Inadvertent Intrathecal Injection of Ionic Contrast – Seeing is Believing!

Gaurav Chauhan  
*Henry Ford Health System*

Aman Upadhyay  
*Henry Ford Health System*

Mun Choe  
*Henry Ford Health System*

Joseph Salama Hanna  
*Henry Ford Health System*

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Inadvertent intrathecal injection of ionic contrast – seeing is believing!

Gaurav Chauhan, MD, Aman Upadhiyay, MD, Mun Choc, MD, Joseph M Salama-Hanna, MD
Department of Anesthesiology, Pain Management and Perioperative Medicine
Henry Ford Health System, Detroit, Michigan

Abstract
The intravenous administration of gadopentetate dimeglumine (GD) is relatively safe and rarely causes systemic toxicity in the course of routine imaging studies. However, the safety margins of intrathecal GD have not been established. We report a very rare case of an inadvertent intrathecal GD injection presenting with neurotoxic manifestations, including a decreased level of consciousness, global aphasia, rigidity, and visual disturbance. In our case due to his shellfish allergy the physician elected to use a gadolinium based contrast rather than the standard iodinated contrast dye. The patient’s cranial resulted in an inadvertent intrathecal injection of GD. In this case report the authors will discuss the pathophysiology and neurological sequelae of intrathecal GD injection along with the current guidelines for management.

INTRODUCTION

- Gadolinium is a rare paramagnetic metal and GD3+ ion is the most effective paramagnetic ion. Gadolinium based contrast agents (GBCAs) are widely used in medicine since 1988.
- GD3+ is a toxic ion which is chelated with organic ligands to create GBCAs with either a linear or macrocyclic structure. Following intravenous injection, all GBCAs distribute in the blood and extravascular-extracellular space. GBCAs are biologically inert and rapidly eliminated by the kidneys.
- GBCA are administered in about 25% of all MRI examinations. They are also widely used to facilitate chronic pain procedures under fluoroscopy. The intravenous application of GD is relatively safe and rarely causes systemic toxicity in the course of routine imaging studies.
- But the impact of GBCA on human health and its mechanism of toxicity remains unknown. Efforts are underway to understand the mechanisms of gadolinium toxicity and to therapeutic and preventive solutions for patients presenting signs and symptoms of gadolinium toxicity. We present a case report of acute Gadobutrol neurotoxicity and its sequelae.

CLINICAL VIGNETTE

81 year old M, BMI 34

- Severe spinal stenosis + neurogenic claudication
- Lumbar epidural steroid injection
- Medical h/o
  - Allergy to shellfish
  - Hypertension
  - COPD
  - 40 C treatment
- Surgical h/o: L4 – L5 laminectomy

L5 – S1 Lumbar epidural steroid injection
(Pain Clinic)

- Elected to inject Gadobutrol instead of iodinated contrast in lieu of shellfish allergy.
- Inadvertent Intrathecal injection
  - 2 ml Gadobutrol
  - procedure aborted

Recovery 5 mins:
- Severe headache → 25 mcg of Fentanyl administered
- Nausea / Vomiting, agitation + unbearable HEADACHE

ER

Agitated → 1 mg Ativan – Agitation persisted → 1 mg Ativan
2 hours: Confused, Global Aphasia, Vomiting, Seizures – GTCS
Emergency Intubation, NIBP – 180/110, HR 120 bpm, Temp -40 C
ABG : Metabolic Acidosis, PO2 99, PaCO2 30, HCO3‘ 14

NICU

- Extensive workup performed – non-Contrast CT, Viral serologies, LP
12 hours: Severe rigidity, lack of left extremities & neck stiffness
- Labs WNL, NCCT reported

48 hours: Alert, oriented – extubated, No neurological abnormality detected
NCCT Head – no abnormality detected

Discharged at 72 hours

REFERENCES


DISCUSSION

Inadvertent GBCA:
- Max dose : 3.3 microM / g of brain in 15 microilters. (Di Chiro et al animal studies)
- GADAVIST – 2 ml → 2000 microilters injected intrathecially
- Current Literature – HIGH dose intrathecal GADAVIST
  - behavioral changes
  - neurological: focal seizure activity, ataxia, hemiparesis and delayed tremor
  - histopathological: oligodendroglioma loss, astrocytastrophy, etc.

Current literature: Few cases of Gadolinium encephalopathy. High dose administration of GD produced a fluctuating level of consciousness and neurological deficits. In our case 100x dose was administered leading to prolonged effect.

Li et al. hypothesized that there is no CSF-brain barrier with regard to GBCA, as diffusion of the GD into the cerebral gray matter was evident on the T1-weighted and FLAIR images. GBCA can also penetrate into the cerebral deep white matter through the perivascular spaces. This provides evidence in vivo to support the idea that the perivascular space is a channel for CSF-brain exchanges.

The patient was managed symptomatically as the diagnosis was made in retrospect as NICU was not aware of the inadvertent intrathecal GBCA injection.

Current Management guidelines:
- prompts continuous CSF drainage through a lumbar drain could be a life-saving procedure.
- Steroids: in case of closed-head injuries or brain tumors to prevent and help reverse brain edema.
- Serum and CSF Gadolinium level to diagnose rule out other differentials.
- Symptomatic management

CONCLUSION

- GBCA injected intrathecally may lead to severe neurological sequelae and caution should be exercised during procedures employing GBCA.
- Physicians should be aware of “Gadolinium encephalopathy” as a clinical entity. A treatment algorithm should be in the facility for inadvertent intrathecal injection of GBCA.
- Communication is key especially during clinical scenarios when multiple providers are involved. The expensive neurological workup would have been avoided if NICU was made aware of events that transpired during the procedure done in pain clinic.
- Iodinated contrast can be used in shellfish allergy.

The molecular structure of Gadobutrol is as follows:

Molecular structure of Gadobutrol

48 hours: Alert, oriented – extubated, No neurological abnormality detected
NCCT Head – no abnormality detected

Discharged at 72 hours

24 hours: No seizure on Keppra, DSA for Sub-Arachnoid hemorrhage –ve

48 hours: Alert, oriented – extubated, No neurological abnormality detected
NCCT Head – no abnormality detected