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Title: Posterior Approach for Microsurgical Resection of a Ventrolateral Cervical Ganglioneuroma: An Illustrative Case and Technical Report

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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

☐ Incorrect

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: 07

Number of Shots: 19

Interviews

NOTE to VO producer: Please generate VO for interviews

INTRODUCTION:

REQUIRED: Briefly describe the clinical case presented in this video and the treatment approach used.

- 1.1. This study presents a 4-year-old female with a large intradural extramedullary tumor in the ventrolateral cervical spine, causing severe spinal cord compression. A posterior midline approach with C2-C6 laminoplasty was performed to achieve gross-total resection.

1.1.1. B: Roll: 2.1.1

Describe the pre-operative features observed in this case.

- 1.2. Preoperative MRI demonstrated an intradural extramedullary dumbbell-shaped mass extending from C2 to C5. The lesion showed foraminal extension into the right C3–C4 neural foramen. There was severe spinal cord displacement with associated myelomalacia.

1.2.1. B: Roll: Figure 1

Explain what treatment approach was selected for this particular case.

- 1.3. Surgical resection of the tumor was recommended to decompress the spinal cord. A laminoplasty was planned following tumor removal to restore the posterior cervical elements. This approach provided exposure of the entire dorsal canal and direct access to the largest component of the tumor.

CONCLUSION:

Describe any important challenges or complications encountered during treatment and how they were managed

- 1.4. To safely resect the tumor, meticulous arachnoid dissection with progressive CSF release was essential to minimize spinal cord retraction. Continuous intraoperative neurophysiological monitoring and periodic micro-Doppler assessment helped protect the spinal cord and vertebral artery.

1.4.1. B: Roll: 2.4.3

Summarize the key clinical lessons or takeaways from this case for other clinicians

- 1.5. Posterior midline laminoplasty provides a safe and effective approach for resecting a ventrolateral cervical ganglioneuroma and may be applicable to other ventrolateral intradural extramedullary tumors.

1.5.1. B: Roll: 2.7.1

Describe any further investigation or follow-up that would be relevant based on this case.

- 1.6. Future studies with larger cohorts are needed to define long-term neurological outcomes, deformity rates and recurrence data in pediatric patients treated with this technique.

1.6.1. B: Roll: Figure 3

Ethics Title Card

This research has been approved by the Institutional Review Board (IRB) of Dell Children's Medical Center

Protocol

Authors: I have moved the previous text cards as the introduction statements, please check.

NOTE: The authors are very particular about the **timestamps** and the **text cards**. Please try to cover most of the timestamps in the video and make sure to include the ending timestamps to show step completion. Please avoid cutting the footage in the middle

2. Microsurgical Resection of the Cervical Ganglioneuroma

Demonstrator: Kevin Kumar

2.1. After the intradural exposure, the tumor was identified [1-TXT]. Using sharp microsurgical dissection, a circumferential plane around the tumor capsule was developed [2].

2.1.1. LAB MEDIA: Segment 1) 00:05-00:20 **TXT: See the text protocol for intraoperative neurophysiological monitoring and patient positioning**

2.1.2. LAB MEDIA: Segment 1) 04:45-04:55 and Segment 2) 02:10-02:15

2.2. The tumor capsule was coagulated with bipolar electrocautery [1]. The tumor capsule was opened using microscissors [2]. A specimen of the capsule contents was sent for intraoperative frozen-section analysis to guide the extent of resection [3].

2.2.1. LAB MEDIA: Segment 3) 00:30-00:35

2.2.2. LAB MEDIA: Segment 3) 00:41-00:47

2.2.3. LAB MEDIA: Segment 4) 00:26-00:33

2.3. The tumor was progressively debulked using Penfield dissectors and a low-amplitude ultrasonic aspirator [1]. Removal of the central tumor resulted in progressive medialization and decompression of the thecal sac [2], improving access to the tumor periphery [3].

