Intrathecal Spinraza: Challenges and Solutions in Image-Guided Administration of the Novel Therapeutics for Spinal Muscular Atrophy

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INTRODUCTION

- Spinal muscular dystrophy **(SMA)** is a major genetic cause of infant mortality and childhood morbidity.
- It is an autosomal recessive disease affecting the **SMN-1 gene** and resulting in **degeneration of motor neuron** of the spinal cord.[1]
- **Spinraza** (Nusinersen) is a novel oligonucleotide therapeutic agent, which acts on the identical SMN-2 gene to compensate for SMN-1 gene expression in patients with SMA.
- Its **intrathecal route of administration** remains a significant factor which discourages patients and caregivers.[2]
- This case series summarizes our experience with administration of Spinraza at the University of Florida Department of Radiology.

METHODS

- Records of adult patients who receive image-guided intrathecal Spinraza at University of Florida Department of Radiology are reviewed.
- **A series of four cases** is presented to illustrate a spectrum of cases that we encountered at our Department.
- For cases 2 and 3 in which both fluoroscopy and CT are utilized for lumbar puncture**, peak skin dose (PSD)** is calculated as a dose metric of interest to compare radiation dose between two modalities.
  - **For fluoroscopy:** PSD is estimated using the Reference Point Air Kerma provided in the dose report and distances provided in the DICOM headers.
  - **For helical CT:** PSD is estimated as 1.2 times CTDIvol provided in the dose report. [3, 4]
  - Of note, the effective dose is deemed clinically irrelevant.

PRELIMINARY RESULTS

CASE 1| 30-year-old female patient with mild scoliosis and lumbar spine fusion. Frequent intrathecal access is successful under fluoroscopy. A fluoroscopic image (**Figure 1**) shows the spinal needle projecting at L3-L4 interlaminar space (arrow).

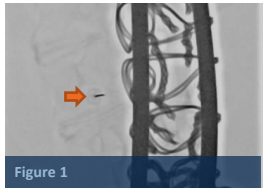


Figure 1

CASE 2| 25-year-old female patient with spinal fusion instrumentation obscuring details of lumbar spine on fluoroscopy, which necessitates CT-guided intrathecal access (**Figure 2a**). Subsequent attempts under fluoroscopy (**Figure 2b**) are successful once access at L4-L5 (**arrow**) has been identified with initial CT guidance. PSD of all attempts are shown (**Figure 2c**).

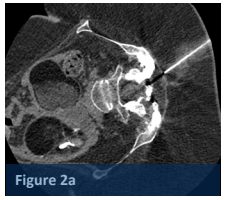


Figure 2a

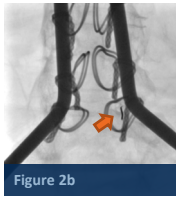


Figure 2b

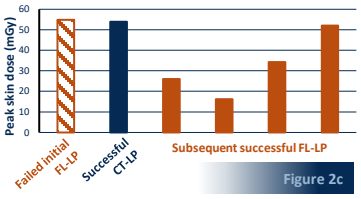


Figure 2c

CASE 3| 27-year-old male patient with severe scoliosis (**Figure 3a**) requiring CT-guided lumbar puncture at L5-S1 interlaminar space (**Figure 3b**) after failed fluoroscopy-guided access. PSD of all attempts are shown (**Figure 3c**).

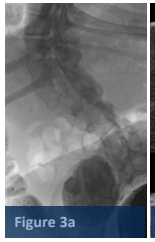


Figure 3a

Figure 2a

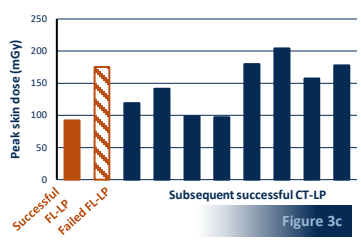
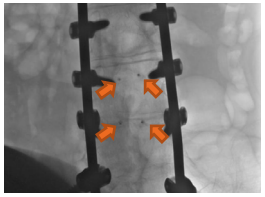


Figure 3c

CASE 4. 16-year-old male patient with L4 laminectomy and placement of 4 fiducials (**arrows**) for radiographic identification of intrathecal access window in future lumbar puncture.



Abbreviations

FL-LP: *fluoroscopy-guided lumbar puncture,* **CT-LP:** *CT-guided lumbar puncture.*

CONCLUSION

- **Case 1** exemplifies cases referred to Department of Radiology for intraspinal Spinraza.
  - Many SMA patients have scoliosis and lumbar spinal hardware.
  - Fluoroscopy-guided LP is sufficient in most cases.
- **Cases 2 and 3** illustrate challenging cases requiring CT-guidance
  - In case 2, CT is used to identify site of access, with similar PSD compared to the initial failed trial under fluoroscopy. However, less PSD is used on subsequent successful fluoroscopy-guided lumbar punctures.
  - In case 3, CT is primarily used to obtain intrathecal access, with similar or less PSD required in successful CT-guided lumbar puncture than the failed attempt under fluoroscopy.
- **Cases 4** is an example of a future solution to frequent intrathecal access in these young patients.
  - Lumbar laminectomy during posterior spinal fusion can provide fluoroscopic reference and maintain intrathecal access. [5, 6]

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