



"Clinical Nurse Educator เชิญเข้าร่วมการนำเสนอ"

Case Conference



ภาวะแพ้น้ำยาดมสลบ (Malignant Hyperthermia)



27 ตุลาคม 2566

9-10 น.

ณ ห้องประชุมกิตติวัฒนา ชั้น 4

นำเสนอโดย

พว.ธัญญา ดาราสุวรรณ

พว.ณัฐณี บัวศรี

งานการพยาบาลผู้ป่วยวิสัญญี



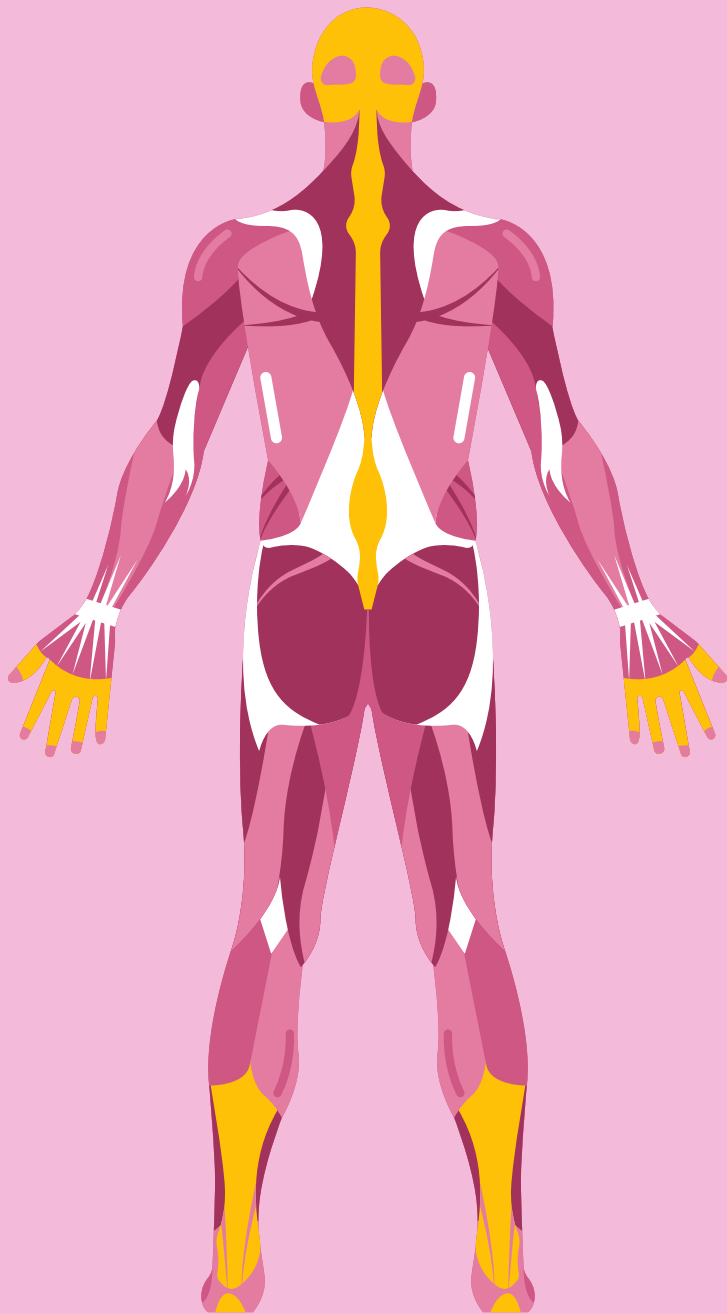


ภาวะแพ้ยาดมสลู

MALIGNANT HYPERTHERMIA

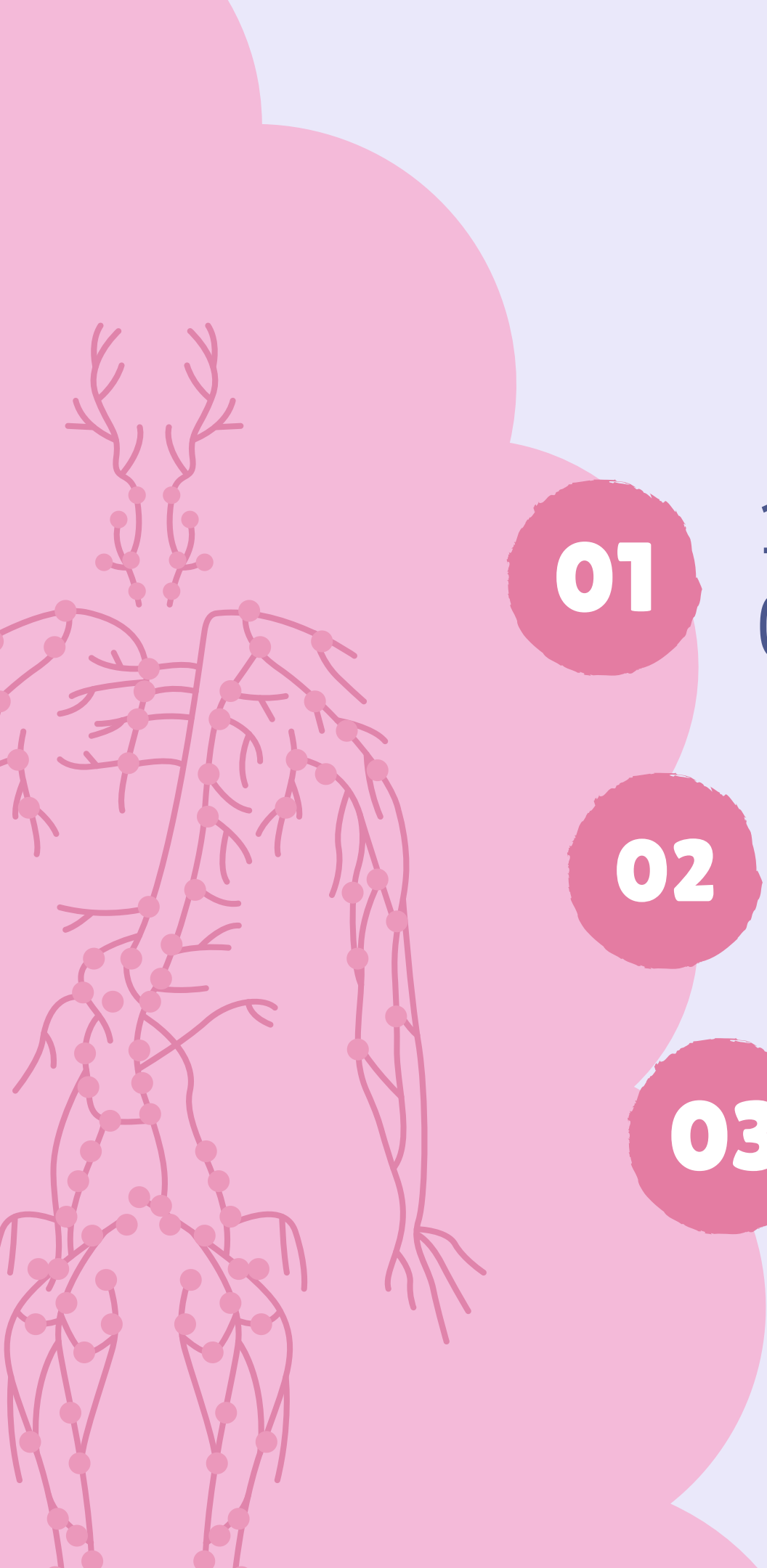
Thananya Darasuwan
Nattanee Buasri
Certified Registered Nurse Anesthetist

Malignant hyperthermia (MH)



- Potentially lethal skeletal muscle disorder
- Calcium release channels abnormal excitation-contraction coupling
- Autosomal dominant associated with Ryanodine receptor type 1 (RYR1)

INCIDENCE MH



01

1 in 10,000 to 30,000 and 1 in 100,000 to 250,000
(depend on geographic location and age)

