

Interesting case

R1 Chanathip Meerod / Lt.Col.Sithapan Munjupong

Interesting case

Case : 19 years old male

Diagnosis : Adolescent idiopathic scoliosis

**Operation : Pedicular screw fixation with
posterior lumbar fusion T10-L4**

Chief complaint

ปวดหลัง 3 ปี PTA

ไปพบแพทย์ พบว่ามีกระดูกสันหลังคด
มารับการผ่าตัดตามนัด



R1 history talking

History

Present illness : 3 ปี PTA ปวดหลังบริเวณเอวซ้าย อาการปวดไม่สัมพันธ์กับท่าทาง ไม่มีอุบัติเหตุมาก่อน ทำงานหรือออกกำลังกายได้ปกติ ไม่มีหอบเหนื่อย จึงไปตรวจที่ รพ. X-ray พบว่ามีกระดูกสันหลังคด

1 ปี PTA อาการปวดทุเลาลง แต่จะปวดมากขึ้นเมื่อออกกำลังกายหรือยกของหนัก **ไม่มี** อาการชาหรืออ่อนแรงของแขนขา สามารถกลั้นปัสสาวะและอุจจาระได้ปกติ ทำกิจวัตรประจำวันได้ปกติ **ไม่มี** หอบเหนื่อยมากขึ้น สามารถออกกำลังกายได้ปกติ นอนราบได้ **ไม่มี** หอบเหนื่อยตอนกลางคืน **ไม่มี** ชาบวม จึงมารับการผ่าตัดตามแพทย์นัด

Etiology of scoliosis

Idiopathic (80%)	Infantile 0-3 yr. Juvenile 4-10 yr. Adolescent 11-18 yr.
Congenital	VATER syndrome
Neuromuscular	Muscular dystrophies Poliomyelitis Cerebral palsy Spina bifida
Neural	Syringomyelia Chiari malformation
Syndromic	Marfan syndrome Neurofibromatosis

Past history

- ปฏิเสธประวัติโรคประจำตัว
- ปฏิเสธการดื่มสุรา
- สุกดิบหรือไฟฟ้านาน 15 วัน (หยุดก่อนผ่าตัด 1 สัปดาห์)
- แพ้ยา penicillin มีอาการผื่นคัน
- ปฏิเสธประวัติการผ่าตัดมาก่อน
- ปฏิเสธโรคพันธุกรรมในครอบครัว

R1 Physical examination and investigation

Physical examination

- **Vital sign** : BT 36.5 °c BP 115/65 mmHg PR 75 bpm RR 18 /min
- BW 58 kg Height 175 cm. BMI 20.26 kg/m²
- **General appearance** : A young Thai male, normosternic build good consciousness , good orientation
- **HEENT** : not pale conjunctivae , anicteric sclerae , no dry lip/dry tongue

Physical examination

- **CVS** : no engorgement of neck vein, pulse full and regular, PMI at 5th ICS at MCL , no heaving, no thrill l, normal S₁ S₂, no murmur
- **RS** : normal chest contour and expansion, clear and equal breath sound both lung, no adventitious sound
- **Back** : *hump at lumbar level, hip and waist asymmetrical, abnormal spine alignment at T-L level, Adams forward bend test positive*
- **Neuro** : E₄V₅M₆, pupil 3 mmRTLBE , motor gr V/V all extremities, sensory intact, BBK- negative, Clonus sign - negative

Airway assessment

- Mallampati grade I
- Thyromental distance > 6 cm.
- Mouth opening > 3 cm.
- No prominent incisor
- Upper lip bite test class I
- No limit ROM of neck

Investigation

- **CBC** : Hb 14.6 g/dl **Hct 44 %** Platelet 236,000 /ul
- **Electrolyte** : Na 140 mEq/L K 3.39 mEq/L Cl 100 mEq/L HCO₃ 28.8 mEq/L
- **BUN** 9.2 mg/dl **Cr** 0.9 mg/dl **GFR** 123 ml/min/1.73m²
- **Echo** : good LV systolic function, LVEF 60%, no RMWA, No LVH, No chamber enlargement, Good RV systolic function, no significant valvular abnormality, normal diastolic function

