

Episode 214: Non-depolarizing Blockers and Myasthenic Syndromes

On this episode: Drs. Gillian Isaac and Jed Wolpaw

In this 214th episode I welcome back Dr. Gillian Isaac to do another ABA Keyword episode. We review non-depolarizing neuromuscular blockers and myasthenic syndromes.

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Questions & Notes

Click → jump to answers/notes.

Rocuronium site of action

- A. Pre-junctional Ca channels
- B. Alpha subunit of acetylcholine receptors
- C. Beta subunit of acetylcholine receptors
- D. Actin-myosin complex

Discussion

Unique advantage of rocuronium over other (non-depolarizing) muscle relaxants

- A. Short duration of action
- B. Metabolism by pseudocholinesterase
- C. Onset of action
- D. Lack of need for reversal

Discussion

True statement of interactions b/w non-depolarizing blocking drugs where duration of action is dissimilar

- A. Long-acting drug admin after intermediate-acting, duration of long-acting drug is longer than expected
- B. Long-acting drug admin after intermediate-acting, duration of long-acting drug is same as expected
- C. Intermediate -acting drug admin after long-acting, duration of intermediate-acting drug is same as expected
- D. Intermediate -acting drug admin after long-acting, duration of intermediate-acting drug is longer than expected

Discussion

Which NMDB indicated where succinylcholine is contraindicated?

- A. Atracurium
- B. Rocuronium
- C. Vecuronium
- D. Cis-atracurium

Discussion

EACH NDMB METABOLIZED DIFFERENTLY

Neuromuscular effects of intubating dose of vecuronium is terminated by

- A. Diffusion of neuromuscular junction back to plasma
 - B. Non-specific cholinesterase
 - C. Kidney
 - D. Liver
- Discussion

Pt w/ renal failure, which of following has most prolonged elimination half-life

- A. Atracurium
 - B. Pancuronium
 - C. Succinylcholine
 - D. Vecuronium
- Discussion

Pt w/ jaundice and minimally elevated AST, markedly elevated ALP, normal PT to receive muscle relaxant. Which most likely?

- A. Decreased intubating dose of pancuronium
 - B. Increased intubating dose of cisatracurium
 - C. Prolonged duration of succinylcholine
 - D. Prolonged duration of vecuronium
- Discussion

For renal failure pt, which of following statement is true

- A. Duration of vecuronium is prolonged
 - B. Elimination half-life of cisatracurium is tripled
 - C. Reversal w/ neostigmine is contraindicated
 - D. Succinylcholine is contraindicated
- Discussion

Which of following eliminated most by renal excretion?

- A. Pancuronium
 - B. Vecuronium
 - C. Cisatracurium
 - D. Rocuronium
- Discussion

Compared to pt w/o liver disease, pt w/ cirrhosis will have

- A. Greater accumulation of vecuronium with infusions
 - B. More Phase-2 block after administration of succinylcholine
 - C. Prolonged elimination of cisatracurium
 - D. Unchanged volume of distribution for pancuronium
- Discussion

Recovery index of which NMDB not affected by aging

- A. Cisatracurium
 - B. Vecuronium
 - C. Rocuronium
 - D. Pancuronium
- Discussion

INTERACTIONS OF NDMB**Each of following enhances effect of NMDB except?**

- A. Calcium
 - B. Aminoglycoside antibiotics
 - C. Magnesium
 - D. IV Lidocaine
- Discussion

Which antibiotic below does not augment neuromuscular blockade

-
- A. Clindamycin
 - B. Neomycin
 - C. Streptomycin
 - D. Erythromycin
- Discussion

Mag for pre-eclampsia results in decreased dose requirement of following except

- A. Bupivacaine
 - B. Midazolam
 - C. Succinylcholine
 - D. Vecuronium
- Discussion

Correct statement on volatile anesthetic effects on NMBD and reversal agents

- A. Volatiles potentiate NMBD but retard reversal agents
 - B. Volatiles potentiate both NMBD and reversal agents
 - C. Volatiles retard both NMBD and reversal agents
 - D. Volatiles retard NMBD but potentiate reversal agents
- Discussion

RECOVERY AND REVERSAL

What % neuromuscular receptors could still be blocked and allow patients to carry out 5-second head-lift

