Dexmedetomidine in Pediatric Procedural Sedation

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Disclosure

Mohamed Mahmoud

None

Linda Schuiten

None

Grant Stuart

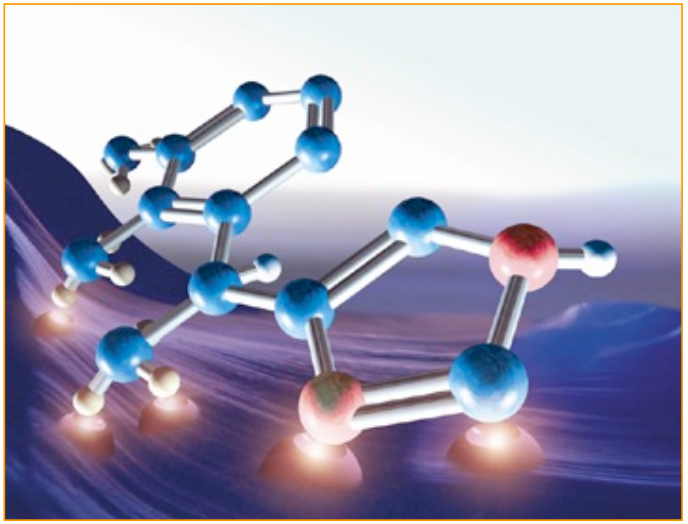
None

Paolo Valerio

None

Outline

- Mechanism of action and Pharmacokinetics
- Side effects
- Indications/contraindications
- Organisation of sedation services and protocols
- Videos
- Cases

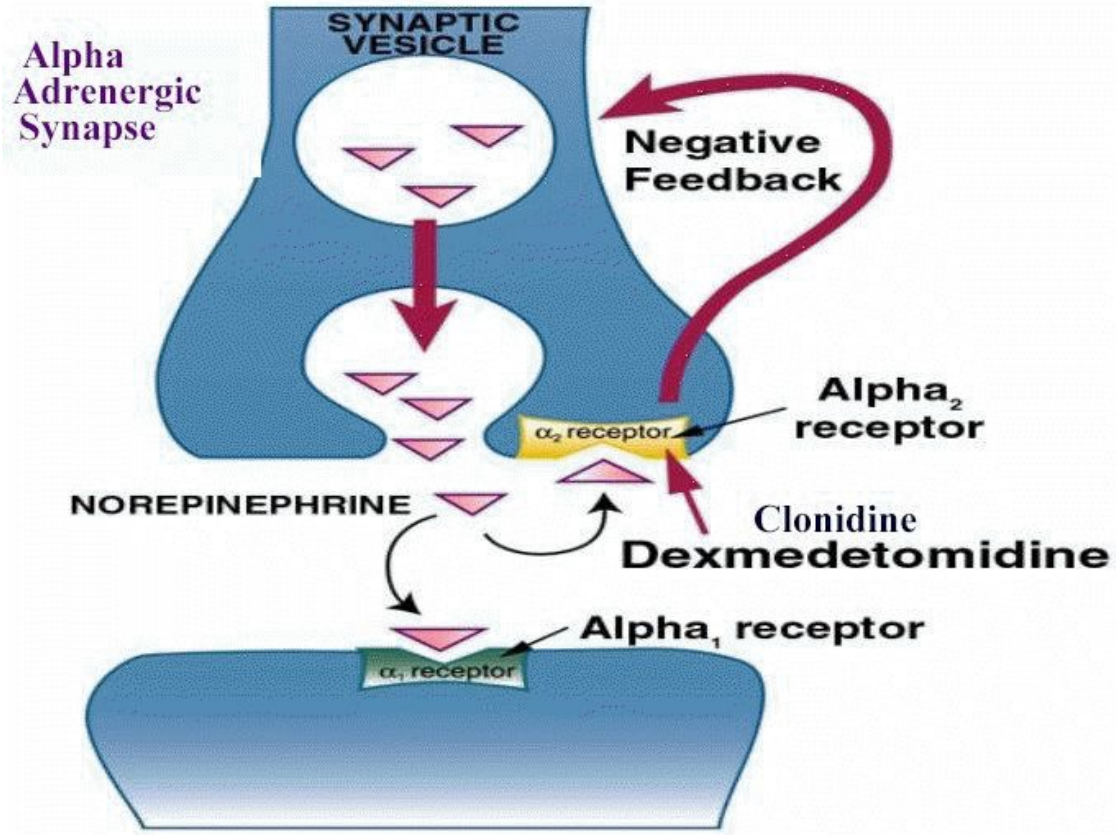


Dexmedetomidine

- Selective Alpha2-Adrenergic agonist (more selective than Clonidine)

