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Title: Integration of Electroporation in Urological Practice: Design and Evaluation of a New Transurethral Electrode

Authors and Affiliations:

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Author Questionnaire

1. We have marked your project as author-provided footage, meaning you film the video yourself and provide JoVE with the footage to edit. JoVE will not send the videographer. Please confirm that this is correct.

✓ Correct

2. Interview statements: Which interview statement filming option is the most appropriate for your group? **Please select one.**



Interview Statements are read by JoVE's voiceover talent.

Current Protocol Length

Number of Steps: 20

Number of Shots: 27

Introduction

Authors: Please note that **the questions will not appear on screen**. Please answer in **stand-alone full sentence with sufficient context**.

INTRODUCTION:

REQUIRED: Summarize the research focus and the main questions this study aims to answer.

- 1.1. This study evaluates a transurethral electrode for electroporation in the porcine bladder, assessing usability, performance, and compatibility with standard urological techniques.

1.1.1. B roll: 3.2.1

Describe the research gap or limitation in existing methods and how this protocol addresses them.

- 1.2. Lack of suitable instruments has limited electroporation in the bladder; this protocol introduces a compatible, user-friendly electrode for transurethral application.

1.2.1. B roll: 2.2.1

CONCLUSION:

What does this protocol allow researchers to study or measure?

- 1.3. The protocol allows researchers to study usability, safety, and performance of transurethral calcium electroporation in a clinically relevant model.

1.3.1. B roll: 3.10.2

Describe the most important consideration or challenge when performing this protocol.

- 1.4. During the treatment, precise electrode placement and clear visualization is important to ensure accurate pulse delivery and effective treatment.

1.4.1. B roll: 3.5.1

~~How can future studies build on this work? Describe the questions or research directions that can be investigated next.~~

- 1.5. Future research will include first-in-human studies to evaluate the clinical safety, feasibility, and therapeutic effectiveness of calcium electroporation for treating urinary bladder tumors.

1.5.1. B roll: 3.8.1

Ethics Title Card

This research has been approved by the Danish Animal Experiments Inspectorate, a division of the Danish Veterinary and Food Administration

Protocol

2. Instrumentation Setup and Preparation for Transurethral Electroporation

Demonstrators: Juan Luis Vásquez and Rose Bryde Laursen

- 2.1. To begin, gather the required equipment for the procedure [1]. Insert the telescope into a bridge with a working channel and insert the instruments into the sheath [2].
 - 2.1.1. WIDE: LAB MEDIA: IMG_5896_indføring_og_kalcium 00:00 – 00:05 *Video editor: Please crop out the animal shown at the left or blur it completely. Show only the talents with wires and telescope equipment*
 - 2.1.2. LAB MEDIA: IMG_0003 00:00 – 00:18
- 2.2. For saline, connect to the irrigation system on the sheath with an intravenous tubing set [1].
 - 2.2.1. LAB MEDIA: IMG_0038 00:00 – 00:06
- 2.3. After filling the tube with saline and displacing the air, attach the camera head and lighting cable to the telescope base [1].
 - 2.3.1. LAB MEDIA: IMG_0047 00:00 – 00:13
- 2.4. Connect the sterile insulated cable at the electrode handle to the clean insulated cable at the external pulse generator [1].
 - 2.4.1. LAB MEDIA: IMG_0041 00:03 – 00:14 and IMG_0043 00:00 – 00:04
- 2.5. Set 8 pulses of 100 microseconds, set frequency to 5000 hertz, and voltage to 400 volts correlating to 1000 volts per centimeter voltage to electrode distance ratio in the designated fields on the screen [1].
 - 2.5.1. LAB MEDIA: IMG_0046 00:00 – 00:03 *Video editor: Highlight the box on the right labelled “High Voltage Pulses”*
- 2.6. Remove the cystoscopy needle from the sterile package [1] and adjust the needle-tip length to 2 millimeters [2].

2.6.1. LAB MEDIA: IMG_0022 00:00 – 00:10

2.6.2. LAB MEDIA: IMG_0024 00:01 – 00:04 and IMG_0028 Timestamps: 00:01 – 00:04

2.7. Acquire a bottle of calcium gluconate 100 milligram per milliliter [1] and Fill one or more syringes with the needed calcium gluconate [2].