- A. 5%
 - B. 15%
 - C. 25%
 - D. 50%
- Discussion

After single-dose of vecuronium, function returns last to which of following muscles

- A. Adductor pollicis
 - B. Diaphragm
 - C. Laryngeal muscle
 - D. Orbicularis oculi
 - E. Rectus abdominus
- Discussion

Which of following muscle relaxants inhibits reuptake of norepi by adrenergic nerves

- A. Pancuronium
 - B. Vecuronium
 - C. Rocuronium
 - D. Cisatracurium
- Discussion

16F undergoes posterior spinal fusion, most likely cause of ↓ amplitude of SSEP

- A. Admin of fentanyl
 - B. 1.3MAC of isoflurane
 - C. Vecuronium 0.15mg/kg
 - D. ↓ body temp 37 → 35
 - E. ↓ CSF pressure
- Discussion

Which of following least likely to cross placenta

- A. Lidocaine
 - B. Meperidine
 - C. Midazolam
 - D. Thiopental
 - E. Vecuronium
- Discussion
-

10 days after burns to > 40% BSA, patient requires greater than expected doses of vecuronium for adequate muscle relaxation. Primary cause is increased

- A. Plasma-binding of vecuronium
- B. Metabolism of vecuronium
- C. Number of acetylcholine receptors
- D. Renal clearance of vecuronium
- E. Blood flow to skeletal muscles

Discussion

NEUROMUSCULAR DISEASES AND MYASTHENIC SYNDROMES

Which of following statements on MG is true

- A. Neostigmine is inappropriate for neuromuscular reversal
- B. Number of acetylcholine receptors is decreased
- C. Plasma cholinesterase concentration is decreased
- D. Risk for MH is increased
- E. Succinylcholine is contraindicated

Discussion

Each of following conditions related to upregulation of acetylcholine receptor at neuromuscular junction except

- A. Burn injury
- B. Myasthenia gravis
- C. Prolonged bedrest
- D. Prolonged used of neuromuscular relaxant
- E. Upper motor neuron injury

Discussion

Which of following disease assoc w/ increased resistance to succinylcholine

- A. Myasthenia gravis
- B. Myasthenia syndrome
- C. Huntington chorea
- D. Polymyositis

Discussion

Hyperkalemia is not a risk of patients receiving succinylcholine w/ the following

- A. Multiple sclerosis
- B. Myasthenia gravis
- C. Guillain-Barre syndrome
- D. Becker muscular dystrophy

Discussion

Pseudocholinesterase is

- A. ↑ in patients w/ MG
- B. Inhibited by glycopyrrolate
- C. Inhibited by pilocarpine
- D. Synthesized by liver
- E. Reverses cisatracurium blockade

Discussion

35F w/ severe MG scheduled for thymectomy. Which of following pulmonary function test most likely to be normal

- A. FEV1
- B. FVC
- C. FEV1/FVC
- D. Max voluntary ventilation
- E. Peak inspiratory force

Discussion

37M w/ MG in ED confused and agitated after 2 days of weakness and ↑ difficulty breathing. ABG on RA: PaO₂ 60, PaCO₂ 51, HCO₃⁻ 25, pH 7.3, SaO₂ 90%. RR 30, tidal volume 4ml/kg. After edrophonium admin, TV ↓ to 2ml/kg. Which is most appropriate step in management of this pt

- A. Tracheal intubation and mechanical ventilation
- B. Repeat test dose of edrophonium
- C. Administer neostigmine
- D. Administer atropine for cholinergic crisis

Discussion

33F G1P0 w/ MG controlled with pyridostigmine is in labor. Has headache, nervous, BP 160/115, pitting edema, 4+ proteinuria. Appropriate management of labor should include

- A. Lumbar epidural w/ bupivacaine
- B. Chlorpromazine 2.5mg IV
- C. Avoidance of narcotics
- D. Lumbar epidural w/ 2-chlorprocaine
- E. Chlorpromazine 10mg IV

Discussion

Lumbar epidural placed in 41F w/ MG in labor. Select true statement regarding neonatal MG

- A. Newborn almost always affected by myasthenia
- B. Newborn affected by maternal IgM
- C. Newborn may require anticholinesterase therapy
- D. Newborn will need lifelong treatment