02

Men > Women

03

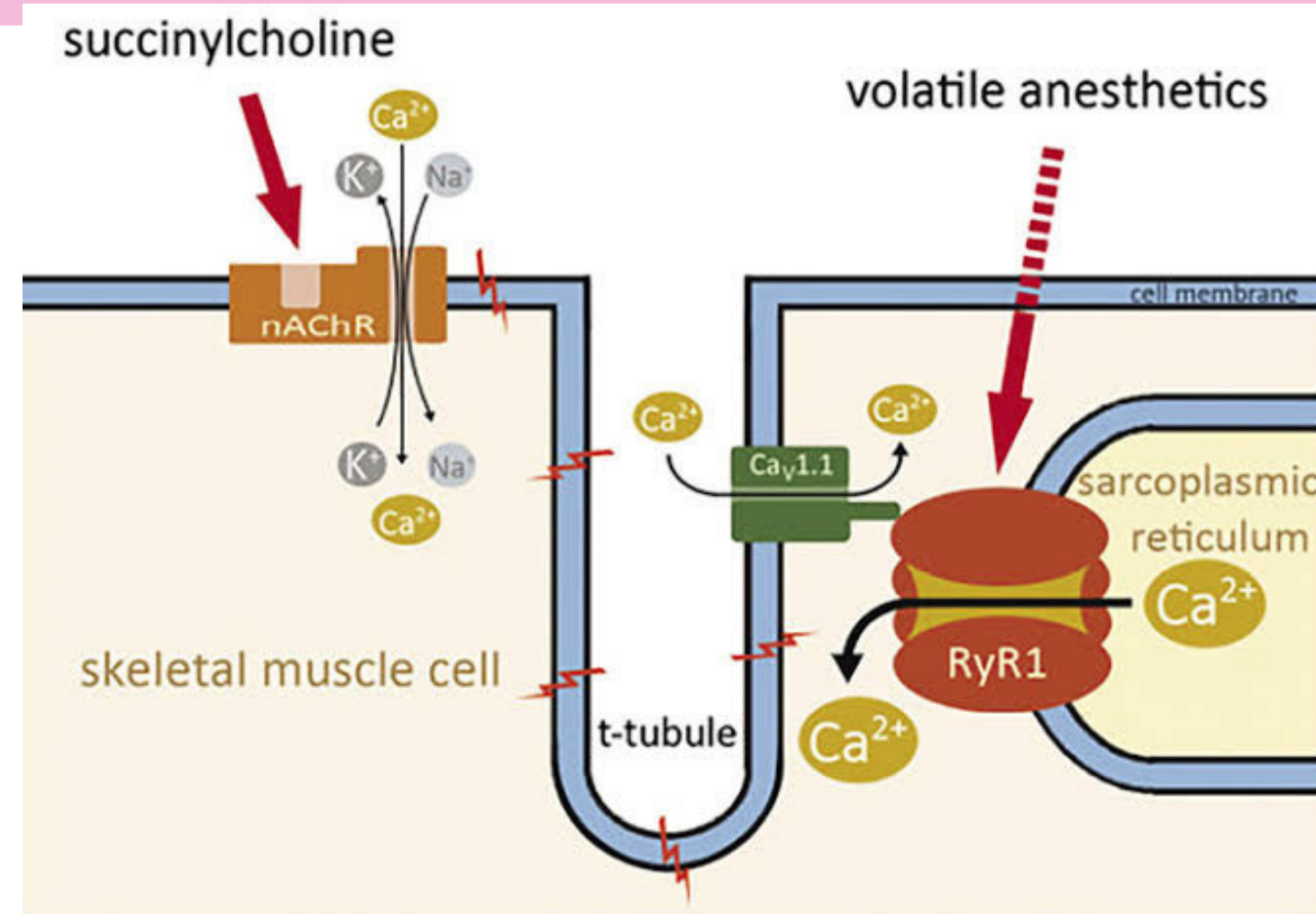
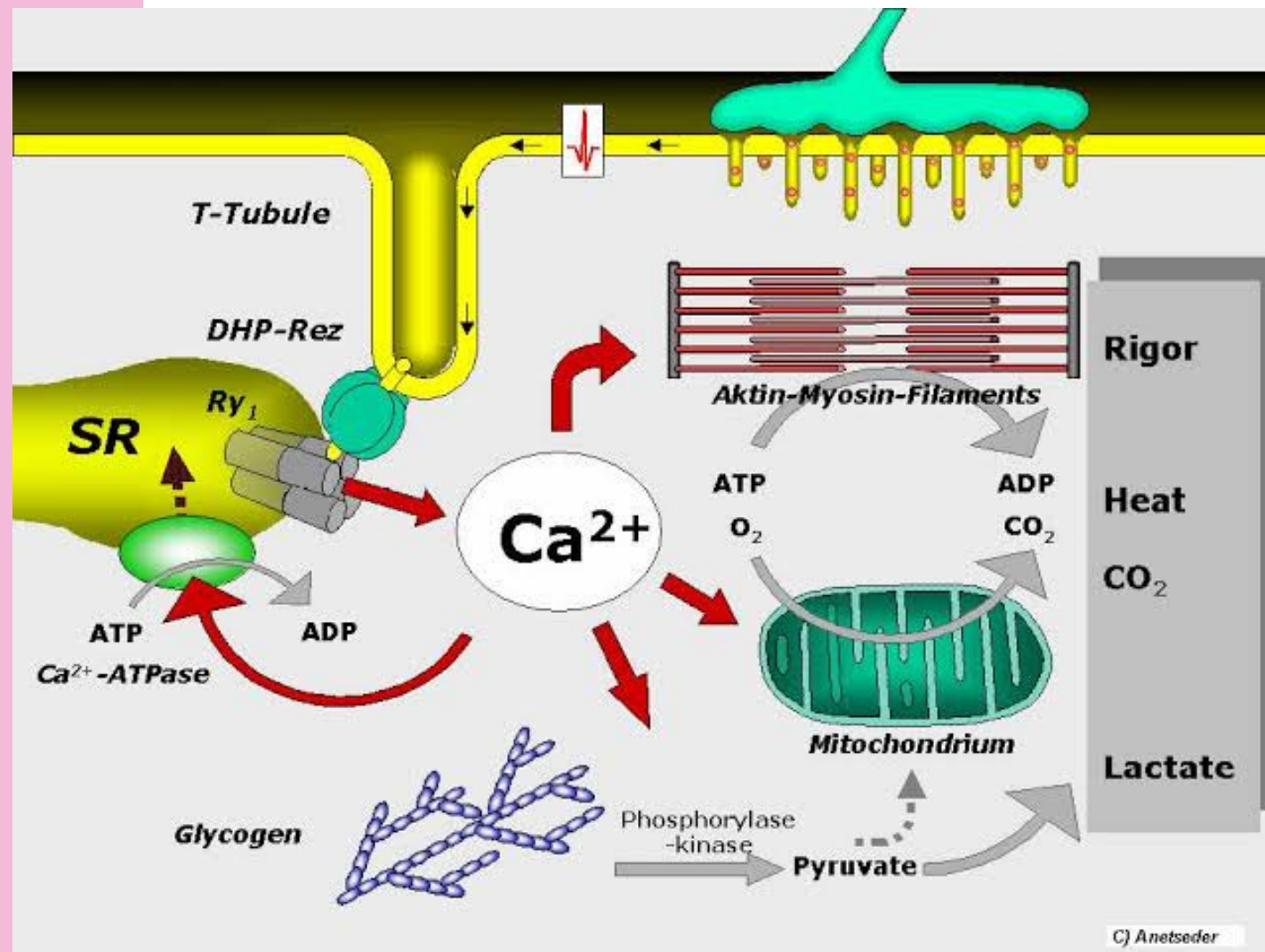
Younger population are more common

Pathophysiology

Normal physiology

- Skeletal muscle contraction occurs when sarcoplasmic calcium is released through the RyR1 receptor & binds to actin-myosin troponin complex
- Intracellular calcium pumps return calcium back to SR to enable muscle relaxation
- Both processes require ATP

Malignant hyperthermia (MH)



Pathophysiology

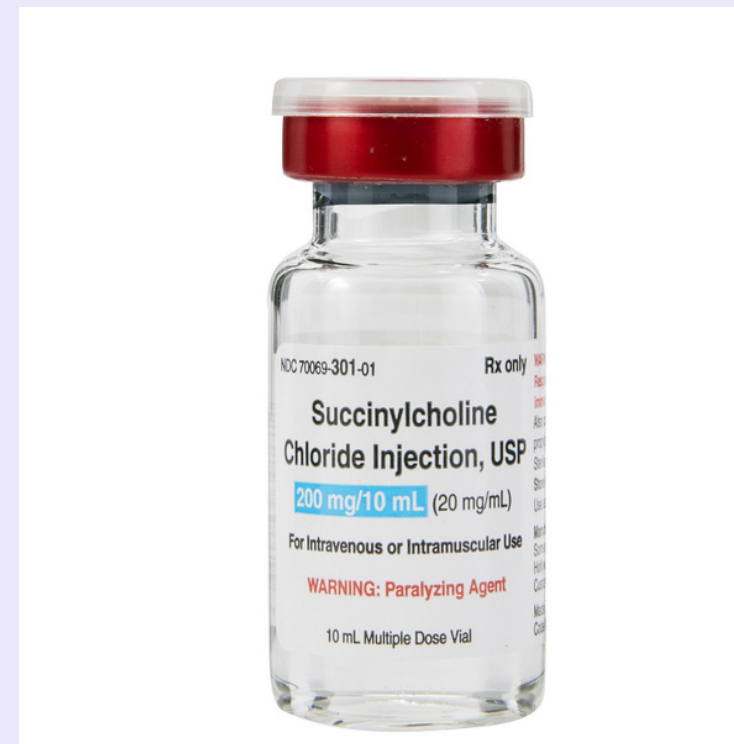
- **MH results in uncontrolled release of calcium from SR**
- Sustained muscle contracture
- Increase O₂ use, CO₂ production
- Excess lactate production
- Elevated heat production
- ATP eventually becomes depleted → failure of membrane pumps
- Leakage of electrolytes, enzymes, myoglobin

TRIGGER ANESTHETIC AGENT



INHALATION ANESTHETIC

- ☐ Halothane
- ☐ Enflurane
- ☐ Isoflurane
- ☐ Desflurane
- ☐ Sevoflurane



SUCCINYLCHOLINE

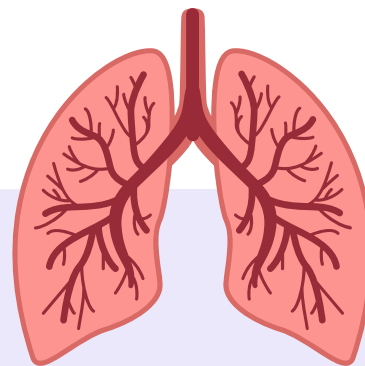
CLINICAL FINDING

- Masseter spasm
- Muscle rigidity



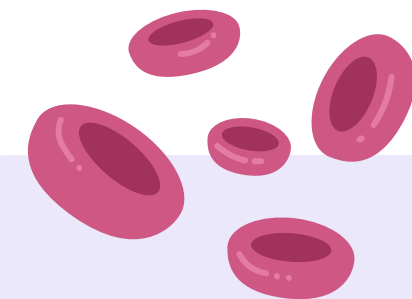
Hypermetabolic state

- Increased CO₂ production
- Respiratory acidosis
- Increased temperature



Anaerobic state

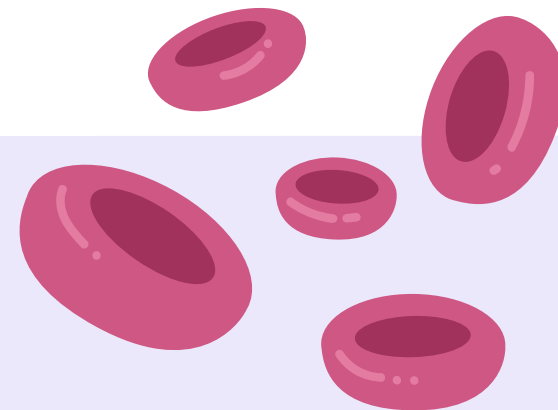
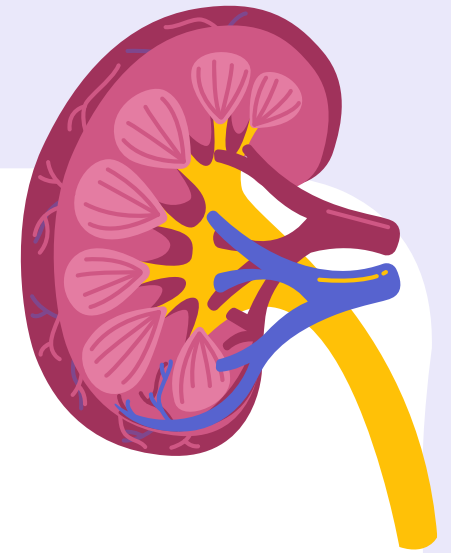
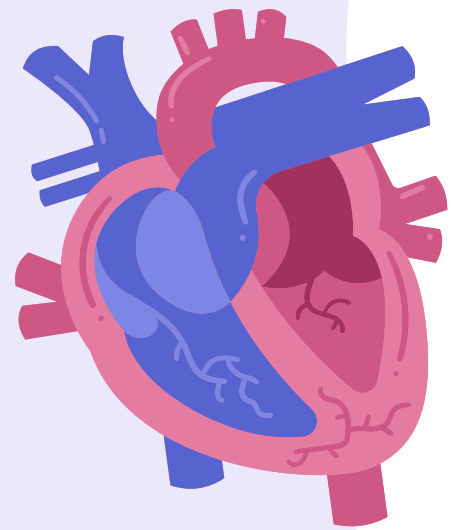
- Metabolic acidosis
- Lactate formation



CLINICAL FINDING

Multiple-organ failure

- Cardiac dysrhythmias (cardiac arrest)
- Renal insufficiency (renal failure, hyperkalemia)
- Disseminated intravascular coagulation (DIC)



CLINICAL FINDING

BOX 35.1 Clinical Signs of Malignant Hyperthermia

Early Signs

- Elevated end-tidal CO₂
- Tachypnea and/or tachycardia
- Masseter spasm if succinylcholine has been used
- Generalized muscle rigidity
- Mixed metabolic and respiratory acidosis
- Profuse sweating
- Mottling of skin
- Cardiac arrhythmias
- Unstable blood pressure

Late Signs

- Hyperkalemia
- Rapid increase of core body temperature
- Elevated creatine phosphokinase levels
- Gross myoglobinemia and myoglobinuria
- Cardiac arrest
- Disseminated intravascular coagulation

