2. The most difficult part of the procedure is how to resect the bladder tumour at the correct depth	4.13 ± 0.79
3. The "bladder tumour" in the TURBT training model is a good target for performing piecemeal and en bloc resection	4.15 ± 0.70
4. The TURBT training model allows piecemeal and en bloc resection that is similar to reality	4.08 ± 0.69
5. Overall speaking, the TURBT training model is similar to reality	4.08 ± 0.76
6. The TURBT training model is useful for training purpose	4.30 ± 0.65
Post-task questionnaire	
1. Anatomy	4.63 ± 0.59
2. Orientation	4.65 ± 0.58
3. Use of resectoscope	4.83 ± 0.39
4. Endoscopic view of the 'bladder tumour'	4.65 ± 0.53
5. Use of foot pedal	4.80 ± 0.41
6. Use of electrocautery	4.78 ± 0.42
7. Auditory feedback from electrocautery	4.73 ± 0.45
8. Piecemeal resection of the 'bladder tumour'	4.50 ± 0.64
9. Tactile feedback during piecemeal resection of the 'bladder tumour'	4.58 ± 0.64
10. En bloc resection of the 'bladder tumour'	4.73 ± 0.51
11. Tactile feedback during en bloc resection of the 'bladder tumour'	4.65 ± 0.53
12. Technical feasibility of the model	4.65 ± 0.62
13. Utility of the model	4.73 ± 0.51
14. Overall opinion	4.73 ± 0.45

with 20 in the junior surgeons group (< 4 years of urology training) and 20 in the senior surgeons group (≥ 4 years of urology training). The senior surgeons group had a higher score than the junior surgeons group for items including time and motion (4.20 ± 0.70 vs 3.70 ± 0.73, $p = 0.038$), hand–eye coordination (4.50 ± 0.61 vs 3.85 ± 0.75, $p = 0.005$), use of foot pedals (4.60 ± 0.60 vs 4.10 ± 0.72, $p = 0.016$), ability to perform piecemeal resection (4.60 ± 0.50 vs 3.90 ± 0.79, $p = 0.003$), strategy (4.30 ± 0.73 vs 3.85 ± 0.67, $p = 0.046$), speed (4.30 ± 0.80 vs 3.70 ± 0.66, $p = 0.014$), need of assistance (4.40 ± 0.82 vs 3.95 ± 0.76, $p = 0.036$) and final result (4.35 ± 0.59 vs 3.90 ± 0.72, $p = 0.041$). The senior surgeons group had a higher total score than the junior surgeons group (48.05 ± 6.47 vs 42.70 ± 6.94, $p = 0.021$). The results were summarized in Table 5.

Table 5 Results of the Global Rating Scale for the junior and senior surgeons groups

	Junior surgeons group ($n = 20$)	Senior surgeons group ($n = 20$)	p value
Respect for tissue	3.85 ± 0.67	4.25 ± 0.72	0.075
Time and motion	3.70 ± 0.73	4.20 ± 0.70	**0.038**
Hand–eye coordination	3.85 ± 0.75	4.50 ± 0.61	**0.005**
Use of foot pedals	4.10 ± 0.72	4.60 ± 0.60	**0.016**
Ability to perform piecemeal resection	3.90 ± 0.79	4.60 ± 0.50	**0.003**
Ability to perform en bloc resection	3.85 ± 0.67	4.20 ± 0.70	0.119
Strategy	3.85 ± 0.67	4.30 ± 0.73	**0.046**
Speed	3.70 ± 0.66	4.30 ± 0.80	**0.014**
Need of assistance	3.95 ± 0.76	4.40 ± 0.82	**0.036**
Final result	3.90 ± 0.72	4.35 ± 0.59	**0.041**
Overall performance	4.05 ± 0.83	4.35 ± 0.67	0.249
Total score	42.70 ± 6.94	48.05 ± 6.47	**0.021**