Discussion

REFERENCES

RANDOM RECS

Rocuronium site of action

4:53

- A. Pre-junctional Ca channels
- B. Alpha subunit of acetylcholine receptors
- C. Beta subunit of acetylcholine receptors
- D. Actin-myosin complex

Discussion

- Answer: Rocuronium → B
- Intermediate NDMB w/ ED95 0.3mg/kg
- Dose range 0.6-1.2mg/kg
- Intubating conditions reached in 1-2 minutes w/ effects lasting 20-35 minutes
- Higher doses provide intubating conditions similar to succinylcholine onset of time within 1 minute

Unique advantage of rocuronium over other (non-depolarizing) muscle relaxants

6:29

- A. Short duration of action
- B. Metabolism by pseudocholinesterase
- C. Onset of action
- D. Lack of need for reversal

Discussion

- C - where the high dose will make onset close to succinylcholine
- First two letters of rocuronium stand for **R**apid **O**nset

True statement of interactions b/w non-depolarizing blocking drugs where duration of action is dissimilar

7:21

- A. Long-acting drug admin after intermediate-acting, duration of long-acting drug is longer than expected
- B. Long-acting drug admin after intermediate-acting, duration of long-acting drug is same as expected
- C. Intermediate -acting drug admin after long-acting, duration of intermediate-acting drug is same as expected
- D. Intermediate -acting drug admin after long-acting, duration of intermediate-acting drug is longer than expected

Discussion

- D b/c if given long-acting drug after intermediate, it will take three half-lives of long-acting drug to go away so still effectively have neuromuscular blockade
- Analogy: needing to give flumazenil again to reverse midazolam because of shorter half-life of reversal

Which NMDB indicated where succinylcholine is contraindicated?

9:58

- A. Atracurium
- B. Rocuronium
- C. Vecuronium
- D. Cis-atracurium

Discussion

- As discussed, rocuronium can achieve near similar onset of onset as succinylcholine

Each NDMB metabolized differently

10:34

- Vecuronium: Metabolized 30-40% by liver/biliary, then eliminated liver/kidney 50/50
- Rocuronium: Mostly eliminated by liver/biliary, then minority is renal
- Pancuronium: Mostly cleared by renal
- Cisatracurium: Hoffman-Degradation

Neuromuscular effects of intubating dose of vecuronium is terminated by

12:17

- A. Diffusion of neuromuscular junction back to plasma
- B. Non-specific cholinesterase
- C. Kidney
- D. Liver

Discussion

- Actual termination of effect is due to diffusion away from junction
- Eventually cleared by metabolism

Pt w/ renal failure, which of following has most prolonged elimination half-life

13:44

- A. Atracurium
- B. Pancuronium
- C. Succinylcholine
- D. Vecuronium

Discussion

- A is via Hoffman-Elimination so can probably eliminate this option
- Succinylcholine is different – eliminate this option
- Pancuronium more reliant on renal → answer: B

Pt w/ jaundice and minimally elevated AST, markedly elevated ALP, normal PT to receive muscle relaxant. Which most likely?

14:35

- A. Decreased intubating dose of pancuronium
- B. Increased intubating dose of cisatracurium
- C. Prolonged duration of succinylcholine
- D. Prolonged duration of vecuronium

Discussion

- Patient has liver and biliary insufficiency
- Pancuronium relies on renal, so likely not the answer
- Cisatracurium not as reliant on liver
- Answer: D

For renal failure pt, which of following statement is true

16:25

- A. Duration of vecuronium is prolonged
- B. Elimination half-life of cisatracurium is tripled
- C. Reversal w/ neostigmine is contraindicated
- D. Succinylcholine is contraindicated

Discussion

- Answer: A based on discussions above

Which of following eliminated most by renal excretion?

16:48

- A. Pancuronium
- B. Vecuronium
- C. Cisatracurium
- D. Rocuronium

Discussion

- Answer: A

Compared to pt w/o liver disease, pt w/ cirrhosis will have

17:05

- A. Greater accumulation of vecuronium with infusions
- B. More Phase-2 block after administration of succinylcholine
- C. Prolonged elimination of cisatracurium
- D. Unchanged volume of distribution for pancuronium

Discussion

- Answer: A
- B is seen with large doses
- Cisatracurium not affected by organ function
- Volume of distribution changes

Recovery index of which NMDB not affected by aging

18:08

- A. Cisatracurium
- B. Vecuronium
- C. Rocuronium
- D. Pancuronium

Discussion

- Assumption is with age, organ function declines
- Answer: A

Interactions of NDMB

18:40

Each of following enhances effect of NMDB except?