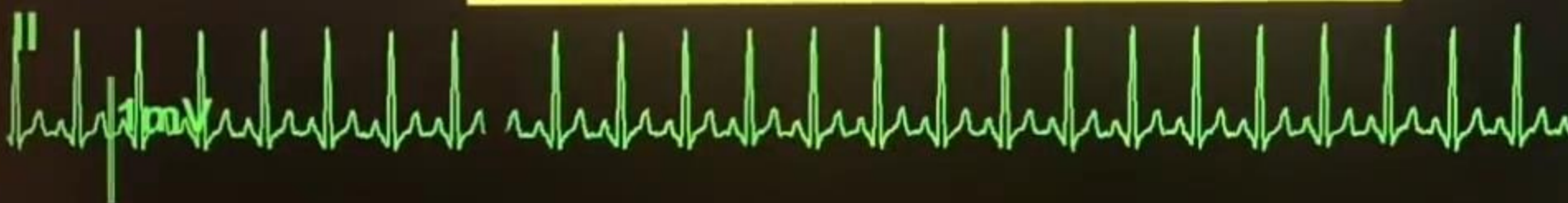
Adult

12/3/2018 08:11 AM

3 wave

✓ ** Tperi

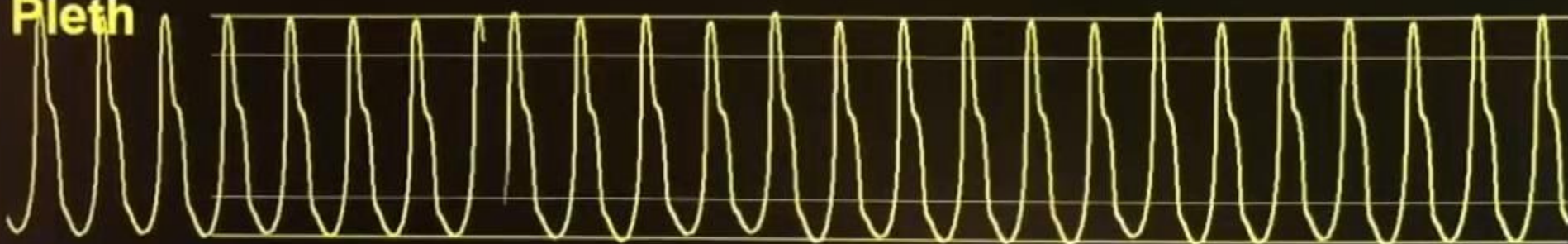
High



HR
130
50

113

Pleth



SpO₂
100
92

98

CO₂



etCO₂
65
25

50

imCO₂ 4

NBP Manual 09:11 AM

Sys. 120/80
160
90
(93)

awRR
30
8

12

Tperi
38.0
26.0

38.1



Silence



Pause Alarms



Start Stop



Graph Trends



Main Setup



Main Screen

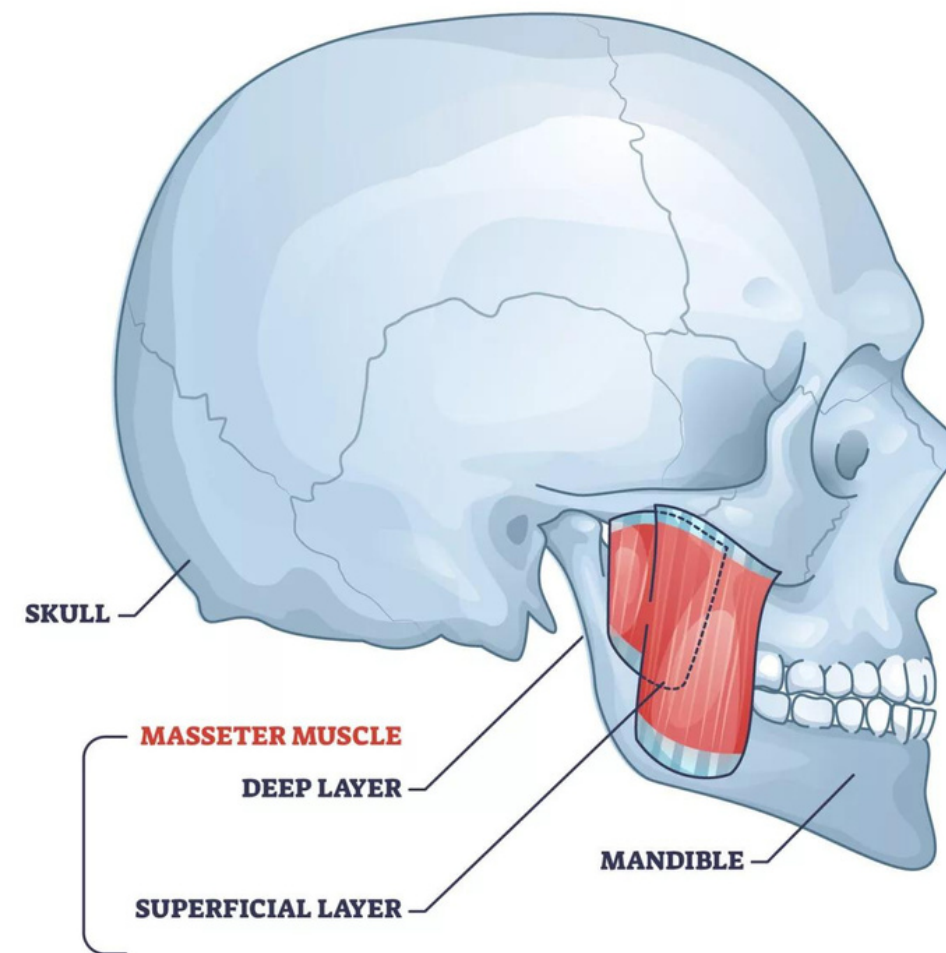
ELITEONE



Patient Monitor

OLUFSEN

MASSETER MUSCLE



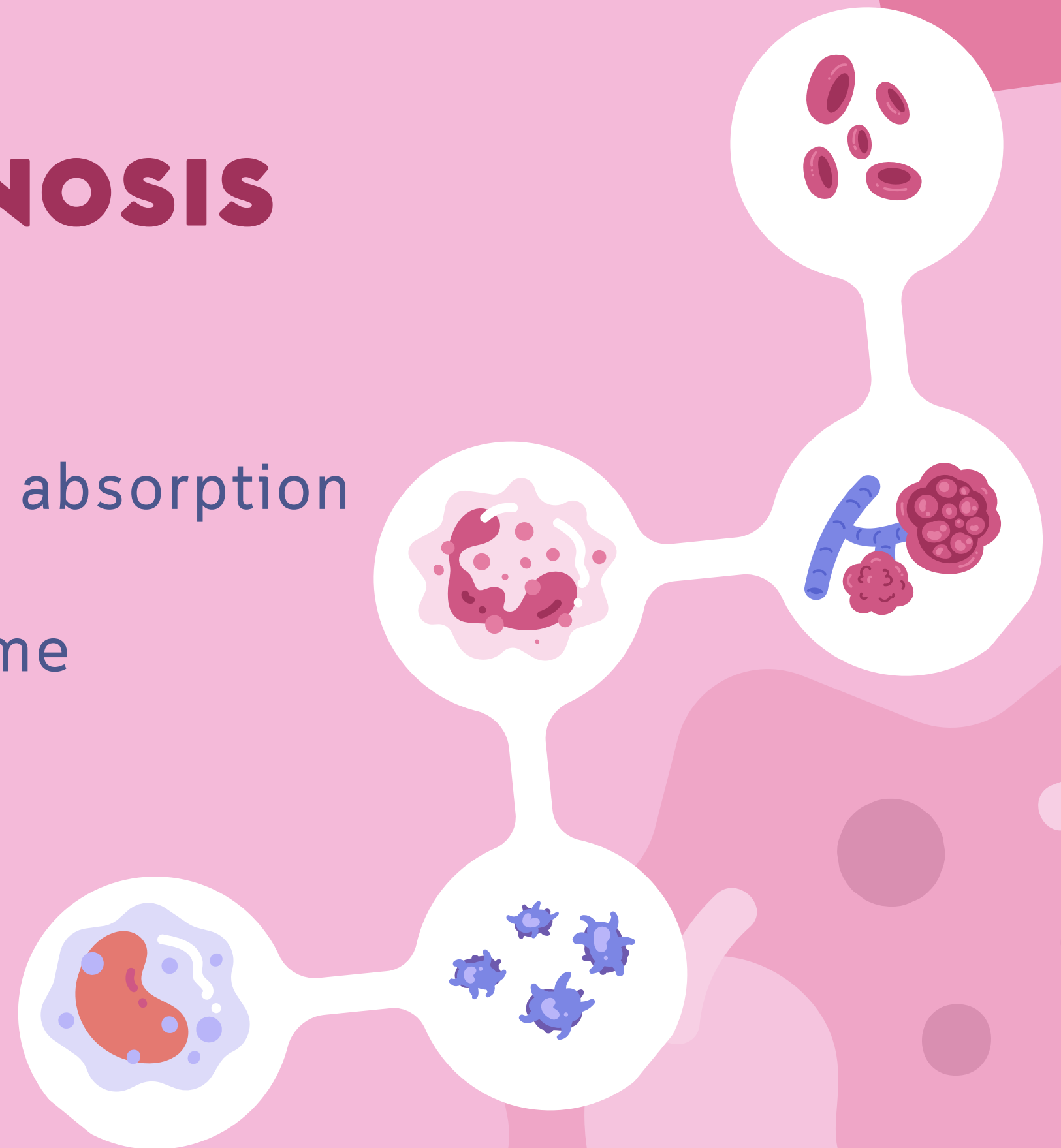
SEEN AFTER **SUCCINYLCHOLINE** ADMINISTRATION

ASSOCIATED DISEASE

- Duchenne Muscular Dystrophy
- King-Denborough Syndrome
- Other Myopathies
- Becker Muscular Dystrophy
- Periodic Paralysis
- Myotonia Congenital
- Schwartz-Jampel Syndrome
- Fukuyama Type of Congenital Muscular Dystrophy
- Mitochondrial Myopathy
- Sacroplasmic Reticulum Adenosine Triphosphate Deficiency

DIFFERENTIAL DIAGNOSIS

- Insufficient anesthesia
- Insufficient ventilation
- Rebreathing or increased CO₂ absorption
- Fever
- Neuroleptic malignant syndrome
- Serotonin syndrome
- Thyroid storm
- Pheochromocytoma



Risk Assessment

Table 2. Clinical Indicators for Use in Determining the Malignant Hyperthermia (MH) Raw Score

Process	Indicator	Points
Process I: Rigidity	Generalized muscular rigidity (in absence of shivering due to hypothermia, or during or immediately following emergence from inhalational general anesthesia)	15
	Masseter spasm shortly following succinylcholine administration	15
Process II: Muscle Breakdown	Elevated creatine kinase >20,000 IU after anesthetic that included succinylcholine	15
	Elevated creatine kinase >10,000 IU after anesthetic without succinylcholine	15
	Cola colored urine in perioperative period	10
	Myoglobin in urine >60 µg/L	5
	Myoglobin in serum >170 µg/L	5
	Blood/plasma/serum K ⁺ >6 mEq/L (in absence of renal failure)	3
Process III: Respiratory acidosis	PETCO ₂ >55 mmHg with appropriately controlled ventilation	15
	Arterial PaCO ₂ >60 mmHg with appropriately controlled ventilation	15
	PETCO ₂ >60 mmHg with spontaneous ventilation	15
	Arterial PaCO ₂ >65 mmHg with spontaneous ventilation	15
	Inappropriate hypercarbia (in anesthesiologist's judgment)	15
	Inappropriate tachypnea	10



Process IV: Temperature increase

Process V: Cardiac involvement

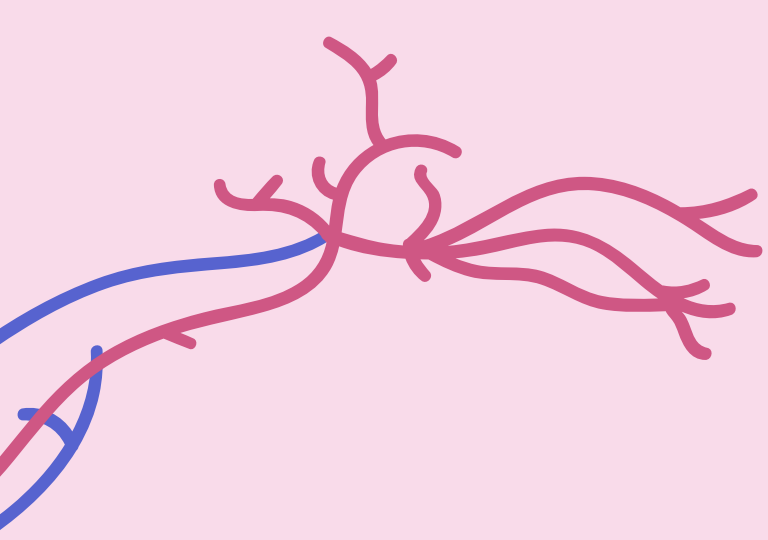
Process VI: Family History
(used to determine MH
susceptibility only)