Bold p value of < 0.05 is considered to be statistically significant

Discussion

TURBT is one of the commonest urological procedures being performed in clinical practice. During conventional piecemeal resection, we aim to resect all visible bladder tumours completely down to the detrusor muscle layer to ensure proper staging of the disease and potential cure in case of non-muscle-invasive bladder cancer [1, 6]. The procedural steps are straightforward but difficult to master, and a proper piecemeal resection requires considerable judgment, experience and skills [1]. Previous studies showed that senior surgeons were more likely to obtain detrusor muscle in the TURBT specimen than junior surgeons, and the presence of detrusor muscle is an independent prognostic factor for disease recurrence at first follow-up flexible cystoscopy [2, 3]. The lack of detrusor muscle in the TURBT specimen also indicates the need of a second look TURBT, which carries significant impact on recurrence-free survival and progression-free survival [7, 8]. TURBT is a procedure that deserves more comprehensive training and the importance of having a high-quality piecemeal resection should not be overlooked.

In recent years, there has been increasing interest in en bloc resection of bladder tumour [4, 5, 9–12]. In principle, en bloc resection may have two potential advantages over piecemeal resection. First, the bladder tumour can be removed in one piece, and the bladder tumour specimen will remain intact for a proper histological assessment; complete tumour resection can be ascertained with the presence of clear resection margins. Second, with en bloc resection, tumour fragmentation can be avoided; the amount of floating tumour cells and the risk of tumour re-implantation can be minimized. A multi-centre randomized controlled trial showed that en bloc resection could achieve a higher rate of complete tumour resection than piecemeal resection [13]. It is a promising technique which may lead to significant clinical impact. On the other hand, the technical difficulty in performing en bloc resection should not be underestimated. The availability of high-quality training models may improve surgical quality as well as ensuring surgical safety [14, 15]. Being a relatively new procedure, appropriate training becomes especially important.

Several TURBT training models had been reported previously. The Uro Trainer (Karl Storz GmbH, Tuttlingen, Germany) is a virtual reality simulator for TURBT [16]. A previous study failed to demonstrate its face and content validity, and it is no longer commercially available [17]. The Simbla TURBT simulator (SAMED GmbH, Dresden, Germany) is a bench model consisting of a basic unit (Resection-Trainer LS10-31 2.0), which allows the placement of a bladder substrate resection [18]. Face, content and construct validity of this training model had been demonstrated [18]. However, the training model carries a cost of €3309 (USD 3898.7) for the simulator and €62 (USD 73.1) for a piece of bladder substrate [18]. The Bristol TURBT model (Limbs & Things, UK) is another bench model which had been used in a validated centralized simulation training programme [19]. However, an individual validation of the training model is lacking. A TURBT training model using porcine bladder had been reported previously, but the training model again lacks formal validation [20]. Moreover, en bloc resection has never been evaluated in any of the previous training models. Whether the training models can be used for training en bloc resection procedures is unknown.

Based on the limitations of the available TURBT training models, we decided to develop a new porcine TURBT training model and investigate its validity for training purposes (both piecemeal and en bloc resections). Pre-task questionnaire, post-task questionnaire and Global Rating Scale were carefully designed to test the validity of the training model. For the pre-task questionnaire, although the participants were rather neutral regarding the difficulty of the TURBT procedure, a mean score of ≥ 4.0 out of 5.0 was achieved in each of the remaining statements. For the post-task questionnaire, a mean score of ≥ 4.5 out of 5.0 was achieved in every item. Looking into the Global Rating Scale, the senior surgeons group had higher scores than the junior surgeons group in 8 out of 11 items. It is interesting to see that the senior surgeons group failed to demonstrate superiority in the 'ability to perform en bloc resection'. This may reflect that even senior surgeons may not have enough experience in performing this procedure. Nevertheless, the senior surgeons group had a higher total score than the junior surgeons groups. Based on the above results, we believed the face, content and construct validity of the porcine TURBT training model has been established. The proposed training model is easy to build, and carries a relatively low cost of USD 232 per model including the ex vivo porcine bladder. We believe the training model has a good generalizability for training purposes worldwide.

There are several limitations regarding the proposed training model and its validation process. First, the training model is an ex vivo model and no bleeding or obturator reflex will be encountered during resection. The endoscopic view will be clearer and resection cannot simulate the reality fully. Second, the porcine bladder is thinner than human bladder. Peri-vesical fat is also absent in porcine bladder. It is therefore more difficult to perform resection at the correct depth without perforating the porcine bladder, though it may be considered an advantage for training purposes. Third, the 'bladder tumours' being created cannot simulate natural bladder tumours fully. The straight urethra and the absence of prostate gland in the porcine model also cannot simulate a male human urinary

tract entirely, though our results showed that the different components of the training model were still considered to be very realistic.