2.7.1. LAB MEDIA: IMG_0031 00:00 – 00:05

2.7.2. LAB MEDIA: IMG_0031 00:06 – 00:16

2.8. Connect the syringe preferably with luer-lock-type syringe to the distal end of the cystoscopy needle [1].

2.8.1. LAB MEDIA: IMG_0034 00:00 – 00:04

3. Cystoscopic Access, Calcium Injection, and Transurethral Electroporation

3.1. Position the pig on the operating table and prepare it for the procedure [1].

3.1.1. TEXT ON PLAIN BACKGROUND:

- Anesthesia: I.v. propofol ($0.3\text{--}0.5\text{ mg}\cdot\text{kg}^{-1}$) + sevoflurane in 60% O₂ for a tidal volume of $10\text{ mL}\cdot\text{kg}^{-1}$
- Place the pig in dorsal lithotomy position at the table edge
- Place drainage pouch underneath
- Clean vulva with soap and water
- Instill urethral gel for disinfection and analgesia

3.2. Open the irrigation system on the resectoscope and confirm saline flow [1].

3.2.1. LAB MEDIA: IMG_0048 00:00 – 00:06

3.3. Insert the resectoscope visually guided through the urethra into the urinary bladder [1].

3.3.1. LAB MEDIA: IMG_5896_indføring_og_kalcium 02:48 – 02:56

3.4. Insert the cystoscopy needle through the working channel of the bridge and visualize

the tip of the needle [1]. Perform cystoscopy on the animal and inspect the urinary bladder [2].

3.4.1. LAB MEDIA: IMG_0029 00:00 – 00:16

3.4.2. LAB MEDIA: Gris2 00:43 – 00:50

3.5. Now, inject 0.3 milliliters of 100 milligram per milliliter calcium gluconate [1] into the bladder wall to produce a vesicle in the bladder wall [2-TXT].

3.5.1. LAB MEDIA: IMG_0035 00:00 – 00:07

3.5.2. LAB MEDIA: Gris2 01:30 – 01:38 **TXT: Repeat the calcium injection as needed**

3.6. Remove the telescope, leaving the outer protective sheath in the urethra [1].

3.6.1. LAB MEDIA: Gris3 21:40 – 21:47

3.7. Next, Remove the bridge [1] and insert the telescope into the transurethral electrode [2].

3.7.1. LAB MEDIA: IMG_0010 00:00 – 00:10

3.7.2. LAB MEDIA: IMG_0014 00:00 – 00:09

3.8. Insert the telescope and the electrode in the sheath to the bladder under visual guidance [1].

3.8.1. LAB MEDIA: Gris2 08:23 – 08:29

3.9. Place the electrode needle in the tissue covering the area injected with calcium gluconate [1].

3.9.1. LAB MEDIA: Gris4 10:05 – 10:19

3.10. Then, apply the electric pulses either using the foot pedal [1], or let a non-sterile assistant operate the external pulse generator to apply the pulses [2-TXT].

3.10.1. LAB MEDIA: IMG_5900_ny_elek_minus_penetration 10:48 – 10:52

3.10.2. LAB MEDIA: IMG_5900_ny_elek_minus_penetration 09:54 – 10:00 **TXT: Mild muscle contractions may appear during pulse delivery**

3.11. Confirm completion of the electric pulses and successful pulse delivery by reading the pulses generated and delivered on the external pulse generator [1].

3.11.1. LAB MEDIA: IMG_5900_ny_elek_minus_penetration 11:01 – 11:03

3.12. Finally, remove the telescope and electrode when every area injected with calcium gluconate has been electroporated [1-TXT].

3.12.1. LAB MEDIA: IMG_5900_ny_elek_minus_penetration 12:00 – 12:05 **TXT:**
Provide post-procedural care to the animal

Authors: As there are no data figures in your manuscript, we are skipping the results section

1. Instrumentation
Pronunciation link: <https://www.merriam-webster.com/dictionary/instrumentation>
IPA: / ˌɪn.strə.mənˈteɪ.ʃən/
Phonetic Spelling: in·struh·men·tay·shuhn
2. Transurethral
Pronunciation link: <https://www.merriam-webster.com/dictionary/transurethral>
IPA: / ˌtrænz.jʊˈriː.θrəl/
Phonetic Spelling: tranz·yoo·ree·thrul
3. Electroporation
Pronunciation link: <https://www.merriam-webster.com/dictionary/electroporation>
IPA: / ɪˌlek.troʊ.pəˈreɪ.ʃən/
Phonetic Spelling: ih·lek·troh·puh·ray·shuhn
4. Irrigation
Pronunciation link: <https://www.merriam-webster.com/dictionary/irrigation>
IPA: / ˌɪr.əˈgeɪ.ʃən/
Phonetic Spelling: ir·uh·gay·shuhn
5. Intravenous
Pronunciation link: <https://www.merriam-webster.com/dictionary/intravenous>
IPA: / ˌɪn.trəˈviː.nəs/
Phonetic Spelling: in·truh·vee·nuhs
6. Electrode
Pronunciation link: <https://www.merriam-webster.com/dictionary/electrode>
IPA: / ɪˌlek.troʊd/
Phonetic Spelling: ih·lek·trohd
7. Insulated
Pronunciation link: <https://www.merriam-webster.com/dictionary/insulated>
IPA: / ˈɪn.səˌleɪ.tɪd/
Phonetic Spelling: in·suh·lay·tuhd