Other indicators that are not
part of a single process

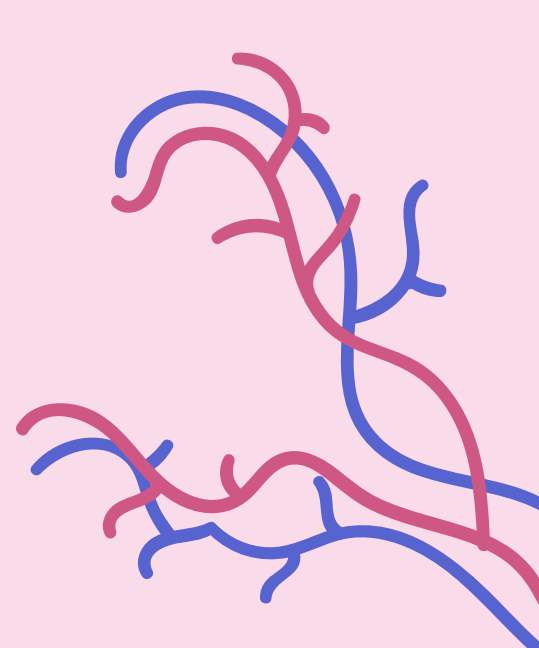
Inappropriately rapid increase in temperature (in anesthesiologist's judgment)	15
Inappropriately increased temperature >38.8°C (101.8°F) in the perioperative period (in anesthesiologist's judgment)	10
Inappropriate sinus tachycardia	3
Ventricular tachycardia or ventricular fibrillation	3
<i>Positive MH family history in relative of first degree*</i>	15
<i>Positive MH family history in relative not of first degree*</i>	5
Arterial base excess more negative than -8 mEq/L	10
Arterial pH <7.25	10
Rapid reversal of MH signs of metabolic and/or respiratory acidosis with iv dantrolene	5
<i>Positive MH family history together with another indicator from the patient's own anesthetic experience other than elevated resting serum creatine kinase*</i>	10
<i>Resting elevated serum creatine kinase* (in patient with a family history of MH)</i>	10

* These indicators should be used only for determining MH susceptibility.
† These should be added without regard to double-counting.

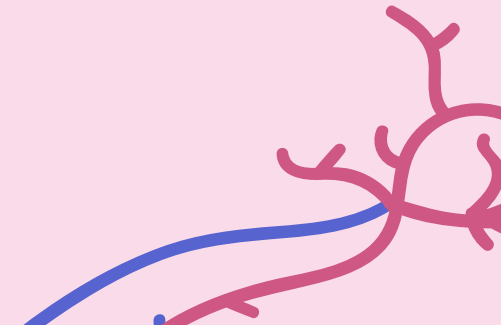
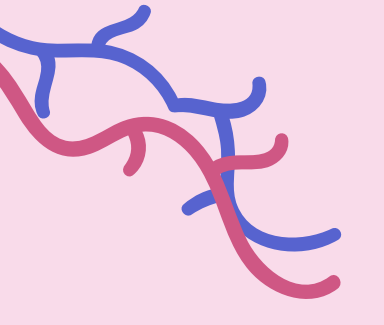


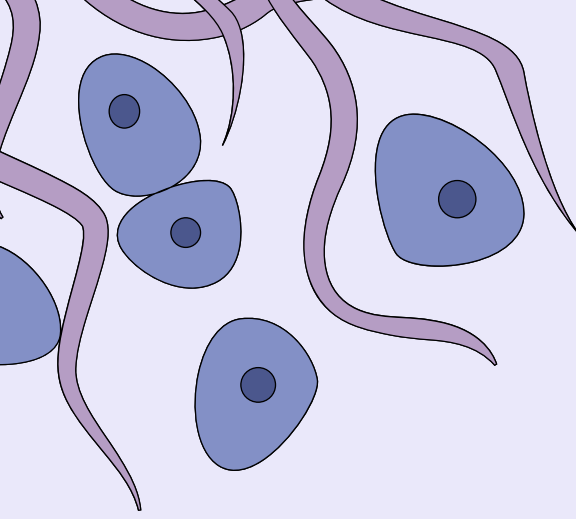


RISK ASSESSMENT



Raw score range	MH rank	Description of likelihood
0	1	Almost never
3–9	2	Unlikely
10–19	3	Somewhat less than likely
20–34	4	Somewhat greater than likely
35–49	5	Very likely
> 50	6	Almost certain