In addition to face, content and construct validity, we hope to evaluate the predictive validity of the porcine TURBT training model in the future. This will require a carefully designed prospective study to evaluate the participants' performances before and after training. The AUSTEG is devoted to surgical education and we will continue to provide high-quality training opportunities to young urologists in Asia.

Conclusions

A porcine training model for TURBT has been developed, and its face, content and construct validity has been established. We believe it is an easy-to-build and low-cost model that can be generalized for training purposes worldwide.

Author contributions JYCT: project development, data collection, data analysis, manuscript writing. CLC: project development, data collection, manuscript writing. YW: project development, data collection, manuscript writing. SI: data analysis, manuscript editing. HYT: data analysis, manuscript editing. TAO: data analysis, manuscript editing. KK: data collection, manuscript editing. PSKC: data collection, manuscript editing. ESYC: project development, data collection, manuscript editing. CFN: project development, data collection, manuscript editing.

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to declare.

Research involving human participants and/or animals For this type of study formal consent is not required.

Informed consent For this type of study formal consent is not required.

References

1. Herr HW, Donat SM (2008) Quality control in transurethral resection of bladder tumours. BJU Int 102(9 Pt B):1242–1246. https://doi.org/10.1111/j.1464-410x.2008.07966.x
2. Mariappan P, Finney SM, Head E, Somani BK, Zachou A, Smith G, Mishriki SF, N'Dow J, Grigor KM, Edinburgh Urological Cancer G (2012) Good quality white-light transurethral resection of bladder tumours (GQ-WLTURBT) with experienced surgeons performing complete resections and obtaining detrusor muscle reduces early recurrence in new non-muscle-invasive bladder cancer: validation across time and place and recommendation for benchmarking. BJU Int 109(11):1666–1673. https://doi.org/10.1111/j.1464-410X.2011.10571.x
3. Mariappan P, Zachou A, Grigor KM, Edinburgh Urological Cancer G (2010) Detrusor muscle in the first, apparently complete transurethral resection of bladder tumour specimen is a surrogate marker of resection quality, predicts risk of early recurrence, and is dependent on operator experience. Eur Urol 57(5):843–849. https://doi.org/10.1016/j.eururo.2009.05.047
4. Kramer MW, Rassweiler JJ, Klein J, Martov A, Baykov N, Lusuardi L, Janetschek G, Hurle R, Wolters M, Abbas M, von Klot CA, Leitenberger A, Riedl M, Nagele U, Merseburger AS, Kuczyk MA, Babjuk M, Herrmann TR (2015) En bloc resection of urothelium carcinoma of the bladder (EBRUC): a European multicenter study to compare safety, efficacy, and outcome of laser and electrical en bloc transurethral resection of bladder tumor. World J Urol 33(12):1937–1943. https://doi.org/10.1007/s00345-015-1568-6
5. Kramer MW, Wolters M, Herrmann TR (2016) En bloc resection of bladder tumors: ready for prime time? Eur Urol 69(5):967–968. https://doi.org/10.1016/j.eururo.2016.01.004
6. Babjuk M, Bohle A, Burger M, Capoun O, Cohen D, Comperat EM, Hernandez V, Kaasinen E, Palou J, Roupret M, van Rhijn BW, Shariat SF, Soukup V, Sylvester RJ, Zigeuner R (2017) EAU guidelines on non-muscle-invasive Urothelial Carcinoma of the Bladder: update 2016. Eur Urol 71(3):447–461. https://doi.org/10.1016/j.eururo.2016.05.041
7. Divrik RT, Sahin AF, Yildirim U, Altok M, Zorlu F (2010) Impact of routine second transurethral resection on the long-term outcome of patients with newly diagnosed pT1 urothelial carcinoma with respect to recurrence, progression rate, and disease-specific survival: a prospective randomised clinical trial. Eur Urol 58(2):185–190. https://doi.org/10.1016/j.eururo.2010.03.007
8. Grimm MO, Steinhoff C, Simon X, Spiegelhalder P, Ackermann R, Vogeli TA (2003) Effect of routine repeat transurethral resection for superficial bladder cancer: a long-term observational study. J Urol 170(2 Pt 1):433–437. https://doi.org/10.1097/01.ju.0000070437.14275.e0
9. Chen X, Liao J, Chen L, Qiu S, Mo C, Mao X, Yang Y, Zhou S, Chen J (2015) En bloc transurethral resection with 2-micron continuous-wave laser for primary non-muscle-invasive bladder cancer: a randomized controlled trial. World J Urol 33(7):989–995. https://doi.org/10.1007/s00345-014-1342-1
10. Liu H, Wu J, Xue S, Zhang Q, Ruan Y, Sun X, Xia S (2013) Comparison of the safety and efficacy of conventional monopolar and 2-micron laser transurethral resection in the management of multiple nonmuscle-invasive bladder cancer. J Int Med Res 41(4):984–992. https://doi.org/10.1177/0300060513477001
11. Naselli A, Puppo P (2017) En bloc transurethral resection of bladder tumors: a new standard? J Endourol 31(S1):S20–S24. https://doi.org/10.1089/end.2016.0534
12. Teoh JYC, Herrmann TRW, Babjuk M et al (2018) Re: Valeria Panebianco, Yoshifumi Narumi, Ersan Altun, et al. Multiparametric Magnetic Resonance Imaging for Bladder Cancer: Development of VI-RADS (Vesical Imaging-Reporting And Data System). Eur Urol 74, 2018, 294–306. Eur Urol 74:294–306. https://doi.org/10.1016/j.eururo.2018.09.007
13. Gakis G, Karl A, Bertz S, Burger M, Fritsche HM, Hartmann A, Jokisch F, Kempkensteffen C, Miller K, Mundhenk J, Schneevoigt BS, Schubert T, Schwentner C, Wullich B, Stenzl A (2017) Transurethral en-bloc hydrodissection for non-muscle invasive bladder cancer: results of a randomized controlled trial. Eur Urol Suppl 16(3):1143–1144. https://doi.org/10.1016/s1569-9056(17)30713-3
14. Clarebrough E, Christidis D, Lindner U, Fernandes K, Fleshner N, Lawrentschuk N (2018) Analysis of a practical surgical skills laboratory for nerve sparing radical prostatectomy. World J Urol. https://doi.org/10.1007/s00345-018-2472-7
15. Van Bruwaene S, Namdarian B, Challacombe B, Eddy B, Billiet I (2018) Introducing new technology safely into urological practice. World J Urol 36(4):543–548. https://doi.org/10.1007/s00345-018-2173-2
16. Schout BM, Bemelmans BL, Martens EJ, Scherpbier AJ, Hendrikx AJ (2009) How useful and realistic is the uro trainer for