19:17

- A. Calcium
- B. Aminoglycoside antibiotics
- C. Magnesium
- D. IV Lidocaine

Discussion

- Answer: A
- Case report of primary hyperparathyroidism, even in absence of hypercalcemia, you may get resistance to competitive blockade. Suggesting that the disease process may cause up-regulation of acetylcholine receptors → hyposensitivity

Which antibiotic below does not augment neuromuscular blockade

21:09

- A. Clindamycin
- B. Neomycin
- C. Streptomycin
- D. Erythromycin

Discussion

- Answer: D (macrolide)
- Aminoglycosides (B,C, gentamycin, tobramycin) and lincosamides (A, lincomycin) can augment neuromuscular blockade

Mag for pre-eclampsia results in decreased dose requirement of following except

22:27

- A. Bupivacaine
- B. Midazolam
- C. Succinylcholine
- D. Vecuronium

Discussion

- C, D: Mag potentiates NMBD as discussed
- A: Don't really change dose of bupivacaine for epidural when many women on OB are on mag

Correct statement on volatile anesthetic effects on NDMB and reversal agents

25:30

- A. Volatiles potentiate NMBD but retard reversal agents
- B. Volatiles potentiate both NMBD and reversal agents
- C. Volatiles retard both NMBD and reversal agents
- D. Volatiles retard NMBD but potentiate reversal agents

Discussion

- Should know volatiles potentiate NMBD
- Recent studies show volatiles retard reversal agents

Recovery and reversal

27:03

- Up to 60% of patients w/ residual weakness in PACU did receive adequate reversal

What % neuromuscular receptors could still be blocked and allow patients to carry out 5-second head-lift

27:28

- A. 5%
- B. 15%
- C. 25%
- D. 50%

Discussion

- What's the point here? You can have a significant blockade and still carry this action out
- Answer: D – don't assume signs of muscular strength is sufficient for reversal

- Cisatracurium DOES need to be reversed!

After single-dose of vecuronium, function returns last to which of following muscles

28:50

- A. Adductor pollicis
- B. Diaphragm
- C. Laryngeal muscle
- D. Orbicularis oculi
- E. Rectus abdominus

Discussion

- What can I use as a reliable indicator of recovery? A
- Facial muscle recovers before laryngeal muscles
- Recovery order: B / D → C → A

Which of following muscle relaxants inhibits reuptake of norepi by adrenergic nerves

31:13

- A. Pancuronium
- B. Vecuronium
- C. Rocuronium
- D. Cisatracurium

Discussion

- Answer: A – was known to increase HR

16F undergoes posterior spinal fusion, most likely cause of ↓ amplitude of SSEP

32:03

- A. Admin of fentanyl
- B. 1.3MAC of isoflurane
- C. Vecuronium 0.15mg/kg
- D. ↓ body temp 37 → 35
- E. ↓ CSF pressure

Discussion

- B/c sensory, not C
- Thinking to these cases, B is likely answer

Which of following least likely to cross placenta

33:33

- A. Lidocaine
- B. Meperidine
- C. Midazolam
- D. Thiopental
- E. Vecuronium

Discussion

- Answer: E

10 days after burns to > 40% BSA, patient requires greater than expected doses of vecuronium for adequate muscle relaxation. Primary cause is increased

33:56

- A. Plasma-binding of vecuronium
- B. Metabolism of vecuronium
- C. Number of acetylcholine receptors
- D. Renal clearance of vecuronium
- E. Blood flow to skeletal muscles

Discussion

- As discussed on episode about succinylcholine, the acetylcholine receptors will up-regulate by 10 days

Neuromuscular diseases and myasthenic syndromes

35:42

- Myasthenia Gravis (MG)
 - o Fatigability of skeletal muscle
 - o Weakness related to autoimmune destruction of post-synaptic acetylcholine receptors of neuromuscular junction
- Lambert-Eaton Myasthenic Syndrome
 - o Paraneoplastic syndrome
 - o Primarily proximal muscle weakness (generally lower)
 - o Antibodies to pre-synaptic voltage-gated calcium channels
 - o Muscle strength improves with repeated efforts
 - o Less marked improvement with anticholinesterase drugs