2.3.1. LAB MEDIA: Segment 4) 02:30-02:38 and Segment 5) 01:32-01:40

2.3.2. LAB MEDIA: Segment 6) 00:10-00:16

2.3.3. LAB MEDIA: Segment 6) 04:42-04:50 and Segment (7) 02:28-02:35

2.4. After adequate internal debulking of the intradural component, the foraminal tumor extension was addressed [1]. The foraminal component of the tumor capsule was coagulated [2] and then resected using microscissors [3]. Lateral drilling in the foramen was avoided to prevent an inadvertent injury to the vertebral artery [4].

2.4.1. LAB MEDIA: Segment 8) 01:40-01:55

2.4.2. LAB MEDIA: Segment 8) 04:05-04:15 and Segment 9) 01:13-01:23

2.4.3. LAB MEDIA: Segment 8) 04:25-04:35 and Segment 9) 03:36-03:46

2.4.4. LAB MEDIA: Segment 10) 03:30-03:35

2.5. Before and during the foraminal dissection, intraoperative micro-Doppler was used to confirm the position of the vertebral artery [1]. Safe dissection limits were defined based on the position of the vertebral artery [2].

2.5.1. LAB MEDIA: Segment 10) 00:27-00:37

2.5.2. LAB MEDIA: Segment 10) 03:40-03:50

2.6. A final intraoperative ultrasound examination was performed to assess the extent of the resection, the re-expansion of the spinal cord, and the restoration of the cerebrospinal fluid spaces [1]. The tumor bed was inspected under high-power microscopic magnification for any residual tumor or bleeding [2].

2.6.1. LAB MEDIA: Segment 11) 00:41-00:50

2.6.2. LAB MEDIA: Segment 11) 03:38-03:43

2.7. Hemostasis was achieved with gentle bipolar coagulation at a low voltage [1]. The intradural space was irrigated with warm normal saline [2-TXT].

2.7.1. LAB MEDIA: Segment 12) 04:05-04:15

2.7.2. LAB MEDIA: Segment 13) 01:58-02:03 **TXT: See the text protocol for the laminoplasty reconstruction and postoperative care**

TEXT card:

Postoperative Care and Early Recovery

- Extubated after completion of the procedure
- Transferred to the intensive care unit in stable condition
- Mean arterial pressure maintained at the upper end of age-adjusted normal parameters
- Dexamethasone administered with a 3-day taper
- Physical and occupational therapy initiated
- Discharged home on postoperative day 3
- Full strength restored in all four extremities

Authors: Would it be acceptable to replace this text-heavy slide with a simple on-screen text overlay that reads:

"Refer to the text protocol for postoperative management and follow-up details."

This approach would help maintain the visual flow of the video while still directing viewers to the complete postoperative information provided in the manuscript.

Author's Response: It is important to report the immediate results of the surgical approach and how the patient recovered. We advocate for including this information in the video.

Results

3. Results

3.1. Histopathology of the resected mass confirmed a mature ganglioneuroma without malignant transformation [1].

3.1.1. LAB MEDIA: Figure 2.

3.2. Postoperative MRI confirmed gross total resection of the neoplasm [1] with decompression of the spinal cord [2].

3.2.1. LAB MEDIA: Figure 3 **edited**. *Video editor: Highlight the first 2 images and the red box.*

3.2.2. LAB MEDIA: Figure 3 **edited**. *Video editor: Highlight the right most image with the red box.*

3.3. At the 6-month follow-up, the patient demonstrated marked neurologic recovery and full strength in all extremities and had returned to normal activities, including running and playing soccer [1].