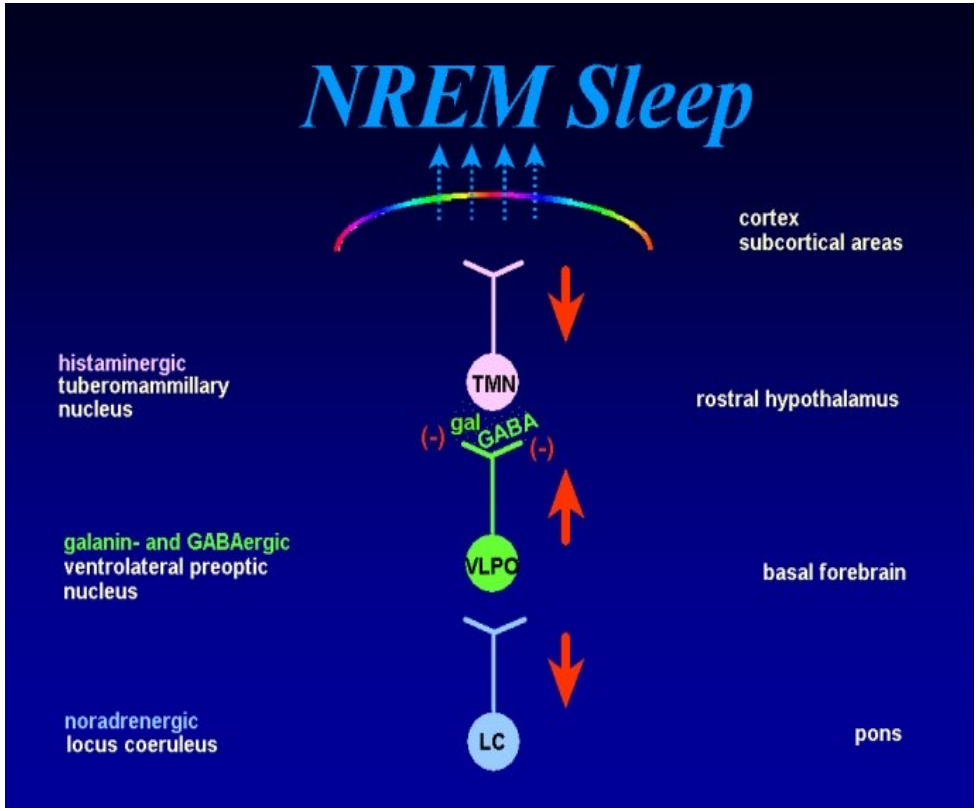
- Sedative properties

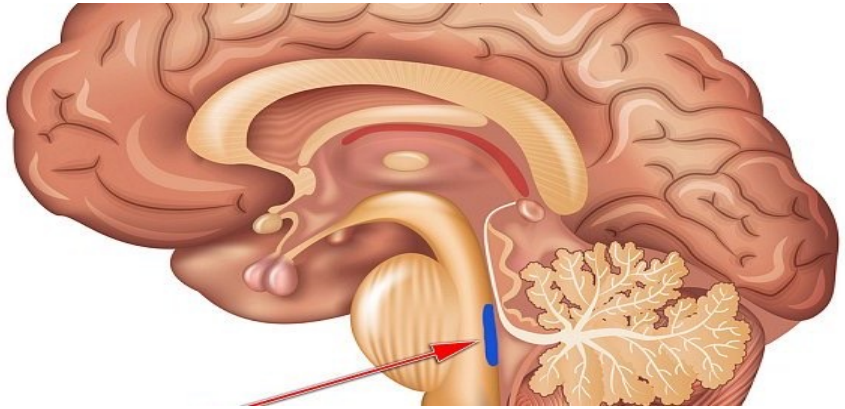
Dexmedetomidine Mechanism of action

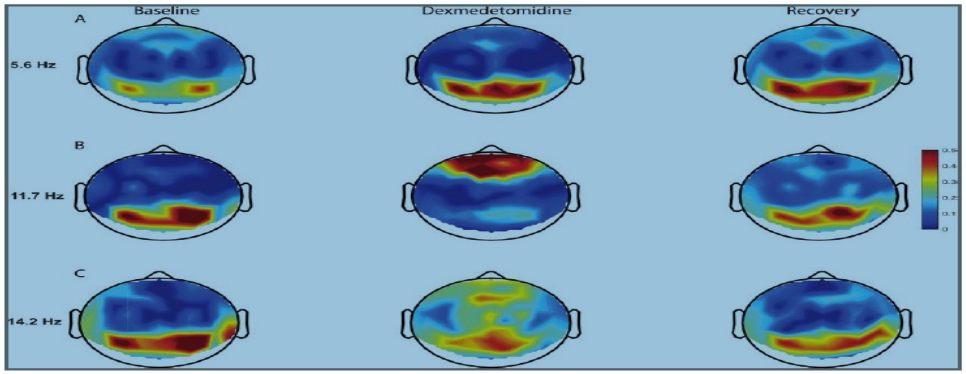


Dexmedetomidie 8x more
α2- selective than clonidine

Mechanism of action

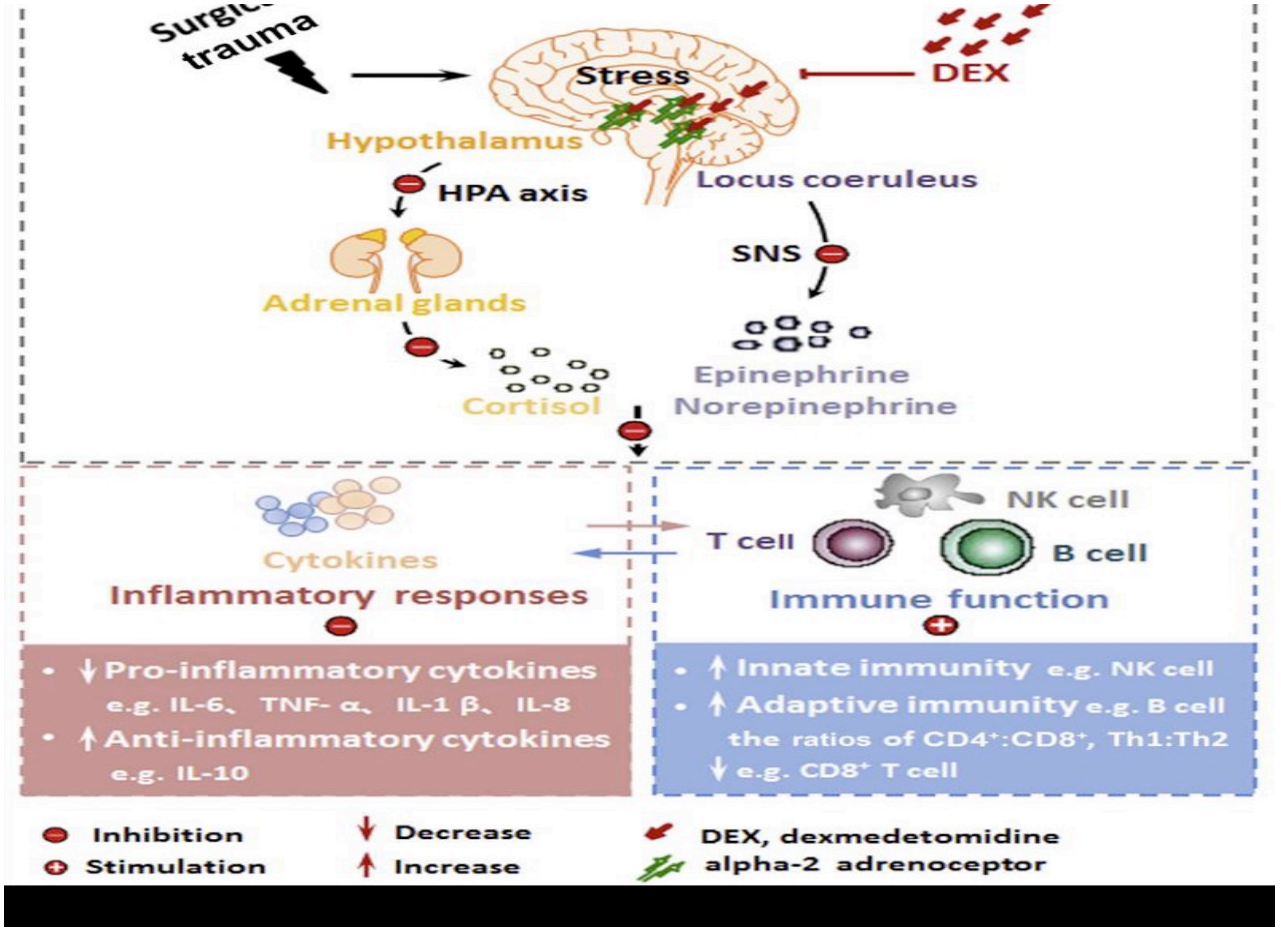






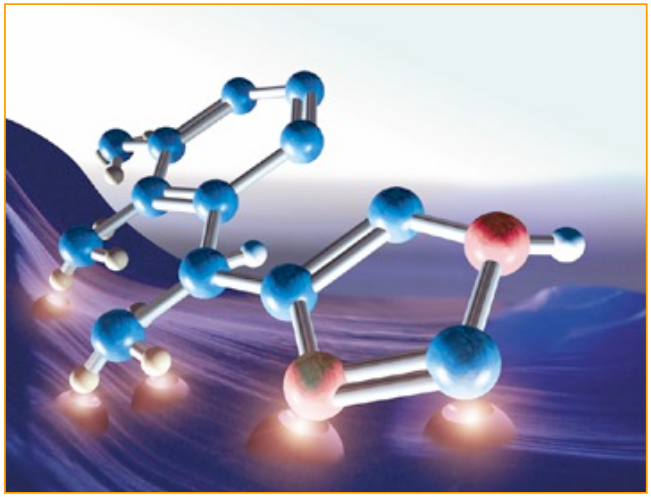
Dyck S. Anaesth Pharm Review1993:1.

Mechanism of action



Dexmedetomidine: Pharmocokinetics

- Rapid redistribution: 6 min
- Elimination half-life: 2 h
- Protein binding: 94%
- Metabolism: Hepatic
  - Inactive metabolites
  - 85% glucuronidation (UDPG)
  - 15% cytochrome p450 (2A6)