Chest X-ray

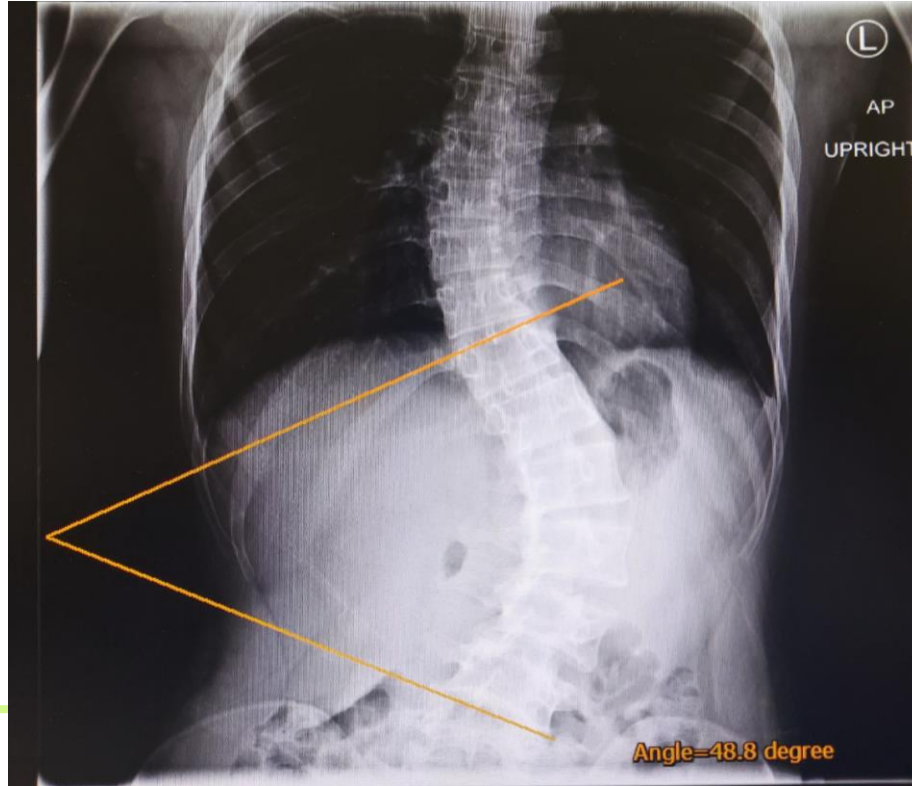
No infiltration

No cardiomegaly

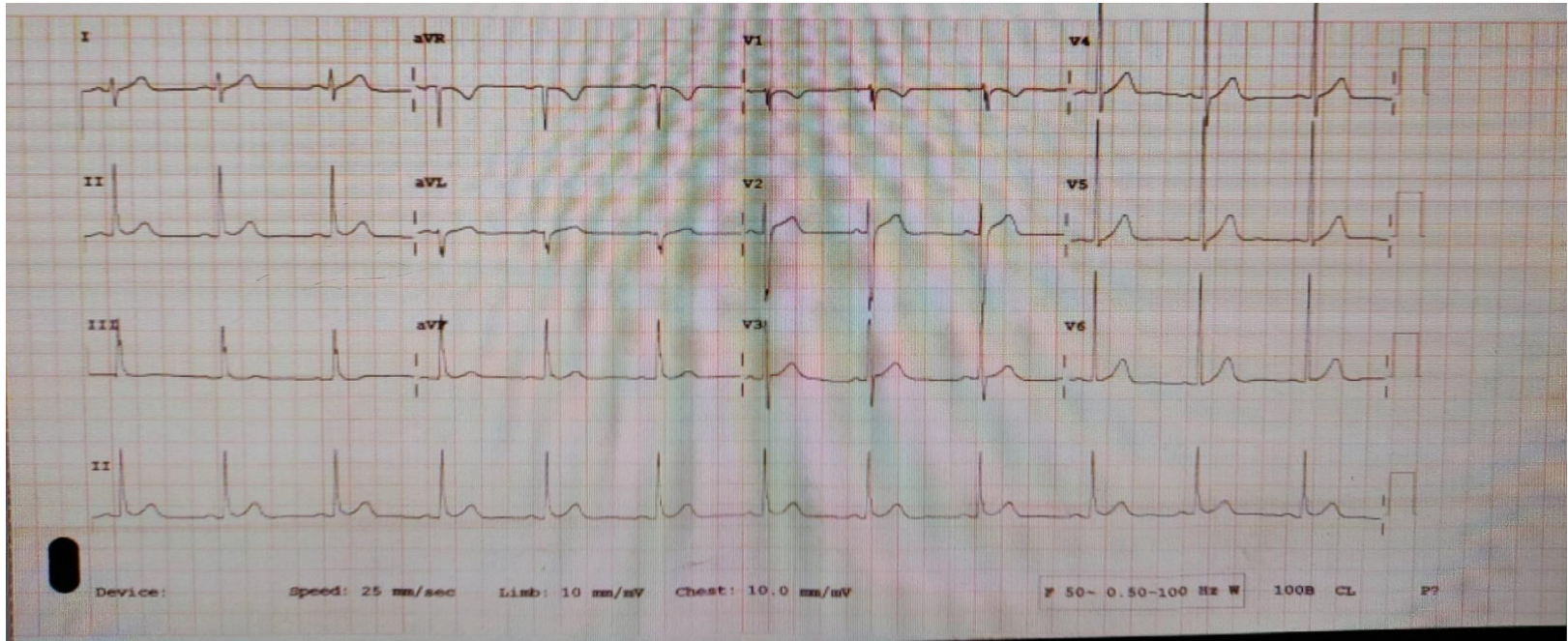
No hypoaeration or hyperaeration



Film T-L spine



EKG



EKG

Right ventricular hypertrophy

- Right axis deviation $+110^\circ$ or more
- Dominant R wave in V1 (> 7 mm tall or R/S ratio > 1)
- Dominant S wave in V5-6 (> 7 mm deep or R/S ratio < 1)
- QRS duration < 120 ms

Right ventricular strain pattern = ST depress / T wave inversion in V1-4 and inferior (II, III, aVF)