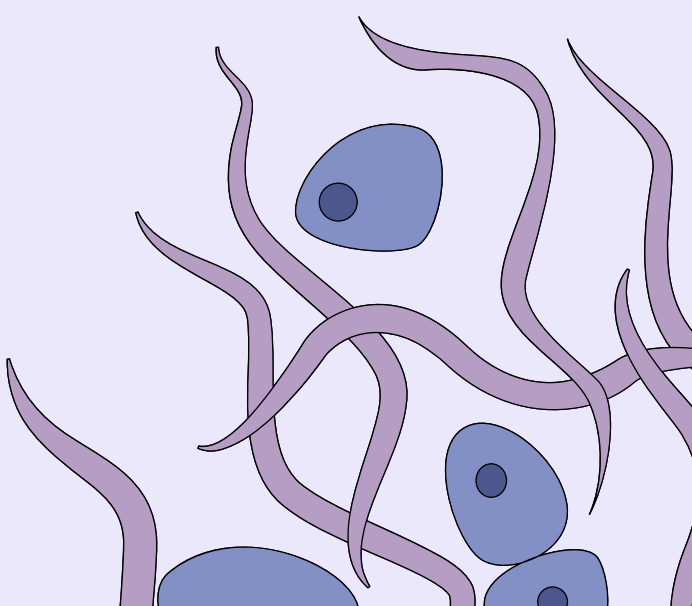




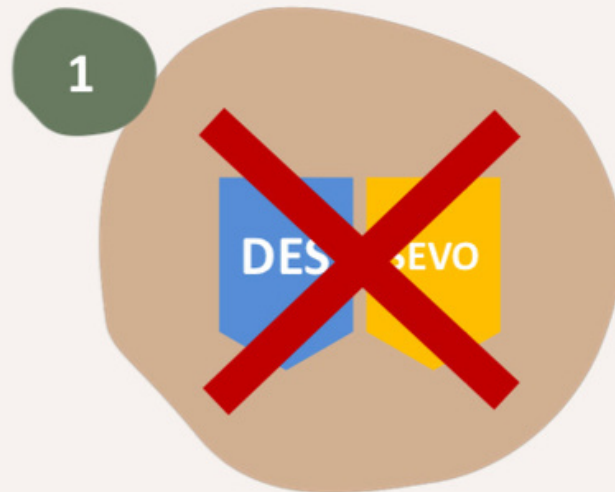
14 นามสกุลที่ต้องพึงระวัง ในการดมยาสูบ

จิวยี่ยน
ทึพยไกรสร
อินเทพ
ต๊อดแก้ว
โพธิเดช
แก่นจันทร์โส
อ่อนนภา

อุ้ยน้ำเที่ยง
เพ็ชรงาม
แป้นหอม
เจริญคง
มาวงศ์
ปรางทอง
กลมกลิ้ง



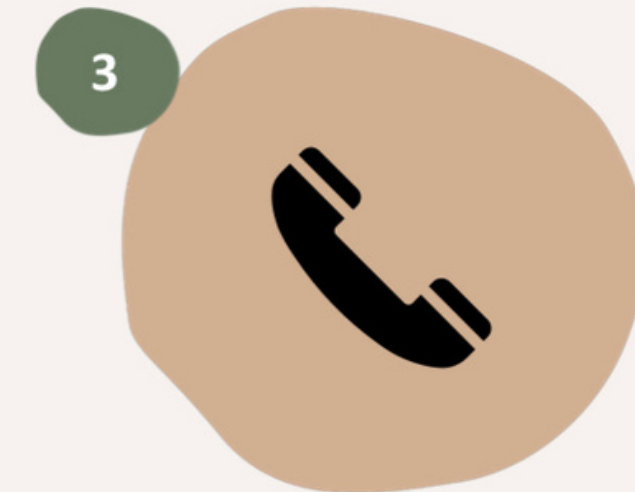
MANAGEMENT DURING OPERATION



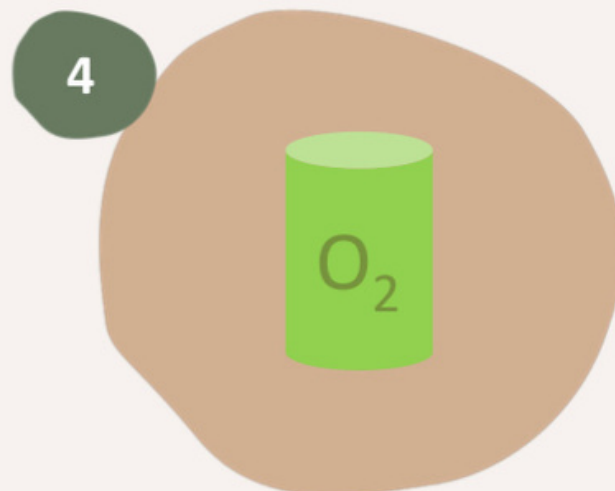
STOP triggering agents



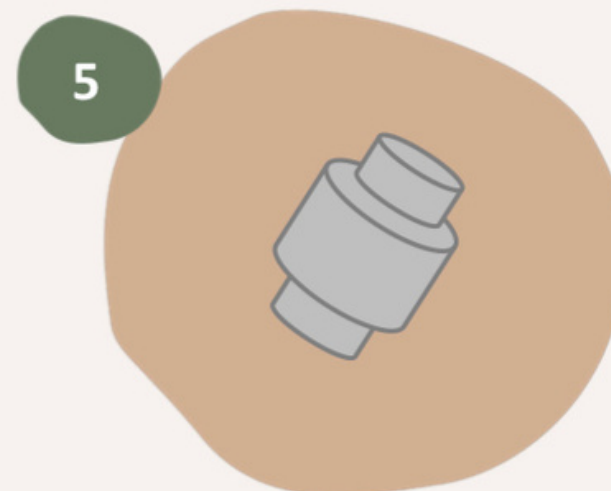
STOP operation



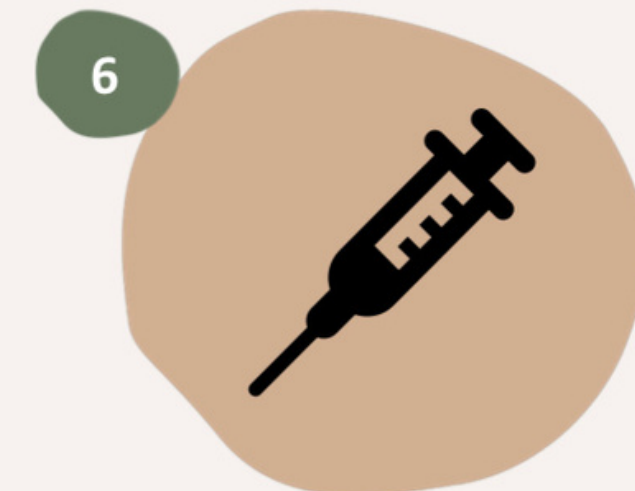
Call for Help



Hyperventilate with
100% O₂, 10 LPM



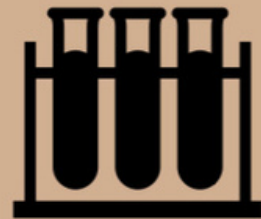
Insert **Activated**
charcoal filter



Administer **Dantrolene**

MANAGEMENT DURING OPERATION

7



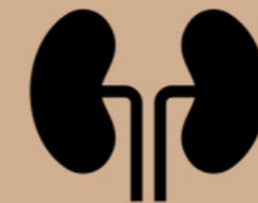
Monitoring lab

8



**Treat acidosis and
hyperkalemia**

9



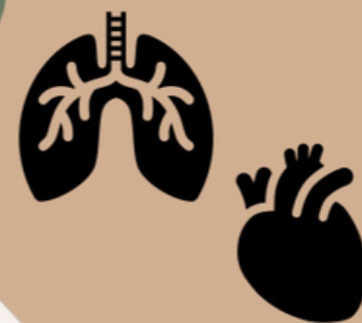
Insert Foley catheter

10



Cooling core body

11

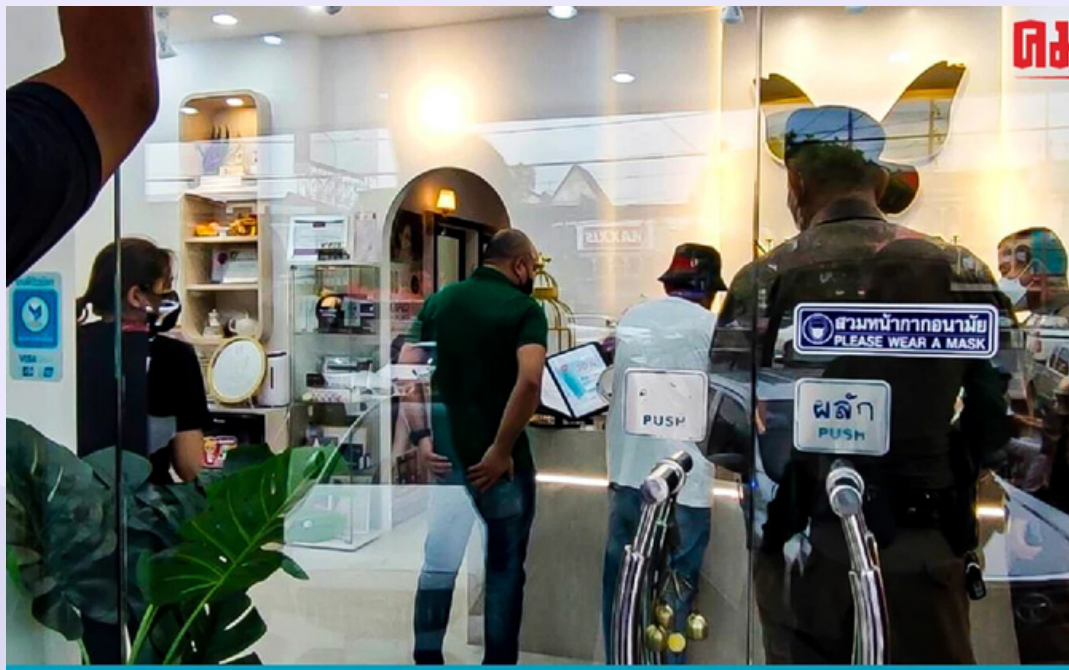


**Consider
Cardiopulmonary bypass**

12



Counselling and Testing





Malignant Hyperthermia Crisis Simulation

Share



Watch on YouTube

DANTROLENE



- A direct-acting skeletal muscle relaxant
- Dissociated the excitation-contraction coupling by **inhibiting calcium release from sarcoplasmic reticulum**
- Base form (pH 9.5) and not across blood brain barrier

DANTROLENE



- 1 vial contain 20 mg
- Usage : 20 mg/vial + sterile water 60 ml
 - 2-3 mg/kg IV repeat 1-2 mg/kg
 - every 5-10 min. Max dose 10 mg/kg

DANTROLENE

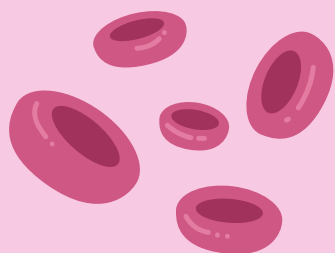
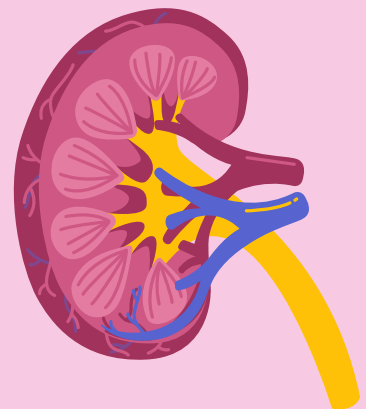
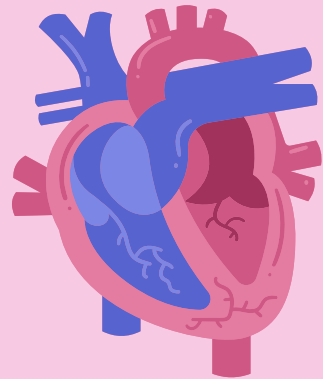


Complications

- | | |
|--------------------------|-------|
| • Muscle weakness | 21.7% |
| • Phlebitis | 9% |
| • Excessive secretion | 8.2% |
| • Gastrointestinal upset | 4.1% |
| • Respiratory failure | 3.8% |
| • Hyperkalemia | 3.3% |

POST OPERATIVE MANAGEMENT

- Monitor in ICU for at least 24 hrs
- 20% of patient have an acute malignant hyperthermia reoccurrence usually within 9 hours, 80% within 16 hours
- Clinical: muscle rigidity, worsening rhabdomyolysis, respiratory acidosis and hyperthermia
- Continue **Dantrolene** 1 mg/kg every 4-6 hours for at least 24 hours
- Stop dantrolene when clinical improve for 24 hours
 - ✓ Core temperature less than 38 C
 - ✓ CK decrease
 - ✓ No myoglobinuria
 - ✓ Decreased muscle rigidity
 - ✓ Metabolic stability



POST OPERATIVE MANAGEMENT

- Inform patient & family of the suspected diagnosis
- Report to RCAT, include copies of anesthetic record
- Obtain a medical alert tag

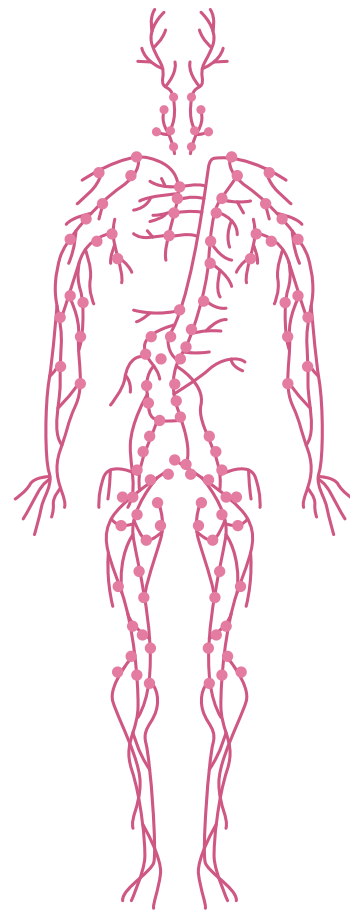
ตารางที่ 5 ระดับความสัมพันธ์ของญาติกับโอกาสเป็น MH

ลำดับความสัมพันธ์	ความสัมพันธ์	โอกาสจะเป็น
ลำดับที่ 1	พ่อ/แม่/พี่น้อง/ลูก	50 %
ลำดับที่ 2	พี่ หรือน้องของพ่อหรือแม่/หลาน	25 %
ลำดับที่ 3	ลูกพี่ลูกน้อง	12.5 %



CASE CONFERENCE

CASE CONFERENCE



Case : Female 19 years old

Diagnosis : Congenital Scoliosis

Operation : Fusion L3-pelvic

Position : Prone

CASE CONFERENCE

Cheif complains : เดินเขย่งขาขวา 11 ปี

Present illness :

11 yr PTA เริ่มมีอาการเดินเขย่งขาด้านขวา

5 yr PTA เดินเขย่งขาด้านขวามากขึ้น และสังเกตเห็นว่ามีหลังคด
ไม่มีอาการปวดหลัง ไม่มีอ่อนแรง แขนขา ไม่มีชาตามร่างกาย
ไม่มีหายใจเหนื่อยหรือหายใจลำบาก

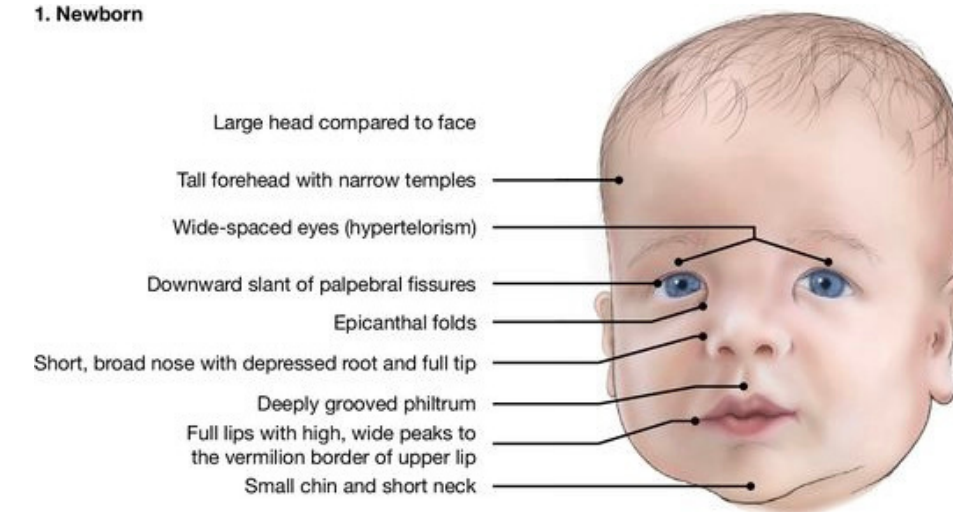
Refer from Lopburi hospital to TUH for corrective surgery

CASE CONFERENCE

Underlying Disease

- Chromosome: 46, XX, 1qh+
- Consult Pediatric geneticists
R/O Noonan syndrome

1. Newborn



CASE CONFERENCE

Past History :

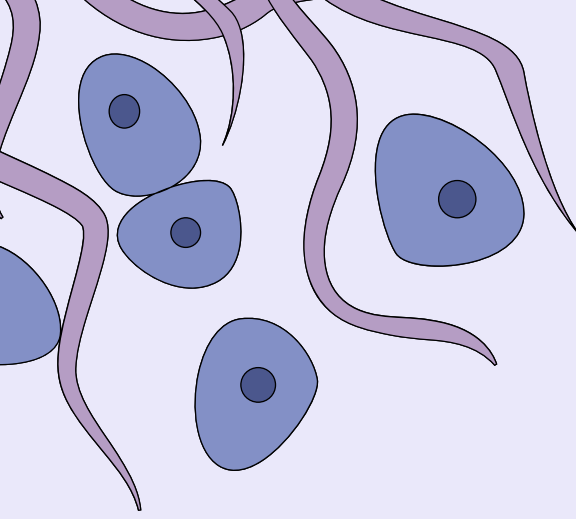
- No Food and drug allergy
- No Herbal/steroid use
- Denied Smoking
- Denied alcohol drinking
- Previous anesthesia