- No accumulation after infusions: 12-24 h
- Similar in young adults and elderly
- Infants appear to clear more quickly than adults



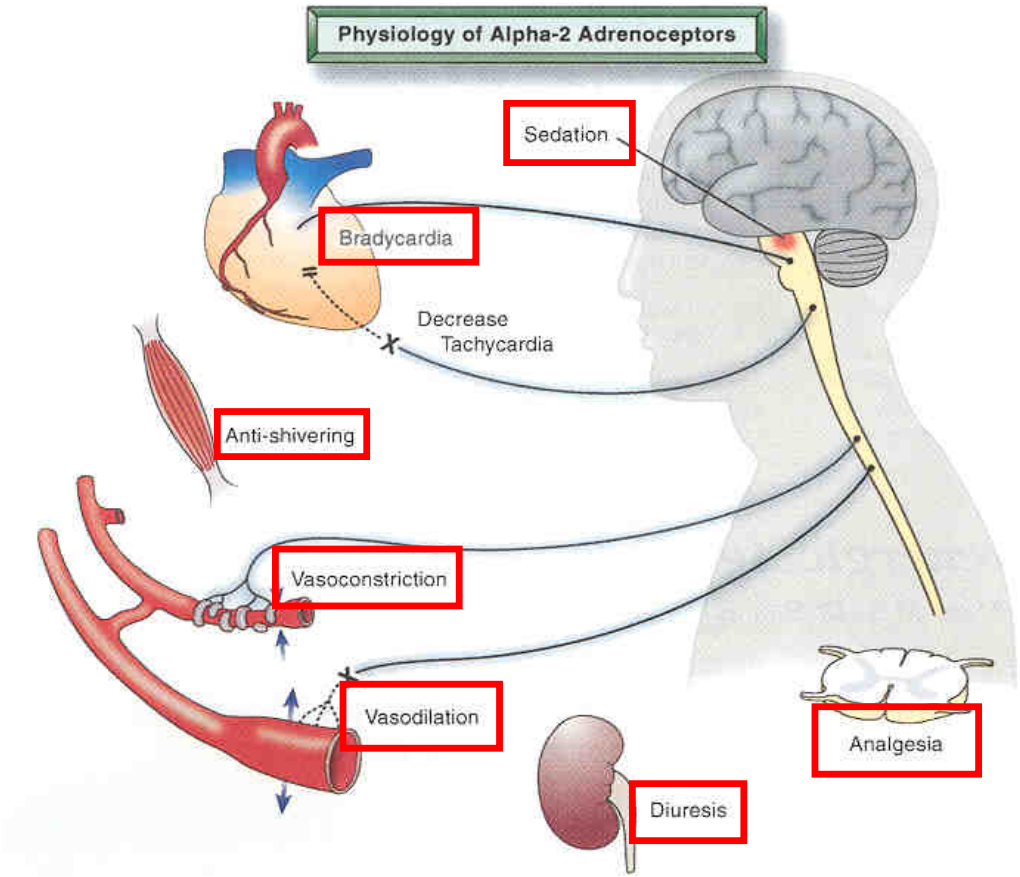
Miller JW et al. Br J Anaesth.2018; 120 (5): 1056-1065
Mahmoud M, Mason KP. Br J Anaesth 2015; 115: 171-82
Perez-Guille et al. Anesth Analg . 2018; 127 (3) 716-723

Administration Routes

- Intravenous
- Intramuscular
- Intranasal/Buccal
- Oral
- Epidural

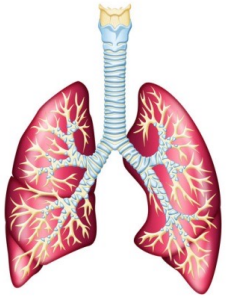
Karaaslan D et al. J Clin Anesth 2006. 18: 589-93
Wang SS et al. Paediatr Anaesth 2014; 24: 275-81
Cimen ZS et al. Paediatr Anaesth 2013; 23: 134-8