training transurethral prostate and bladder tumor resection procedures? J Urol 181(3):1297–1303. https://doi.org/10.1016/j.juro.2008.10.169 **(discussion 1303)**
17. Aydin A, Raison N, Khan MS, Dasgupta P, Ahmed K (2016) Simulation-based training and assessment in urological surgery. Nat Rev Urol 13(9):503–519. https://doi.org/10.1038/nrurol.2016.147
18. de Vries AH, van Genugten HG, Hendrikx AJ, Koldewijn EL, Schout BM, Tjiam IM, van Merrienboer JJ, Muijtjens AM, Wagner C (2016) The Simbla TURBT simulator in urological residency training: from needs analysis to validation. J Endourol 30(5):580–587. https://doi.org/10.1089/end.2015.0723
19. Shamim Khan M, Ahmed K, Gavazzi A, Gohil R, Thomas L, Poulsen J, Ahmed M, Jaye P, Dasgupta P (2013) Development and implementation of centralized simulation training: evaluation of feasibility, acceptability and construct validity. BJU Int 111(3):518–523. https://doi.org/10.1111/j.1464-410X.2012.11204.x
20. Schout B, Dolmans V, Bemelmans B, Schoot D, Scherpbier A, Hendrikx A (2008) Teaching diagnostic and therapeutic procedures of bladder pathology using a newly developed pig bladder model. J Endourol 22(11):2547–2553. https://doi.org/10.1089/end.2008.0316