3.3.1. LAB MEDIA: Figure 3

1. Intradural

Pronunciation link: <https://www.merriam-webster.com/medical/intradural>

IPA: /ˌɪn.trəˈdʊr.əl/, /ˌɪn.trəˈdjʊr.əl/

Phonetic Spelling: in·truh·DOOR·uhl

2. Extradural

Pronunciation link: <https://www.merriam-webster.com/medical/extradural>

IPA: /ˌɛk.strəˈmed.əl.ər.i/, /ˌɛk.strəˈmedʒ.əl.ər.i/, /ˌɛk.strə.məˈdʌl.ər.i/

Phonetic Spelling: ek·struh·MED·uhl·air·ee / ek·struh·MEJ·uh·lair·ee /

ek·struh·muh·DUL·uh·ree

3. Ventrolateral

Pronunciation link: No confirmed link found

IPA: /ˌven.troʊˈlæt.ər.əl/

Phonetic Spelling: ven·troh·LAT·uh·ruhl

4. Cervical

Pronunciation link: <https://www.merriam-webster.com/dictionary/cervical>

- IPA: /'sɜː.vɪ.kəl/, /sɜː'vaɪ.kəl/
Phonetic Spelling: SUR·vih·kuhl / sur·VY·kuhl
5. Laminoplasty
Pronunciation link: No confirmed link found
IPA: /'læm.i.noʊ.plæs.ti/
Phonetic Spelling: LAM·ih·noh·plas·tee
 6. Foraminal
Pronunciation link: No confirmed link found
IPA: /fə'ræm.i.nəl/
Phonetic Spelling: fuh·RAM·ih·nuhl
 7. Myelomalacia
Pronunciation link: No confirmed link found
IPA: /,maɪ.ə.loʊ.mə'leɪ.ʃə/
Phonetic Spelling: my·uh·loh·muh·LAY·shuh
 8. Ganglioneuroma
Pronunciation link: <https://www.merriam-webster.com/medical/ganglioneuroma>
IPA: /,gæŋ.gli.oʊ.nə'roʊ.mə/, /,gæŋ.gli.oʊ.njə'roʊ.mə/
Phonetic Spelling: gang·glee·oh·noo·ROH·muh / gang·glee·oh·nyoo·ROH·muh
 9. Arachnoid
Pronunciation link: <https://www.merriam-webster.com/dictionary/arachnoid>
IPA: /ə'ræk.nɔɪd/
Phonetic Spelling: uh·RAK·noyd
 10. Cerebrospinal
Pronunciation link: <https://www.merriam-webster.com/dictionary/cerebrospinal>
IPA: /sə'riː.broʊ'spaɪ.nəl/, /,ser.ə.broʊ'spaɪ.nəl/
Phonetic Spelling: suh·ree·broh·SPY·nuhl / ser·uh·broh·SPY·nuhl
 11. Neurophysiological
Pronunciation link: No confirmed link found
IPA: /,nɔr.oʊ'fɪz.i.ə'lɑː.dʒɪ.kəl/
Phonetic Spelling: nur·oh·fiz·ee·uh·LAH·jih·kuhl
 12. Micro-Doppler
Pronunciation link: No confirmed link found
IPA: /,maɪ.kroʊ'dɑː.plər/
Phonetic Spelling: my·kroh·DAH·plur
 13. Vertebral
Pronunciation link: <https://www.merriam-webster.com/dictionary/vertebral>
IPA: /'vɜː.tə.brəl/, /vɜː'tiː.brəl/
Phonetic Spelling: VUR·tuh·bruhl / vur·TEE·bruhl
 14. Neurological
Pronunciation link: <https://www.merriam-webster.com/dictionary/neurological>
IPA: /,nɔr.ə'lɑː.dʒɪ.kəl/
Phonetic Spelling: nur·uh·LAH·jih·kuhl
 15. Intraoperative
Pronunciation link: No confirmed link found