Pharmacodynamics



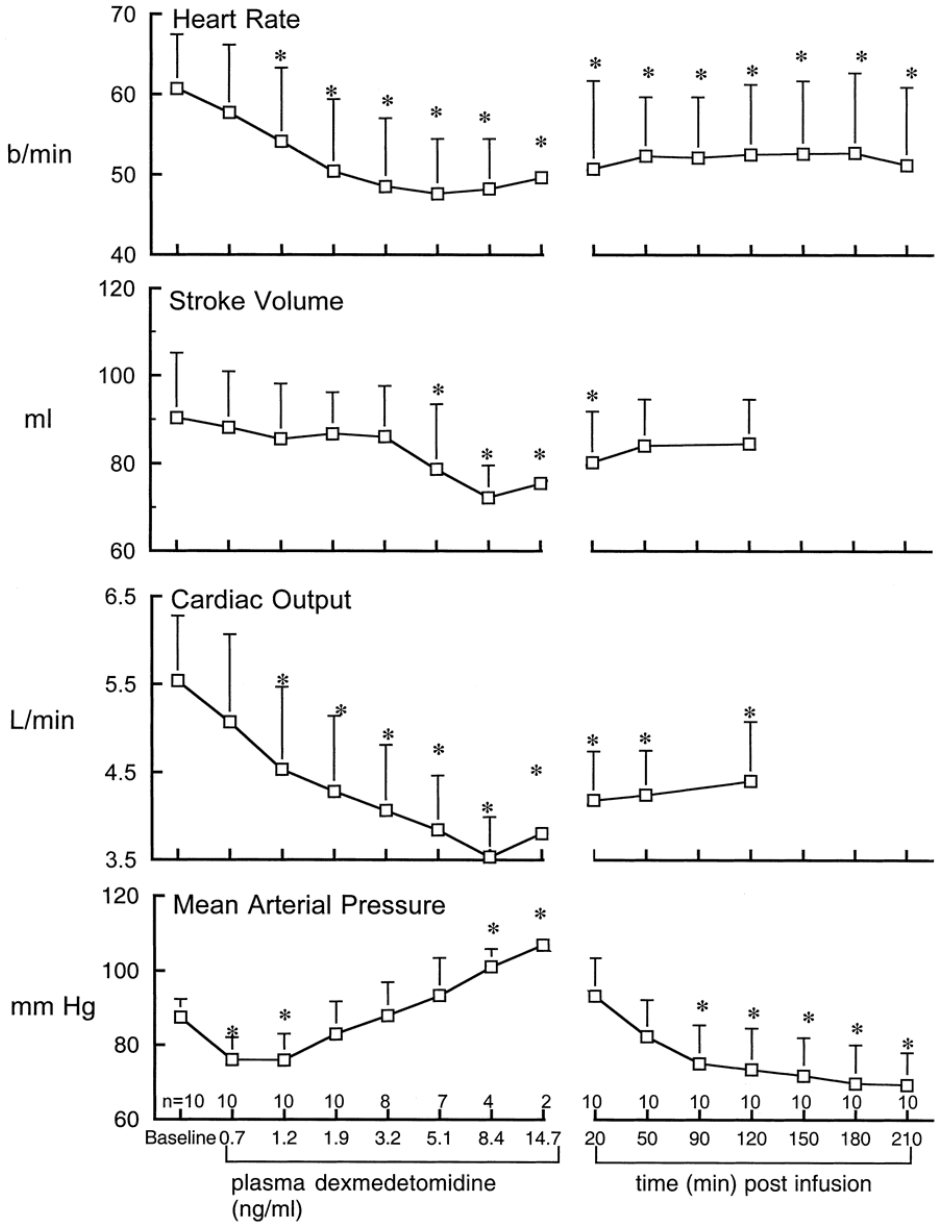
Kamibayashi T, et al. Anesthesiology. 2000;93:1345-1349

Non-CNS effects
Respiratory



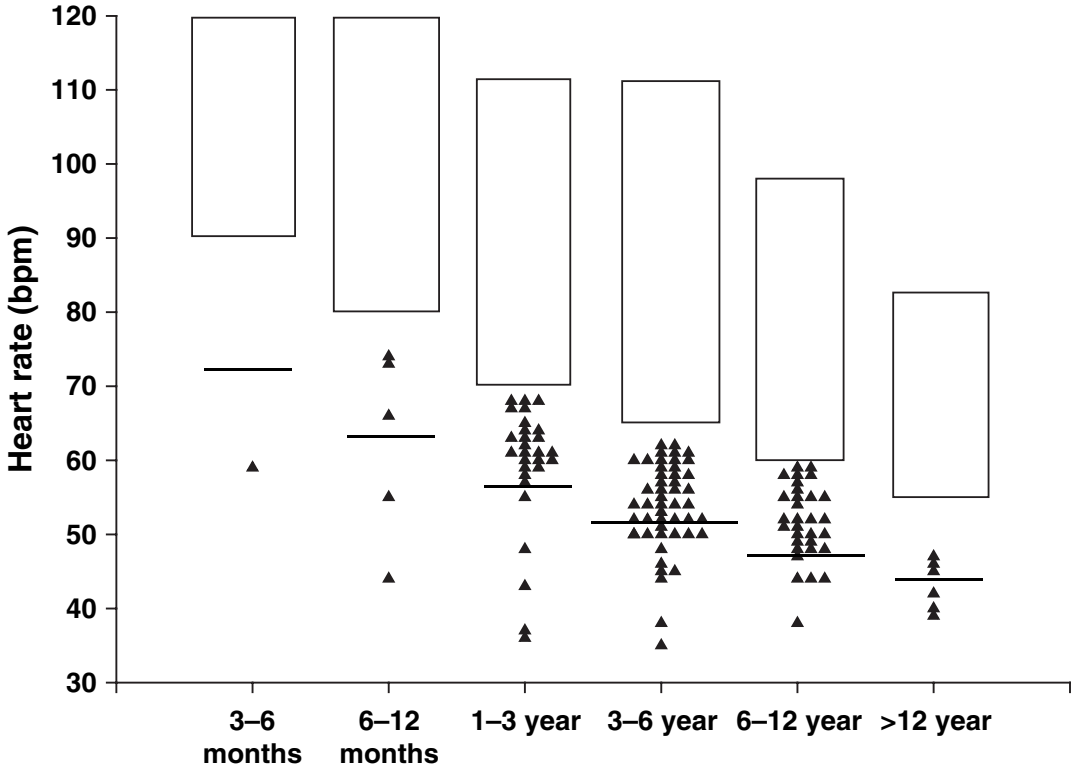
- No effects on respiration
- Airway protecting reflexes stay intact