Which of following statements on MG is true

38:24

- A. Neostigmine is inappropriate for neuromuscular reversal
- B. Number of acetylcholine receptors is decreased
- C. Plasma cholinesterase concentration is decreased
- D. Risk for MH is increased
- E. Succinylcholine is contraindicated

Discussion

- Answer: B

Each of following conditions related to upregulation of acetylcholine receptor at neuromuscular junction except

39:31

- A. Burn injury
- B. Myasthenia gravis
- C. Prolonged bedrest
- D. Prolonged used of neuromuscular relaxant
- E. Upper motor neuron injury

Discussion

- Answer: B

Which of following disease assoc w/ increased resistance to succinylcholine

40:04

- A. Myasthenia gravis
- B. Myasthenia syndrome
- C. Huntington chorea
- D. Polymyositis

Discussion

- As discussed, answer is A

Hyperkalemia is not a risk of patients receiving succinylcholine w/ the following

40:54

- A. Multiple sclerosis
- B. Myasthenia gravis
- C. Guillain-Barre syndrome
- D. Becker muscular dystrophy

Discussion

- Answer: B

Pseudocholinesterase is

41:24

- A. ↑ in patients w/ MG
- B. Inhibited by glycopyrrolate
- C. Inhibited by pilocarpine
- D. Synthesized by liver
- E. Reverses cisatracurium blockade

Discussion

- Answer: D

35F w/ severe MG scheduled for thymectomy. Which of following pulmonary function test most likely to be normal

42:51

- A. FEV1
- B. FVC
- C. FEV1/FVC
- D. Max voluntary ventilation
- E. Peak inspiratory force

Discussion

- Realize that MG is weakness, not an obstructive process - thus getting volume out over time is decreased
- Answer: C since both decrease
- Can cause severe respiratory muscle weakness
- Primarily treated by anticholinesterase drugs – pyridostigmine
- Excess can cause cholinergic crisis

37M w/ MG in ED confused and agitated after 2 days of weakness and ↑ difficulty breathing. ABG on RA: PaO₂ 60, PaCO₂ 51, HCO₃⁻ 25, pH 7.3, SaO₂ 90%. RR 30, tidal volume 4ml/kg. After edrophonium admin, TV ↓ to 2ml/kg. Which is most appropriate step in management of this pt

43:43

- A. Tracheal intubation and mechanical ventilation
- B. Repeat test dose of edrophonium
- C. Administer neostigmine
- D. Administer atropine for cholinergic crisis

Discussion

- Answer: A
- Cholinergic crisis can be differentiated by myasthenic crisis by giving small dose of edrophonium. TV will decrease in cholinergic crisis, which is treated with atropine, but emergently need intubation first.

33F G1P0 w/ MG controlled with pyridostigmine is in labor. Has headache, nervous, BP 160/115, pitting edema, 4+ proteinuria. Appropriate management of labor should include

46:30

- A. Lumbar epidural w/ bupivacaine
- B. Chlorpromazine 2.5mg IV
- C. Avoidance of narcotics
- D. Lumbar epidural w/ 2-chlorprocaine
- E. Chlorpromazine 10mg IV

Discussion

- Pt with MG appears to have pre-eclampsia with severe features
- No indication for a STAT section, where you'd use 2-chlorprocaine, thus answer is A
- Be careful with neuraxial because of tenuous respiratory muscle status in MG

Lumbar epidural placed in 41F w/ MG in labor. Select true statement regarding neonatal MG

48:45

- A. Newborn almost always affected by myasthenia
- B. Newborn affected by maternal IgM
- C. Newborn may require anticholinesterase therapy
- D. Newborn will need lifelong treatment

Discussion

- Answer C
- 10-20% of newborns born to mothers with MG are transiently affected
- Typically goes away after 6 months
- IgG Ab transferred through placenta

References

- Barash Clinical Anesthesia 8th edition and Anesthesiahub.com

Random Recs

- Ted Lasso: [Link](#)
- Hamnet: [Link](#)
- Amicus Podcast Interview with Michael Heller: [Link](#)

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