- IPA: /ˌɪn.trəˈɑː.pər.ə.tɪv/
Phonetic Spelling: in·truh·AH·puh·ruh·tiv
16. Neuromonitoring
Pronunciation link: No confirmed link found
IPA: /ˌnɒr.oʊˈmɑː.nə.tər.ɪŋ/
Phonetic Spelling: nur·oh·MAH·nih·tur·ing
17. SSEP
Pronunciation link: No confirmed link found
IPA: /ˌes.es.iːˈpiː/
Phonetic Spelling: ess·ess·ee·PEE
18. MEP
Pronunciation link: No confirmed link found
IPA: /ˌem.iːˈpiː/
Phonetic Spelling: em·ee·PEE
19. Microsurgical
Pronunciation link: No confirmed link found
IPA: /ˌmaɪ.kroʊˈsɜː.dʒɪ.kəl/
Phonetic Spelling: my·kroh·SUR·jih·kuhl
20. Circumferential
Pronunciation link: <https://www.merriam-webster.com/dictionary/circumferential>
IPA: /ˌsɜː.kəm.fəˈren.ʃəl/
Phonetic Spelling: sur·kum·fuh·REN·shuhl
21. Bipolar
Pronunciation link: <https://www.merriam-webster.com/dictionary/bipolar>
IPA: /baɪˈpoʊ.lər/
Phonetic Spelling: by·POH·lur
22. Electrocautery
Pronunciation link: No confirmed link found
IPA: /ɪˌlek.troʊˈkɔː.tər.i/
Phonetic Spelling: ih·lek·troh·KAW·tuh·ree
23. Microscissors
Pronunciation link: No confirmed link found
IPA: /ˌmaɪ.kroʊˈsɪz.ərz/
Phonetic Spelling: my·kroh·SIZ·urz
24. Frozen-section
Pronunciation link: No confirmed link found
IPA: /ˈfroʊ.zən ˌsek.ʃən/
Phonetic Spelling: FROH·zuhn·SEK·shuhn
25. Penfield
Pronunciation link: No confirmed link found
IPA: /ˈpen.fiːld/
Phonetic Spelling: PEN·feeld
26. Ultrasonic
Pronunciation link: <https://www.merriam-webster.com/dictionary/ultrasonic>

- IPA: /ˌʌl.trəˈsɑː.nɪk/
Phonetic Spelling: ul·truh·SAH·nik
27. Aspirator
Pronunciation link: <https://www.merriam-webster.com/dictionary/aspirator>
IPA: /ˈæs.pəˌreɪ.tər/
Phonetic Spelling: AS·puh·ray·tur
28. Medialization
Pronunciation link: No confirmed link found
IPA: /ˌmiː.di.ə.ləˈzeɪ.ʃən/
Phonetic Spelling: mee·dee·uh·luh·ZAY·shuhn
29. Thecal
Pronunciation link: No confirmed link found
IPA: /ˈθiː.kəl/
Phonetic Spelling: THEE·kuhl
30. Hemostasis
Pronunciation link: <https://www.merriam-webster.com/dictionary/hemostasis>
IPA: /ˌhiː.məˈsteɪ.sɪs/
Phonetic Spelling: hee·muh·STAY·suhs
31. Dexamethasone
Pronunciation link: <https://www.merriam-webster.com/dictionary/dexamethasone>
IPA: /ˌdek.səˈmeθ.əˌsoʊn/, /ˌdek.səˈmeθ.əˌzoʊn/
Phonetic Spelling: dek·suh·METH·uh·sohn / dek·suh·METH·uh·zohn
32. Histopathology
Pronunciation link: <https://www.merriam-webster.com/dictionary/histopathology>
IPA: /ˌhɪs.toʊ.pəˈθɑː.lə.dʒi/, /ˌhɪs.toʊ.pæˈθɑː.lə.dʒi/
Phonetic Spelling: hiss·toh·puh·THAH·luh·jee / hiss·toh·pa·THAH·luh·jee
33. Neoplasm
Pronunciation link: <https://www.merriam-webster.com/dictionary/neoplasm>
IPA: /ˈniː.əˌplæz.əm/
Phonetic Spelling: NEE·uh·plaz·uhm
34. Malignant
Pronunciation link: <https://www.merriam-webster.com/dictionary/malignant>
IPA: /məˈlɪɡ.nənt/
Phonetic Spelling: muh·LIG·nuhnt