Biphasic effect on blood pressure



T.J. Eber, Anesthesiology 2000; 93:382–94

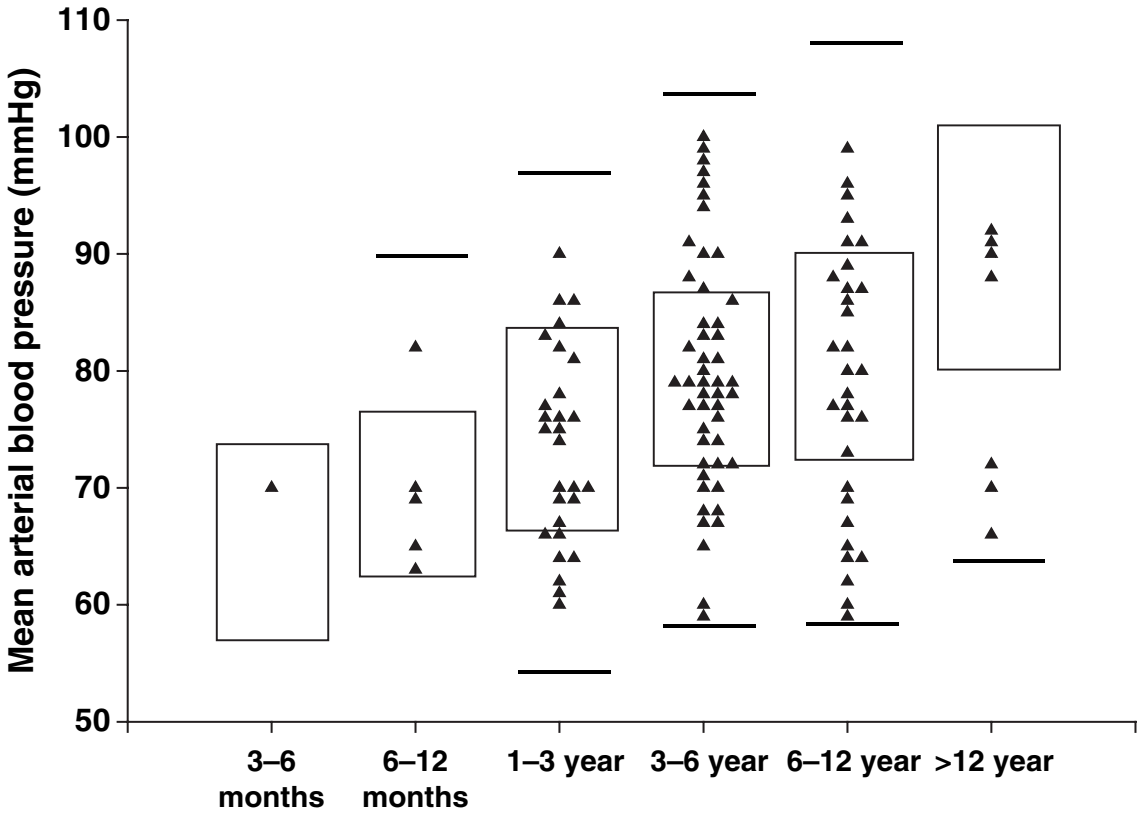
High dose dexmedetomidine i.v. Effect on heart rate (n=747)



Boxes: normal ranges heart rate
Horizontal lines: 20% below normal range

Mason KP et al, Ped Anesth 2008;18: 403-411

High dose dexmedetomidine i.v. Effect on mean blood pressure



Boxes: normal ranges MAP

Horizontal lines: 20% below and above normal range

Mason KP et al, Ped Anesth 2008;18: 403-411

Contraindications (relative)

- AV node dysfunction/Heart Block
- Sinus node dysfunction
- Heart rate altering medications
  - Beta-blockers
  - Digoxin
- Cerebral aneurysm, AVM, Moyamoya
- Severe ventricular dysfunction

Summary potential benefits of dexmedetomidine

- Unique “asleep-but-arousable” sedation
- Natural sleep pattern (does not influence neurophysiology)
- No respiratory changes

Summary potential disadvantages of dexmedetomidine

- Arousability
- Bradycardia
- Decrease in blood pressure (low serum levels)
- Increase in blood pressure (high serum levels)

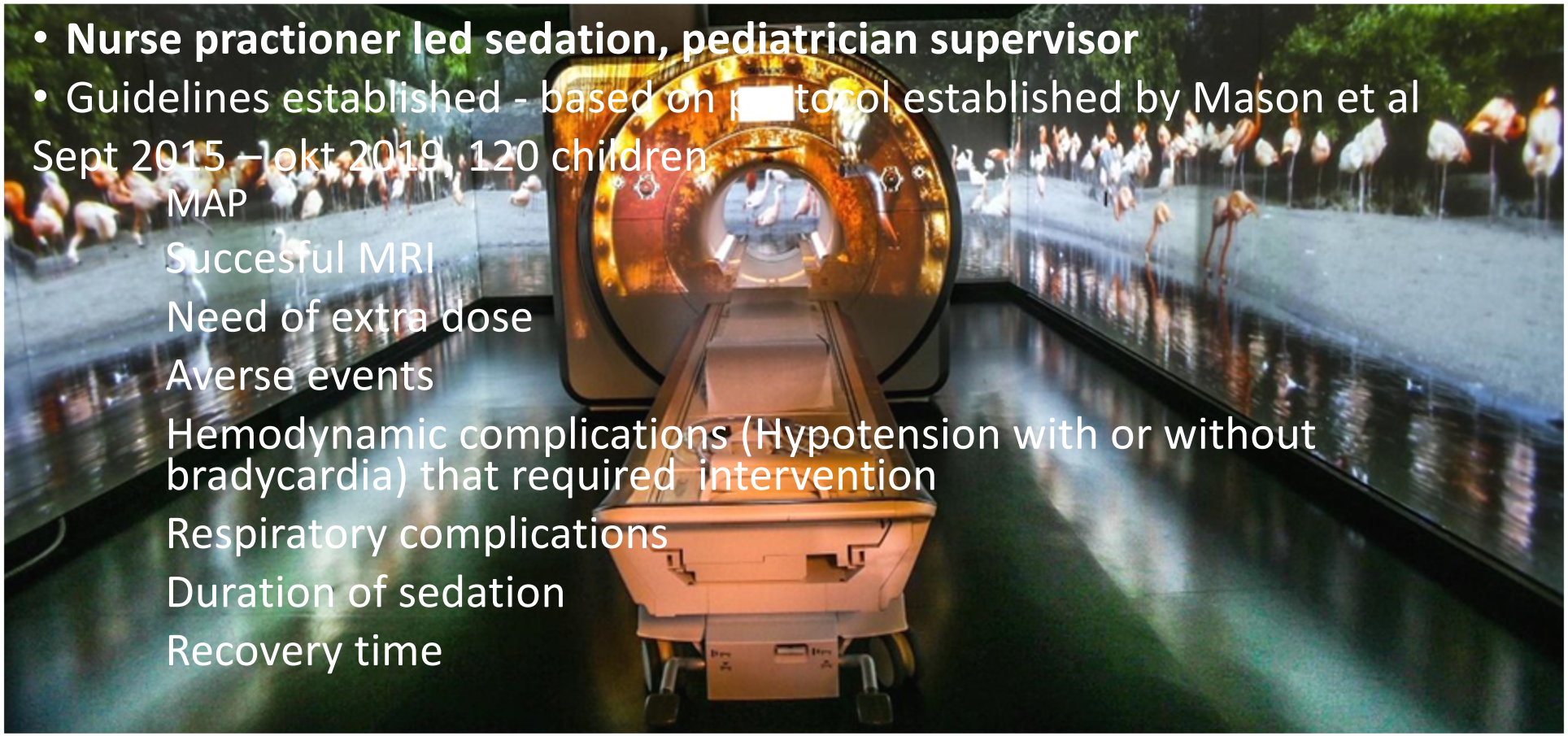
The use of dexmedetomidine for procedural sedation in children

Indications:

- Sedation for non-painful or minimal painful* procedures such as
- CT-scan (i.n.)
- MRI-scan (i.v.)
- Other non-painful radiological imaging
- EEG (i.n.)
- As an alternative for nitrous oxide in very anxious children or mentallly disabled children who do not accept mask (i.n.)
- I.V. Catheter placement in very anxious children or mentally disabled children (i.n.)