14/06/61 : TAL with PL transfer with plantar fascia release

Anesthesia : SB (0.5% heavy marcaine) with Propofol sedation

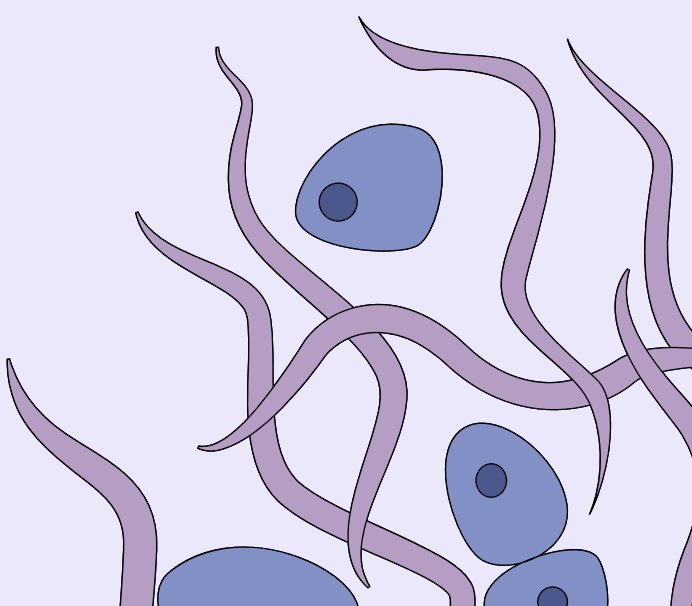
No complication

- Denied history of malignant hyperthermia in family



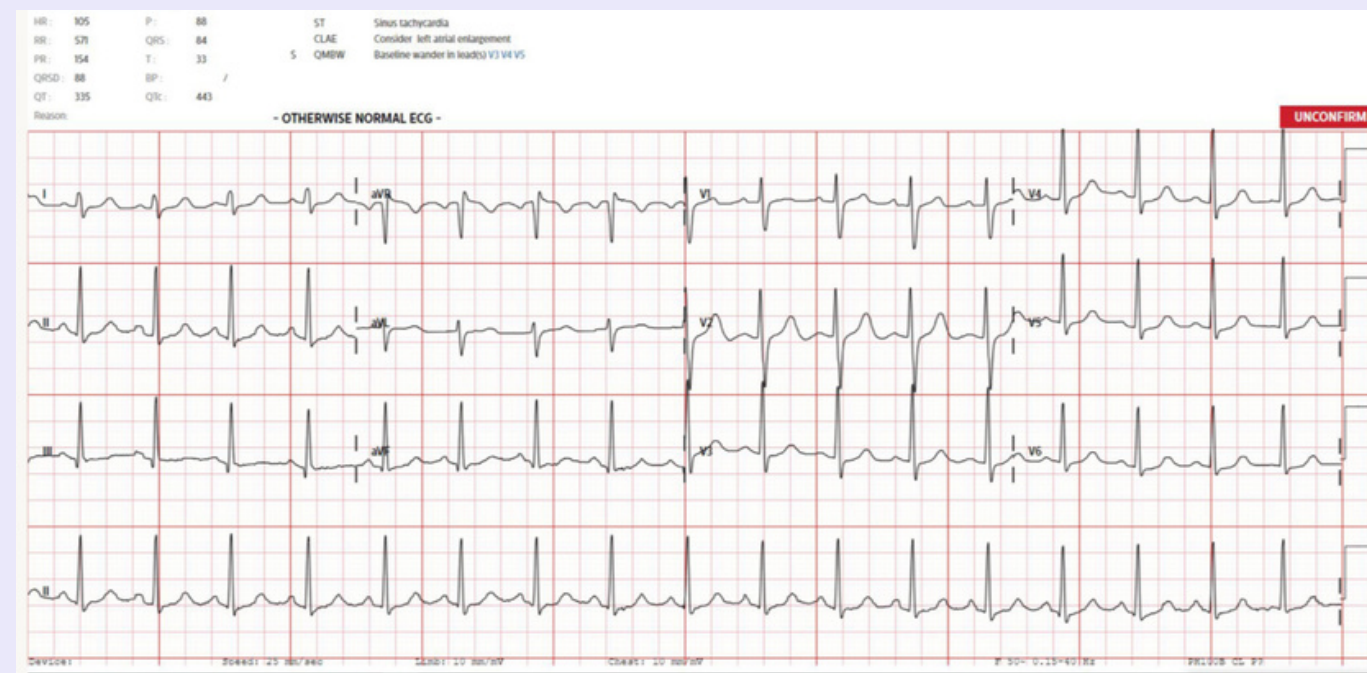
PHYSICAL EXAMINATION



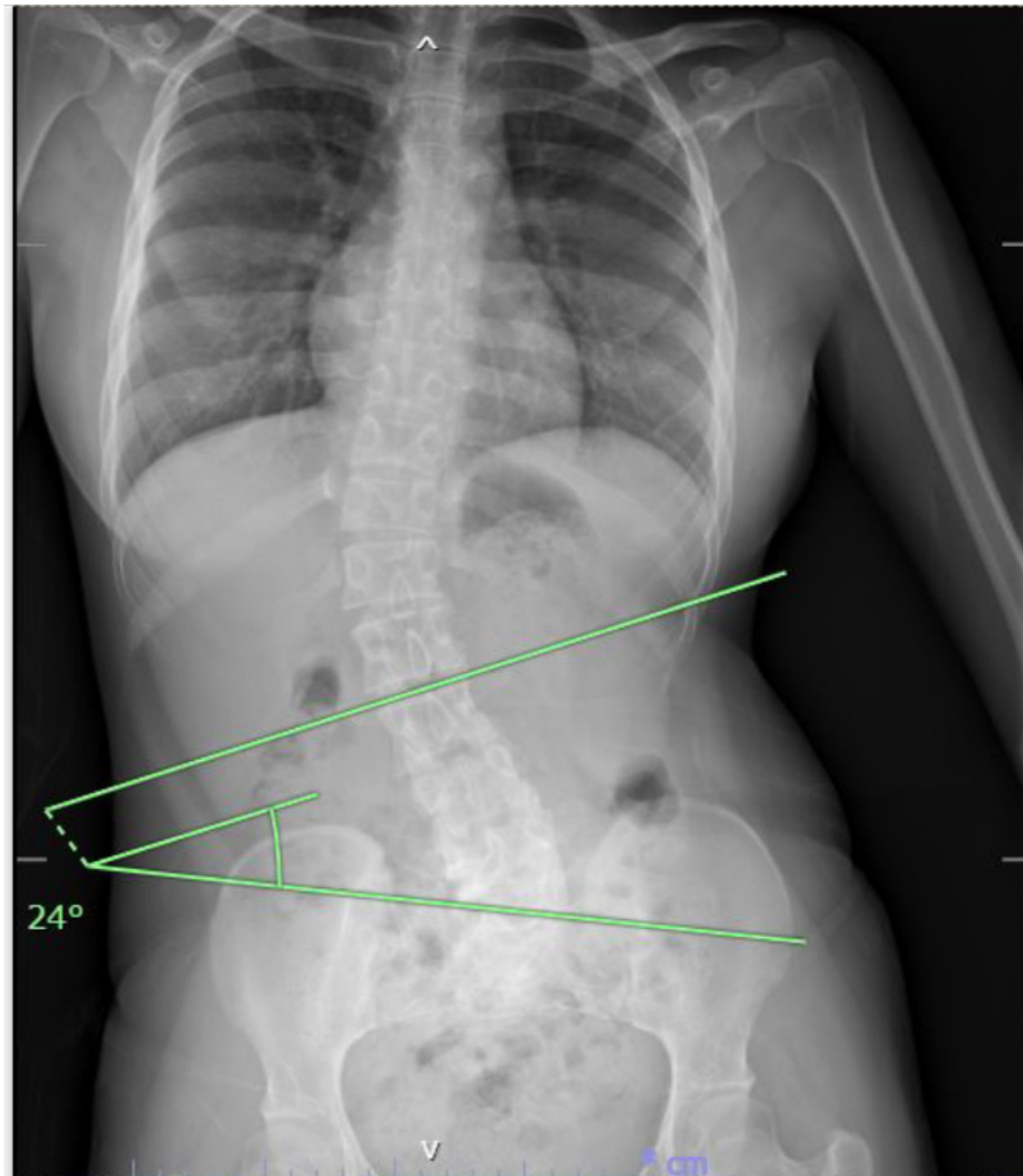
- **General appearance** : Thai female, good consciousness
 - **HEENT** : no enlarged thyroid gland, no LN can be palpated, downslanting palpebral fissures, downturn corner of mouth, long phitrum, thin upper lip, low set ears, no jugular venous engorement
 - **Ext** : no edema, no muscle atrophy, lumbar scoliosis
- 
- 

INVESTIGATION

- **CBC** : 10.1 g/dL, Hct 36 % platelets 269000/uL
- **Electrolyte** : Na 139 mmol/L, K 3.5 mmol/L, Cl 103 mmol/L HCO₃ 26 mmol/L Bun 10 mg/dL Cr 0.56 mg/dL GFR 110 mL/min/1.73m²
- **Chest X-ray** : No cardiomegaly, No abnormal infiltration, No cephalization, Trachea in midline
- **EKG 12 leads** : Normal sinus rhythm



INVESTIGATION



In this patient

- Lumbar scoliosis
- Cobb angle 24 degree
- W/U cause of scoliosis : CT spine
 - Rt bone block of L5-S1 (fusion)
- Same exercise tolerance as friends
- No clinical and PE of RV failure
 - >> Acceptable cardiopulmonary reserve

>> No pulmonary function test

INTRA-OPERATIVE

Induction at 09.30

- Lidocaine 30 mg
- Propofol 90 mg
- Cisatracurium 6 mg
- Fentanyl 75 mcg

Intubation with ETT No. 7.0 depth 20 cm.

>> No jaw muscle rigidity during intubation

Desflurane 12% → 6%

>> Supine → prone position

- AWP 21 → 24

Maintenance

- Desflurane 0.9-1.0 MAC
- Cisatracurium 2 mg IV q 30-40 min
- Fentanyl 25 mcg IV
- Force air warmer at upper and lower extremities + warm IV