8. Generator
Pronunciation link: <https://www.merriam-webster.com/dictionary/generator>
IPA: /'dʒen.ə.reɪ.tər/
Phonetic Spelling: jen·uh·ray·ter
9. Microseconds
Pronunciation link: <https://www.merriam-webster.com/dictionary/microsecond>
IPA: /'maɪ.kroʊ.sɛk.ənd/
Phonetic Spelling: my·kroh·sek·uhndz
10. Hertz
Pronunciation link: <https://www.merriam-webster.com/dictionary/hertz>
IPA: /hɜːts/
Phonetic Spelling: herts
11. Voltage
Pronunciation link: <https://www.merriam-webster.com/dictionary/voltage>
IPA: /'voʊl.tɪdʒ/
Phonetic Spelling: vohl·tij
12. Cystoscopy
Pronunciation link: <https://www.merriam-webster.com/dictionary/cystoscopy>
IPA: /sɪ'stɑː.skə.pi/
Phonetic Spelling: sis·tos·kuh·pee
13. Millimeters
Pronunciation link: <https://www.merriam-webster.com/dictionary/millimeter>
IPA: /'mɪl.ə.mi:.tər/
Phonetic Spelling: mil·uh·mee·terz
14. Calcium
Pronunciation link: <https://www.merriam-webster.com/dictionary/calcium>
IPA: /'kæl.si.əm/
Phonetic Spelling: kal·see·uhm
15. Gluconate
Pronunciation link: <https://www.merriam-webster.com/dictionary/gluconate>
IPA: /'glu:.kə.nɛt/
Phonetic Spelling: gloo·kuh·nayt
16. Syringes
Pronunciation link: <https://www.merriam-webster.com/dictionary/syringe>
IPA: /sə'rɪndʒ/
Phonetic Spelling: suh·rinj·iz
17. Luer-lock
Pronunciation link: <https://www.howtopronounce.com/luer-lock>
IPA: /'lu:.ər.lɒk/
Phonetic Spelling: loo·er·lok
18. Distal
Pronunciation link: <https://www.merriam-webster.com/dictionary/distal>
IPA: /'dɪs.təl/
Phonetic Spelling: dis·tuhl

19. Resectoscope
 Pronunciation link: <https://www.howtopronounce.com/resectoscope>
 IPA: /rɪˈsek.təˌskoʊp/
 Phonetic Spelling: ri·sek·tuh·skohp
20. Urethra
 Pronunciation link: <https://www.merriam-webster.com/dictionary/urethra>
 IPA: /jʊˈriːθrə/
 Phonetic Spelling: yoo·ree·thruh
21. Vesicle
 Pronunciation link: <https://www.merriam-webster.com/dictionary/vesicle>
 IPA: /ˈves.ɪ.kəl/
 Phonetic Spelling: ves·ih·kuhl
22. Anesthesia
 Pronunciation link: <https://www.merriam-webster.com/dictionary/anesthesia>
 IPA: /ˌæn.əsˈθiː.ʒə/
 Phonetic Spelling: an·uhs·thee·zhuh
23. Propofol
 Pronunciation link: <https://www.merriam-webster.com/medical/propofol>
 IPA: /ˈproʊ.pəˌfɔːl/
 Phonetic Spelling: proh·puh·fawl
24. Sevoflurane
 Pronunciation link: <https://www.merriam-webster.com/medical/sevoflurane>
 IPA: /ˌsev.ooˈflʊr.eɪn/
 Phonetic Spelling: sev·oh·floor·ayn
25. Lithotomy
 Pronunciation link: <https://www.merriam-webster.com/dictionary/lithotomy>
 IPA: /lɪˈθɑː.tə.mi/
 Phonetic Spelling: li·thaa·tuh·mee
26. Analgesia
 Pronunciation link: <https://www.merriam-webster.com/dictionary/analgesia>
 IPA: /ˌæn.əlˈdʒiː.zi.ə/
 Phonetic Spelling: an·uhl·jee·zee·uh
27. Cystoscopic
 Pronunciation link: <https://www.merriam-webster.com/medical/cystoscopic>
 IPA: /ˌsɪs.təˈskaː.pɪk/
 Phonetic Spelling: sis·tuh·skah·pik
28. Electroporated
 Pronunciation link: <https://www.howtopronounce.com/electroporated>
 IPA: /ɪˈlek.troʊ.pəˌreɪ.tɪd/
 Phonetic Spelling: ih·lek·troh·por·ay·tuhd