*combine with topical anestethic or analgesic (e.g. EMLA®, Rapydan®, Fentanyl)

Research OLVG, Paolo Valerio and Linda Schuiten
Sedation with dexmedetomidine i.v during MRI in children



- **Nurse practioner led sedation, pediatrician supervisor**
- Guidelines established - based on protocol established by Mason et al

Sept 2015 – okt 2019, 120 children

MAP

Succesful MRI

Need of extra dose

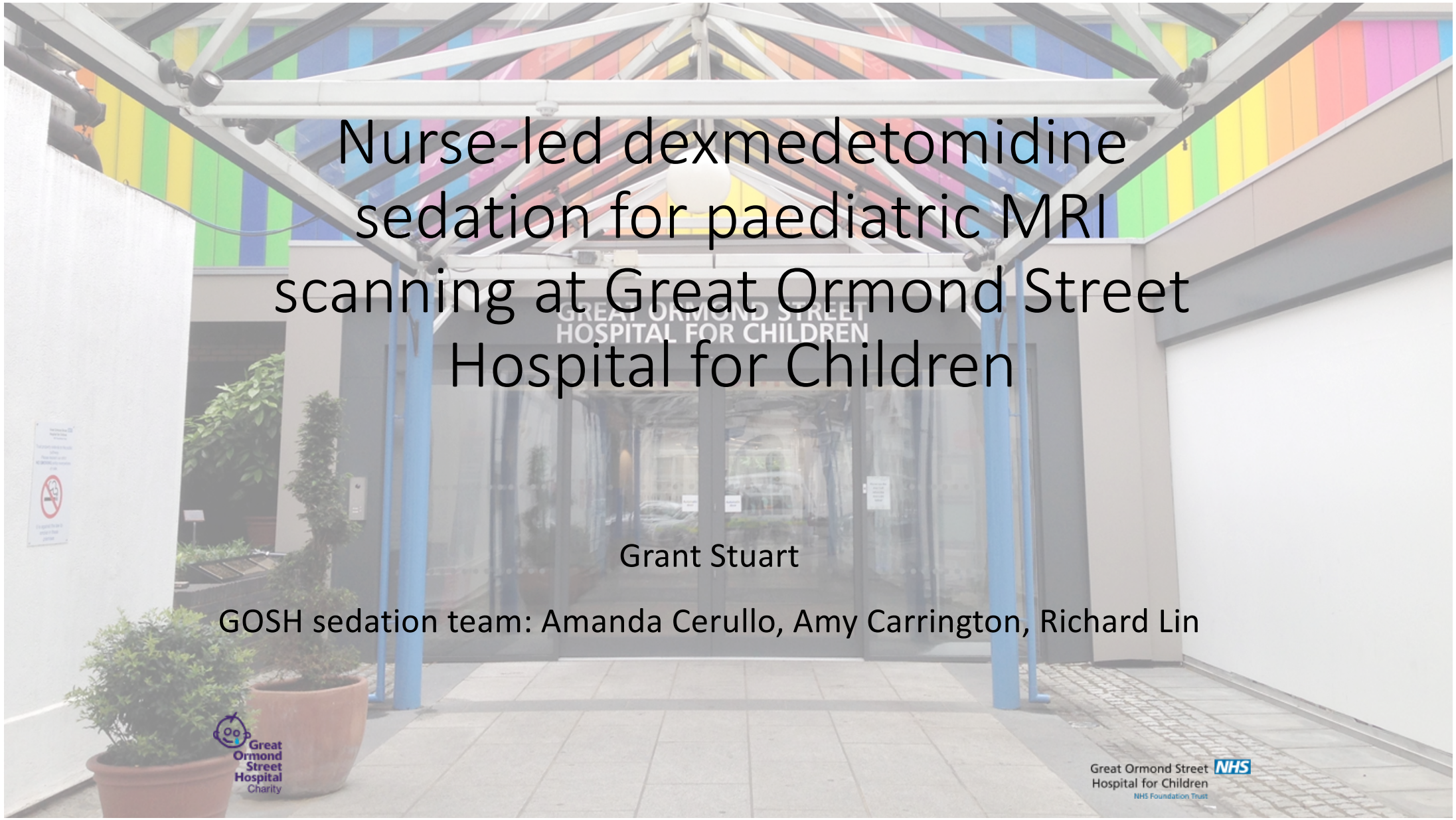
Averse events

Hemodynamic complications (Hypotension with or without bradycardia) that required intervention

Respiratory complications

Duration of sedation

Recovery time



Nurse-led dexmedetomidine sedation for paediatric MRI scanning at Great Ormond Street Hospital for Children