Time	1:30	10:00	11:00	12:00	Total	Line
O ₂	6	→ 0.45	→	→	→	IV... # 20 LR... (ward)
N ₂ O	6	→ 0.37	→	→	→	H. 20 Rm (An)
SEVO	6	→ 12/16	→ 17/11	→	→	A-line... # 20 Rm (An)
Thio/Prop/Etomidate/Ket	90					C-line... 13.15V... 7 Fr. 2.1mm
Midazolam				2	5	Reverse
Succinyl choline						Reverse time.....
Cis Atr/Roc	6	2	2	2	14	Atropine.....mg
Morphine/Pethidine		75	75	50	25	Glycopylorate.....mg
Fentanyl						Neostigmine.....mg
2% Lidocaine	30					Extubation Yes
Levophed						No
Crystalloid: Acetar (35)	350	300	650	600	1150	Transfer
Colloid:						☐ PACU ☐ Ambulatory
Blood&Components:						☒ ICU/Ward
Output						Vital signs:
EBL	300	50	50	50	100	BP...../.....mmHg
Urine Output F/C in OR	300		300		600	HR.....bpm RR.....
Monitoring						SpO ₂%
SpO ₂	100	100	94	99	94	97
EKG	SR	SR	SR	SR	SR	SR
EtCO ₂	39	37	38	39	40	42
MAC	0.9	0.9	1.0	1.0	1.1	1.0
Temperature	36.2	36.2	36.5	36.6	36.4	37.0
AWP / PEEP	21	24	25	25	26	29
VCV mode	325x4	→ 350x4	→	→	→	→
Monitors						
☒ EKG	BP					
☒ SpO ₂ (site... LH)	X					
☒ NIBP (site... RA)	Pulse					
☒ EtCO ₂						
☒ Temp 1 (site... Nasal)	Start AN					
☐ Temp 2 (site...)	X					
☐ IBP	Start Op					
☐ CVP/PAP	Stop AN					
☐ CCO	Intubatio					
☐ TEE	T					
Special Technique						
☐ Fiberoptic intubation						
☐ One lung ventilation	☐ CPB					
☐ VDO laryngoscope	☐ Jet					
☐ Awake						
Position						
☐ Supine	☐ Sitting	☒ Prone				
☐ Lithotomy	☐ Lateral Rt/Lt					
Symbols						
GA	☐ TIVA	☐ MAC	☐ Local/Topical			
RA	☐ Spinal block	☐ Epidural block	☐ Caudal block	☐ OCSE	Needle.....Level.....Approach.....	
Attempt.....	Agents&Dose.....					
Catheter No.....	at skin.....cm in space.....cm	Agents.....				
Neuraxial narcotic:Used/Wasted.....	mg/mcg/Witness.....	☐ USC ☐ PNS ☐ Single shot ☐ Continuous				
☐ PNB	☐ FNB	☐ SNB	☐ ACB	☐ TFP	☐ Pop	☐ FIB
☐ ESP	☐ Paravertebral	☐ Cervical	☐ TAP	☐ PECS		
☐ Inguinal	☐ Penile	☐ BPB: IS/IF/SC/AX	RL/Lt/Bilat.	☐ Other.....	Needle.....	
Agents&Dose.....						
Airway Management						
☒ Oral/Nasal ETT	☐ Endobronchial tube: RL / Lt					
☐ Oral/Nasal RAE	☐ Under mask					
☐ LMA	☐ Tracheostomy	☐ Cannula /Mask /Mask with bag				
No. 7.0	Secured.....20.....cm	☒ Cuff LV gr.....1.....	Attempt.....1.....			
☐ RSI	☐ Cricoid pressure	Confirmed by: ☒ BBS ☒ EtCO ₂ ☐ FOB				
☐ Difficult.....						

INTRA-OPERATIVE

10.45 (1.15 hr after induction)

>> Increased EtCO₂ and temperature

- Change Sodalime
- Notify staff

Time	9.30	10.00	11.00	12.00	Total	Line
O ₂	LPM 6 → 0.65 → → → → →					IV # 20 LH (ward)
N ₂ O	LPM 6 → 0.65 → → → → →					# 20 RH (AN)
SEVO	Press Esc to exit full screen					A-line # 20 RH (AN)
Thio/Prop/Etomidate/Ket						C-line 15 IN 7 Fr 3 lumen
Midazolam						20X 15 cm
Succinyl choline						Reverse
Cis/Atra/Roc/	6	2	2	2	4	Reverse time
Morphine/Pethidine						Atropine
Fentanyl		75	25	50	25	Glycopylorate
2% lidocaine	30					Neostigmine
Crystallloid: Acetar (350)	350	300	650	600	1150	Extubation
Colloid:						Yes
Blood&Components:						No
EBL		50	5	50	100	Transfer
Urine Output F/C in or	300		300		300	PACU Ambulatory
SpO ₂	100	100	99	99	98	ICU/Ward
EKG	SR	SR	SR	SR	ST	Vital signs
EtCO ₂	39	37	38	39	40	BP
MAC	0.9	0.9	1.0	1.0	1.0	HR
Temperature	36.2	36.2	36.5	36.6	36.9	RR
AWP	21	24	25	26	29	SpO ₂
VCV mode	325x	4	350x			Note
Monitors						Remark
BP	200					ATB Surgeon not considering ATB
SpO ₂ (site LH)	X					Cefazolin 1 gm
NIBP (site RA)	Pulse					time 9:30
EtCO ₂	•					① Paracetamol 750 mg
Temp 1 (site Nasal)	Start AN					② ABG → PH 7.315, PCO ₂ 50.8, PO ₂ 215
Temp 2 (site)	X					BE > 0, Na = 138, K = 6.1, Urea 2.8
IBP	Start Op.					③ Dantrolene 20 mg
CVP/PAP	Stop AN					④ Dantrolene 20 mg
CCO	Intubation					⑤ Dantrolene 20 mg
TEE	T					⑥ Dantrolene 20 mg
Special Technique						⑦ Glucose 50 mg
Fiberoptic intubation						⑧ FI 10 S
One lung ventilation	CPB					⑨ Dantrolene 20 mg
VDO laryngoscope	Jet					⑩ Calcium gluconate 1 gm
Awake						⑪ Dantrolene 20 mg
Position						⑫ Dantrolene 20 mg
Supine						
Sitting						
Prone						
Lithotomy						
Lateral Rt/Lt						
Symbols	X T					Airway Management

INTRA-OPERATIVE

11.30 >> R/O MH

- Off desflurane
- Midazolam 2 mg IV
- Paracetamol 750 mg IV
- Access A-line for blood sampling

Time	9.30	10.00	11.00	12.00	Total	Line
O ₂	LPM 6	0.65	→	→	→	IV... # 20 LR (WARD)
N ₂ O	LPM 6	0.37	→	→	→	# 20 RH (AN)
SEVO	%	12.16	7.71	7.71	7.71	A-line... # 20 RH (AN)
Thio/Prop/Etomidate/Ket	90					C-line... 1.5 IN 3 Fr 3 (un)
Midazolam						3.5 cm
Succinyl choline						Reverse
Cis/Atra/Roc	6	2	2	2	4	Reverse time...
Morphine/Pethidine						Atropine... mg
Fentanyl		75	75	50	25	Glycopylorate... mg
2% lidocaine	30					Neostigmine... mg
Levophen						Extubation Yes
Crystalloid: Acetar (350)	350	200	650	600	1950	No
Colloid:						Transfer
Blood&Components:						PACU Ambulatory
EBL		50	50	50	100	ICU/Ward
Urine Output F/C in OR	300		300		300	Vital signs:
SpO ₂	%	100	99	99	99	BP... 129/81 mmHg
EKG	SR	SR	SR	SR	SR	HR... 112 bpm RR... 60/min
EtCO ₂	mmHg	34	37	38	40	SpO ₂ ... 100%
MAC		0.9	0.9	1.0	1.0	Note...
Temperature	°C	36.2	36.2	36.5	36.6	
ANP	/ REEP 5	21	24	25	26	
VCV mode		325x	4	350x		
Monitors	Symbols					
☒ EKG	BP	200				
☒ SpO ₂ (site... LH)	X	180				
☒ NIBP (site... RA)	Pulse	160				
☒ EtCO ₂	•	140				
☒ Temp 1 (site... NAS)	Start AN	120				
☐ Temp 2 (site...)	X	100				
☐ IBP	Start Op.	80				
☐ CVP/PAP	Stop AN	60				
☐ CCO	⊗	40				
☐ TEE	Intubation	20				
☐	T	0				
Special Technique						
☐ Fiberoptic intubation						
☐ One lung ventilation	CPB					
☐ VDO laryngoscope	Jet					
☐ Awake						
Position						
☐ Supine	☒ Sitting	☐ Prone				
☐ Lithotomy	☐ Lateral Rt/ Lt.					
Symbols	X T					

Remark

ATB ☒ Surgeon not considering ATB

☒ Cefazolin 1 gm @

time: 9.30 hr

① Paracetamol 750 mg @

② ABG → PH 7.315, PCO₂ 35.8, PO₂ = 215

BE = 0, Na = 136, K = 5.1, Urea = 2.8

lab 10.2 Wt = 30.4

③ Dantrolene 20 mg @ ①

@ Dantrolene 20 mg @ ②

⑤ Dantrolene 20 mg @ ③

⑥ Dantrolene 20 mg @ ④

⑦ Glucose 50 mg @

FI 10 @

⑧ Dantrolene 20 mg @ ⑤

⑨ Calcium gluconate 1 gm @ ⑤

⑩ Dantrolene 20 mg @ ⑥

Dantrolene 20 mg @ ⑦

INTRA-OPERATIVE

12.00

- ABG : pH 7.315 PaCO₂ 50.8 PaO₂ 215 BE 0 Na 138 K 5.1 HCO₃ 25.8 Hb 10.2 Hct 30.4
- Urine : clear yellow color

Clinical

- Unexplained sinus tachycardia
- Increased end-tidal CO₂ with adequate ventilation
- Unexpected respiratory acidosis
- Increased body temperature > 38.8c with no obvious cause

>> Suspected malignant hyperthermia

Time	9.30	10.00	11.00	12.00	Total	Line				
O ₂	LPM 6	0.65	→	→	→	→	used	waste	IV... # 20 LR (WARD)	
N ₂ O	LPM 6	0.37	→	→	→	→	90	110mg	... # 20 RM (AN)	
SEVO	%	2.16	7.71	7.71	7.71	7.71	10	2mg	A-line... # 20 Radial	
Thio/Prop/Etomidate/Ket	90						10	2mg	C-line... 1.5N 3.5R 3.5L	
Midazolam							10	2mg	3.5X 3.5Y	
Succinyl choline							10	2mg	Reverse	
Cis/Atra/Roc	6	2		2			10	2mg	Reverse time.....	
Morphine/Pethidine							10	2mg	Atropine.....mg	
Fentanyl							10	2mg	Glycopylorate.....mg	
2% lidocaine	30	75	25	50	25	25	10	2mg	Neostigmine.....mg	
Urethane							10	2mg	Extubation Yes	
Crystalloid: Acetar (350)	350	200	650	600	1150	200+400/1750	1750	ml	No	
Colloid:								ml	Transfer	
Blood&Components:								ml	☐ PACU ☐ Ambulatory	
EBL								ml	☒ ICU/Ward	
Urine Output F/C in OR	300	50	50	50	100	100	100	ml	Vital signs :	
SpO ₂	%	100	94	99	94	99	94	96	100	BP.....2.4/1.1 mmHg
EKG	SR	SR	SR	SR	SR	SR	SR	ST	ST	HR.....112 bpm RR.....60/min
EtCO ₂	mmHg	39	37	38	39	40	42	46	58	SpO ₂100%
MAC		0.9	0.9	1.0	1.0	1.1	1.0	1.0	0.5	Note.....
Temperature	°C	36.2	36.2	36.5	36.6	36.9	37.4	38.6	38.7	
AWP	/ REEP 5	21	24	25	25	26	28	30	29	
VCV mode		325x	4	350x	→	→	→	→	→	
Monitors	Symbols									
☒ EKG	BP	200								
☒ SpO ₂ (site... LH)	X									
☒ NIBP (site... RA)	Pulse	180								
☒ EtCO ₂	•									
☒ Temp 1 (site... N2)	Start AN									
☐ Temp 2 (site...)	X									
☐ IBP	Start Op.									
☐ CVP/PAP	Stop AN.									
☐ CCO	Intubation									
☐ TEE	T									
Special Technique										
☐ Fiberoptic intubation										
☐ One lung ventilation	☐ CPB									
☐ VDO laryngoscope	☐ Jet									
☐ Awake										
Position										
☐ Supine	☐ Sitting	☒ Prone								
☐ Lithotomy	☐ Lateral Rt./ Lt.									
Symbols	X T									
Anesthetic Technique										
Airway Management										

Remark

ATB ☐ Surgeon not considering ATB

☒ Cefazolin 1 gm @

time: 9.30

① Paracetamol 750 mg @

② ABG → pH 7.315, PaCO₂ 50.8, PaO₂ 215
BE > 0, Na = 138, K = 5.1, HCO₃ = 25.8
Hb 10.2 Hct 30.4

③ Dantrolene 20 mg @ ①

④ Dantrolene 20 mg @ ②

⑤ Dantrolene 20 mg @ ③

⑥ Dantrolene 20 mg @ ④

⑦ Glucose 50 mg @

⑧ FI 10 @

⑨ Dantrolene 20 mg @ ⑤

⑩ Calcium gluconate 1 gm @ ⑤

⑪ Dantrolene 20 mg @ ⑥

⑫ Dantrolene 20 mg @ ⑦

INTRA-OPERATIVE

>>> Suspected MH

- Call for help
- Notify surgeon
- 100% Oxygen flush then 7 LPM
- Blood for CBC, BUN, Cr, electrolyte, Ca, Mg, P, CPK, myoglobin, Thyroid function test
- Start Dantrolene IV
- 50 % glucose 50 ml + RI 10 u IV
- Calcium gluconate 1 gm IV
-

Time	9.30	10.00	11.00	12.00	13.00	Total	Line
O ₂	LPM 6	→ 0.65	→	→	→	→	IV #20 LR (Ward)
N ₂ O	LPM 6	→ 0.37	→	→	→	→	#20 RA (AN)
SEVO	%	1.16	→	→	→	→	A-line #20 @ Radial A
Thio/Prop/Etomidate/Ket	90						C-line 1.5 LBN 7.5 L. 3.5 L. 1.5 L.
Midazolam							2.5 X 25 cm
Succinyl choline							Reverse
Cis Atra/Roc	6	2	2			10	Reverse time
Morphine/Pethidine							Atropine.....mg
Fentanyl		75	75	50	25	250	Glycopyllorlate.....mg
2% lidocaine	30					30	Neostigmine.....mg
Levophed				44.4		12	Extubation Yes
Crystalloid: Acetar (350)	350	300	650	600	1150	1750	No
Colloid:							Transfer
Blood & Components:							☐ PACU ☐ Ambulatory
EBL		50	50	50	100	100	☒ ICU/Ward
Urine Output F/C in OR	300		300		300	400	Vital signs:
SpO ₂	%	100	99	99	99	99	BP 120/80
EKG	SR	SR	SR	SR	SR	SR	HR 112 bpm RR 20
EtCO ₂	mmHg	39	37	38	39	40	SpO ₂ 100%
MAC		0.9	0.9	1.0	1.0	1.0	Note
Temperature	°C	36.2	36.2	36.5	36.6	36.9	
PAP	/ REEP 5	21	24	25	26	29	
VCV mode		325x	4	350x			
Monitors							
☒ EKG	BP	200					
☒ SpO ₂ (site: LH)	X						
☒ NIBP (site: RA)	Pulse						
☒ EtCO ₂	•						
☒ Temp 1 (site: Nasal)	Start AN						
☒ Temp 2 (site:)	X						
☐ IBP	Start Op.						
☐ CVP/PAP	Stop AN						
☐ CCO	Intubation						
☐ TEE	T						
Special Technique							
☐ Fiberoptic intubation							
☐ One lung ventilation	☐ CPB						
☐ VDO laryngoscope	☐ Jet						
☐ Awake							
Position							
☐ Supine	☒ Sitting						
☐ Lithotomy	☐ Lateral Rt/ Lt.						
Symbols	X	T					
Anesthetic Technique							
☒ GA	☐ TIVA	☐ MAC	☐ Local/Topical				
☐ RA	☐ Spinal block	☐ Epidural block	☐ Caudal block	☐ OCSE	Needle.....	Level.....	Approach.....
Attempt.....	Agents & Dose.....						
Catheter No.....	at skin.....	cm in space.....	cm	Agents.....			
Neuraxial narcotic: Used/Wasted.....	mg/mcg	Witness.....		☐ USC	☐ PNS	☐ Single shot	☐ Continuous
☐ PNB	☐ FNB	☐ SNB	☐ ACB	☐ TFP	☐ Pop	☐ FIB	☐ ESP
☐ Inguinal	☐ Penile	☐ BPB: IS/IF/SC/AX	RL/LI/Bilat.	☐ Other.....	Needle.....		
Agents & Dose.....							
Airway Management							
☒ Nasal ETT	☐ Endobronchial tube: Rt/ Lt.						
☐ Oral Nasal RAE	☐ Under mask						
☐ LM	☐ Tracheostomy	☐ Cannula / Mask / Mask with bag					
No.....	Secured.....	cm	☒ Cuff LV gr.....	1	Attempt.....	1	
☐ RS	☐ Cricoid pressure	Confirmed by: ☒ BBS	☒ EtCO ₂	☐ FOB			
☐ Difficult.....							

INTRA-OPERATIVE

At Dantrolene 5th dose → EtCO₂ and body temperature were stabilized and not increased

Prone → supine position

- Insert C-line for IV access and monitoring
- Transfer to ICU for closed monitoring

I/O Acetar 1780 ml/EBL 100 ml + UOP 400 ml

Op-time: 3.15 hr

Time		9.30				10.00				11.00				12.00				Total		Witness	Line	
		LPM														used	waste	IV. # 20 LH (L ward)				
Agents	O ₂	LPM	6	→	0.65	→	→	→	→	→	→	→	→	→	→	→	→	→	IV. # 20 RH (AN)			
	N ₂ O/Air	LPM			0.37	→	→	→	→	→	→	→	→	→	→	→	→	→	A-line. # 20 Radial A.			
	SEVO/DES	%			12/16	17/11	11	11	11	11	11	11	11	11	11	11	11	11	C-line. 1.5 IN. 7. Fr. 3 lum			
	Thio/Propofol/Etomidate/Ket		90																3.0 X 15 (m)			
	Midazolam																					
	Succinyl choline																					
	Cis/Atra/Roc/		6			2				2							2	4	17	3		
	Morphine/Pethidine																					
Fentanyl																						
2% lidocaine		30																				
Evaphed																						
Intake	Crystalloid: Acetar (350)		350			200			650			600				1150		200	200	1750		
Output	Colloid:																					
	Blood&Components:																					
	EBL																					
	Urine Output F/C in or		300						50			50				100			100			
Monitoring																						
	SpO ₂	%	100	100	99	99	98	97	98	96	100	100	100	100	100							
	EKG		SR	SR	SR	SR	SR	SR	ST	ST	ST	ST	ST	ST	ST							
	EtCO ₂	mmHg		39	37	38	39	40	42	46	58	59	45	35	30							
	MAC			0.9	0.9	1.0	1.0	1.1	1.0	1.0	0.5	0.5	0.1	0.0	0.0							
	Temperature	°C		36.2	36.2	36.5	36.6	36.9	37.4	38.6	38.7	39.1	39.4	39.2	36.2							
	AWP			21	24	25	25	26	29	30	29	29	29	32	22							
	VCV mode			325x	4	350x	1	1	1	1	1	1	1	1	1							
ATB																				Surgeon not considering ATB		
time: 9.30																				Cefazolin 1 gm @		
① Paracetamol 750 mg ②																						

POST-OPERATIVE

	Pre-op	Intra-op 9/8/66 12.30	Post-op Day 0 9/8/66	Post-op Day1 10/8/66
Hb / Hct	10.7/33.7	6.0/19.5	7.5/24.4	7.8/25.2
Platelets	269,000	158,000	206,000	163,000
BUN/Cr	10/0.56	12/0.64		14/0.35
Na	139	139	134	132
K	3.5	5.1	3.9	3.5
Cl	103	105	101	103
HCO3	26	25	22	21
CPK		636	967	1072

S : Alert E4VtM6

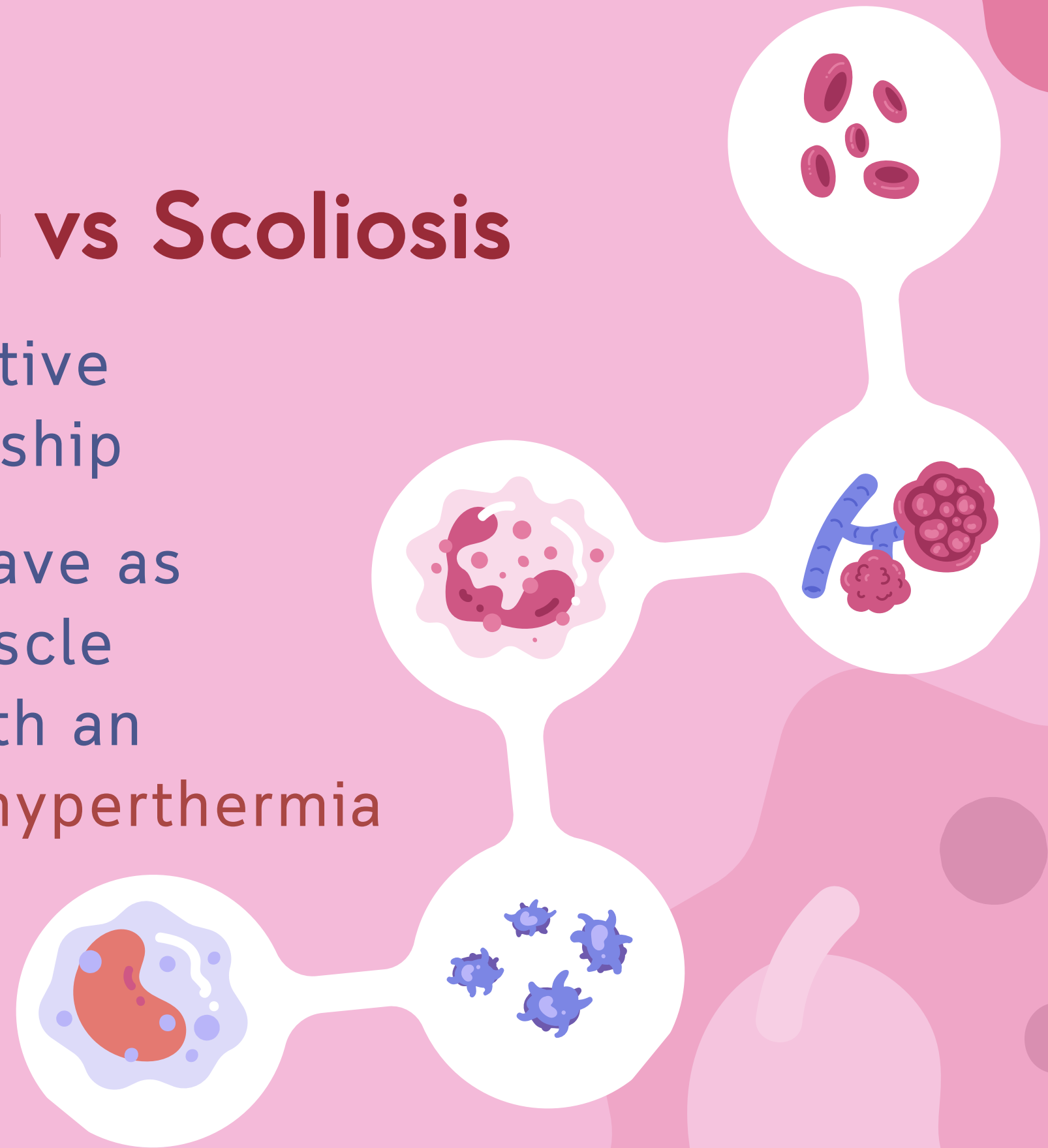
O : V/S 105/68 mmHg PR 90 bpm RR 16/min BT 37.2 c

Management

- off ETT
- PRC 1 U IV drip in 3 hr * II U
- Furosemide 5 mg IV
- 5% DN/2 1000 ml IV rate 60 ml/hr
- Discharge to ward

Malignant hyperthermia vs Scoliosis

- There is has been no supportive evidence of a direct relationship
- But **scoliosis** patients may have as associated or underlying muscle disorders that associated with an increased risk of malignant hyperthermia



MALIGNANT HYPERTHERMIA





THANK YOU
FOR ATTENTION