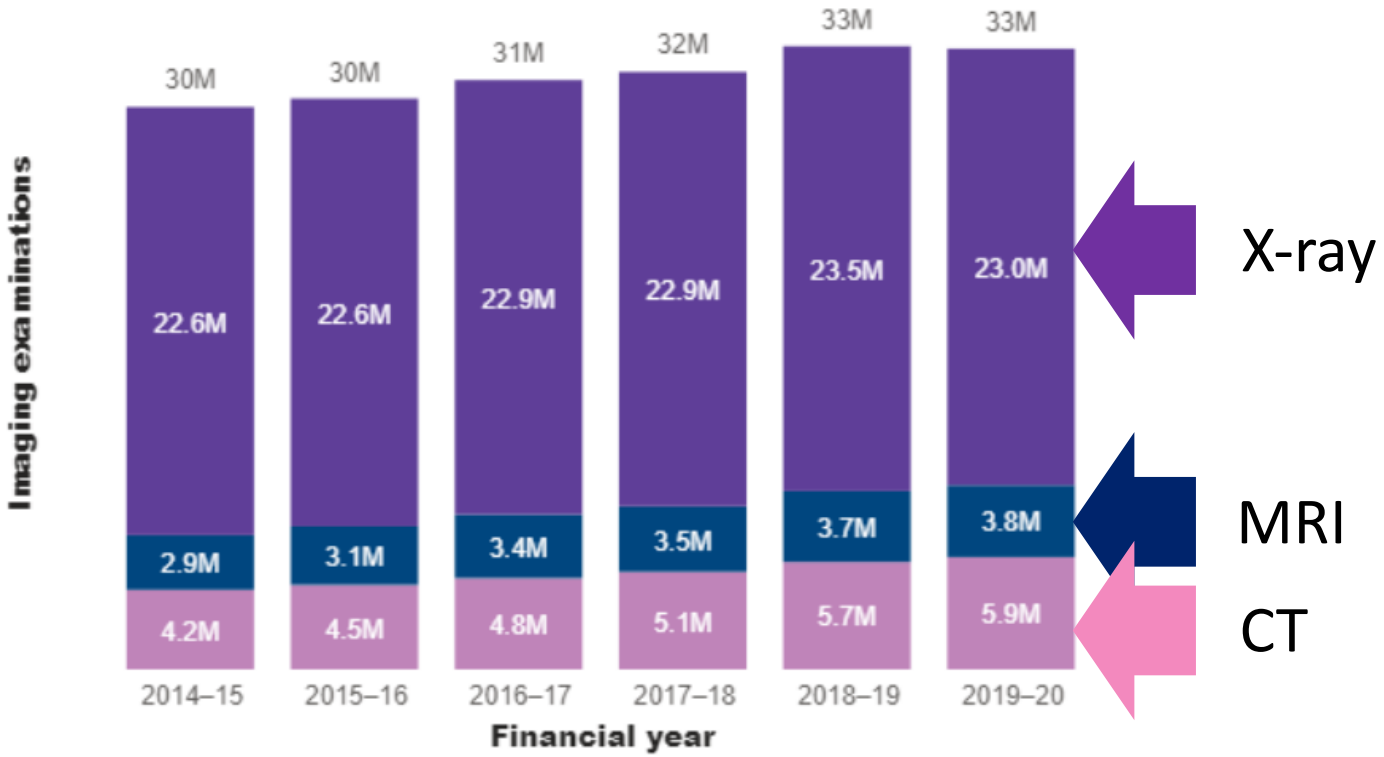
Grant Stuart

GOSH sedation team: Amanda Cerullo, Amy Carrington, Richard Lin

Great Ormond Street Hospital Charity

Great Ormond Street Hospital for Children NHS Foundation Trust

Figure 1. NHS imaging activity – England, five-year trend (2014/15 –2019/20)[5]



What was in place pre-2016?

Well functioning single nurse-led MRI sedation service

All patients assessed/consented by sedation team

Most required cannula

Standard G.A. fasting protocol

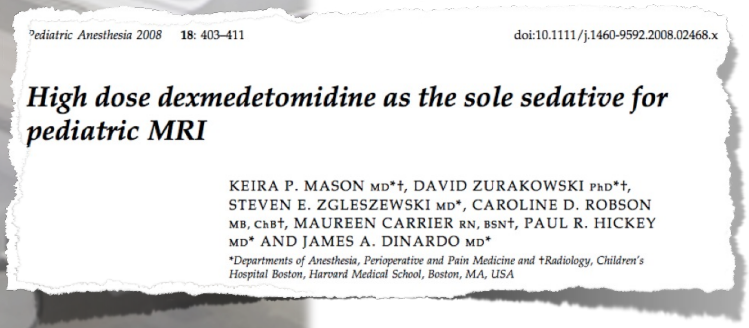
Chloral hydrate orally (Diazemuls IV for top up)

Limited to primarily younger patients (<15 kg)

Formal guidelines for contraindications and recovery (no bed model)

Dex sedation for MRI at GOSH

- Nurse- led sedation team maintained
- Experienced and motivated staff recruited
- Guidelines established - based on protocol established by Mason et al
- Minimal disruption or change to existing sedation practices and pathways
- Patient/case selection vital



Pediatric Anesthesia 2008 18: 403–411 doi:10.1111/j.1460-9592.2008.02468.x

High dose dexmedetomidine as the sole sedative for pediatric MRI

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*Departments of Anesthesia, Perioperative and Pain Medicine and †Radiology, Children's Hospital Boston, Harvard Medical School, Boston, MA, USA

Patient preparation

- Pre-visit phone consultation and selection by sedation team
- On the day patient and family go to child friendly sedation room
- Reassess and consent patient – select sedation protocol
- Play therapists invaluable (especially if IV access required)
- Standardised pharmacy prescription based on weight
- Cool down/time out period useful if child has been upset before starting sedation

Protocol 1: For ≥ 5 kg children having scan with contrast or ≥ 45 minutes scan without contrast

- Dexmedetomidine Intravenous
- Loading dose of 3 microgram/kg over 10 minutes then
- 2 microgram/kg/hour as a continuous infusion until the end of scan
- A repeat loading dose may be required in the event of poor-quality sedation

Sedation for MRI Scans ONLY for Patients 26-40kg
INTRAVENOUS PRESCRIPTION CHART

Great Ormond Street Hospital for Children NHS Foundation Trust. Great Ormond Street London WC1N 3JH

Ward: MRI Turtle/Otter

SURNAME	FIRST NAME	HOSPITAL NUMBER	D.O.B.	WEIGHT	ALLERGIES / SENSITIVITIES
		CONSULTANT	AGE	HEIGHT	NAME & POSITION OF PERSON RECORDING ALLERGIES*

*(ALLERGIES MUST BE DOCUMENTED BEFORE PRESCRIBING / ADMINISTRATION EXCEPT IN EXCEPTIONAL CIRCUMSTANCES)

DATE		TOTAL VOLUME	DILUENT	RATE	DR or ANP SIG	ADMINISTERED DATE & TIME	Made & Given By / Checked By	NOTES
	Dexmedetomidine 200microgram	50 ml	Sodium Chloride 0.9%	See chart below				

Weight (kg) (round to nearest kg)	Bolus 3 microgram/kg (over 10 min) SET VTBI		Maintenance infusion 2 microgram/kg/hr		Total volume given (if 1 hour infusion)	Prescriber to circle weight and sign below against rate
26	19.5ml (78 microgram)	117ml/hr for 10 min	13ml/hr	(52microgram/hr)	32.5ml	Signature:
27	20.25ml (81microgram)	121.5ml/hr for 10 min	13.5ml/hr	(54microgram/hr)	33.75ml	Signature:
28	21ml (84microgram)	126ml/hr for 10 min	14ml/hr	(56microgram/hr)	35ml	Signature:
29	21.75ml (87microgram)	130.5ml/hr for 10 min	14.5ml/hr	(58microgram/hr)	36.25ml	Signature:
30	22.5ml (90microgram)	135ml/hr for 10 min	15ml/hr	(60microgram/hr)	37.5ml	Signature:
31	23.25ml (93microgram)	139.5ml/hr for 10 min	15.5ml/hr	(62microgram/hr)	38.75ml	Signature:
32	24ml (96microgram)	144ml/hr for 10 min	16ml/hr	(64microgram/hr)	40ml	Signature:
33	24.75ml (99microgram)	148.5ml/hr for 10 min	16.5ml/hr	(66microgram/hr)	41.25ml	Signature:
34	25.5ml (102microgram)	153ml/hr for 10 min	17ml/hr	(68microgram/hr)	42.5ml	Signature:
35	26.25ml (105microgram)	157.5ml/hr for 10 min	17.5ml/hr	(70microgram/hr)	43.75ml	Signature:
36	27ml (108microgram)	162ml/hr for 10 min	18ml/hr	(72microgram/hr)	45ml	Signature:
37	27.75ml (111microgram)	166.5ml/hr for 10 min	18.5ml/hr	(74microgram/hr)	46.25ml	Signature:
38	28.5ml (114microgram)	171ml/hr for 10 min	19ml/hr	(76microgram/hr)	47.5ml	Signature:
39	29.25ml (117microgram)	175.5ml/hr for 10 min	19.5ml/hr	(78microgram/hr)	48.75ml	Signature:
40	30ml (120microgram)	180ml/hr for 10 min	20ml/hr	(80microgram/hr)	50ml	Signature:

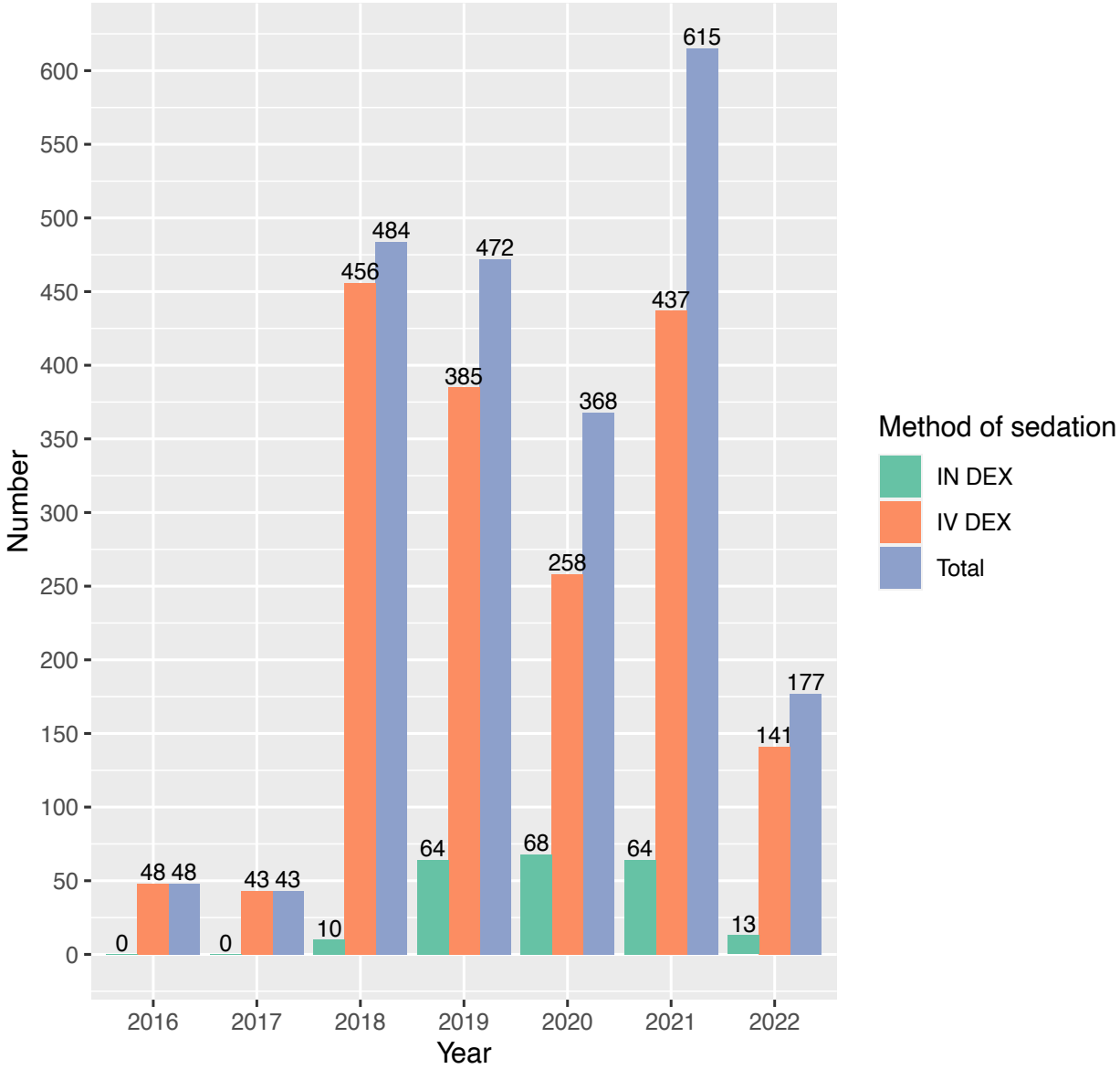
Created by: Judith Cope Chief Pharmacist Feb 2016 Checked by: Rachelle Booth Reviewed by: Kuan Ooi (May 2022)

Protocol 2 : For ≥ 5 kg children having < 45 minutes scan without contrast

- Dexmedetomidine Intranasal 4 microgram/kg (to maximum of 200 microgram)
- **Administration:** undiluted via a MAD® device
- **In the event of failure** administer 0.2 mg/kg of buccal midazolam (to maximum of 10mg dose) post intranasal dose ONLY.

Protocol 3: For anxious children ≥ 5 kg having scan with contrast or ≥ 45 minutes scan without contrast

- Dexmedetomidine Intranasal 3 microgram/kg (to maximum of 200 microgram)
- **Administration:** undiluted via a MAD® device
- Insert cannula once asleep followed by 2 microgram/kg/hour continuous infusion until the end of scan
- A repeat loading dose may be required in the event of poor-quality sedation



Graph of nurse practitioner led dexmedetomidine sedation for MRI by year

CASES

Case 1

- Boy 16 years old
- mentally and physically impaired
- MLCD syndrome
- mitochondrial DNA mutation
- Needs ear inspection and remove excessive earwax
- And dentist check-up, X-ray and physical examination

Case 2

4 yr old girl on E.D.

Laceration forhead, needs suturing

Very anxious

Didn’t accept mask for Nitrous Oxide on previous occasion.

Case 3

- 5-year-old with Kniest Dysplasia (short limbs/Joint deformity/Shortened trunk and neck, scoliosis, club foot, cleft palate)
- 10.3 kg
- Cervical spine stenosis – unstable and protection required
- Gastro-oesophageal reflux –on thickened fluids
- Cleft palate – difficult intubation / procedure abandoned (2019)
- 2 x sedations for MRI scan of C-spine with dexmedetomidine