R1 Problem list and ASA classification

Problem list

1

Adolescent idiopathic scoliosis
with cobb angle 48°

2

Current smoking

ASA Class II

R2 Preoperative evaluation and preparation

Preoperative evaluation

1

Patient factor

2

Surgical factor

3

Anesthetic factor

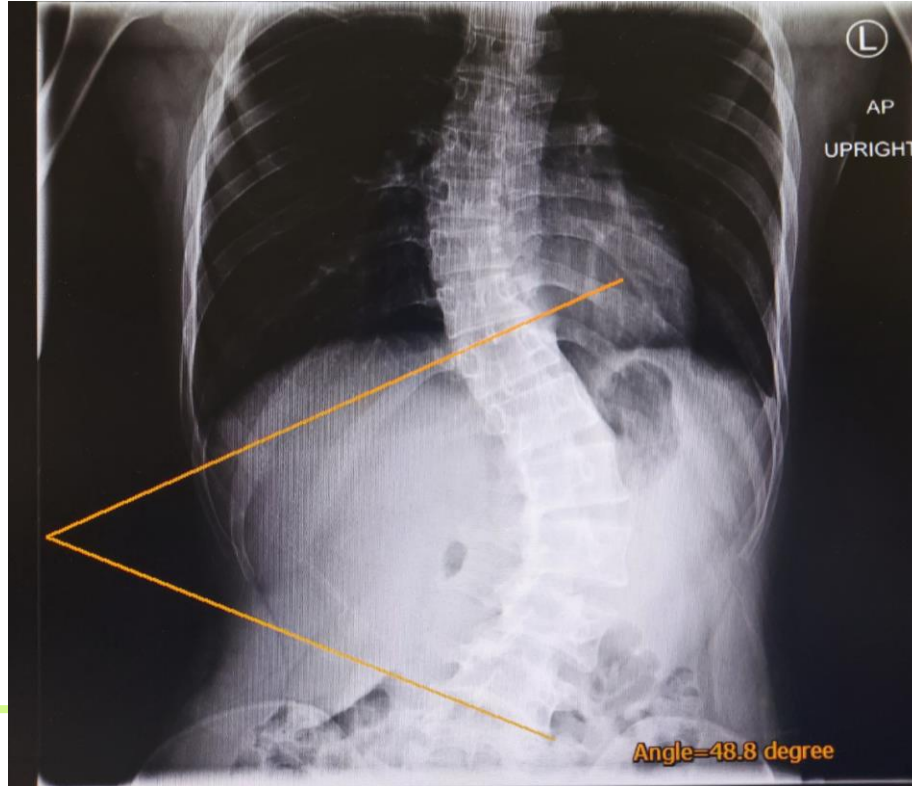
Patient factor

Cobb angle $> 40-50^\circ$ → Surgery

Cobb angle $> 60^\circ$ → ↓ pulmonary function



Film T-L spine



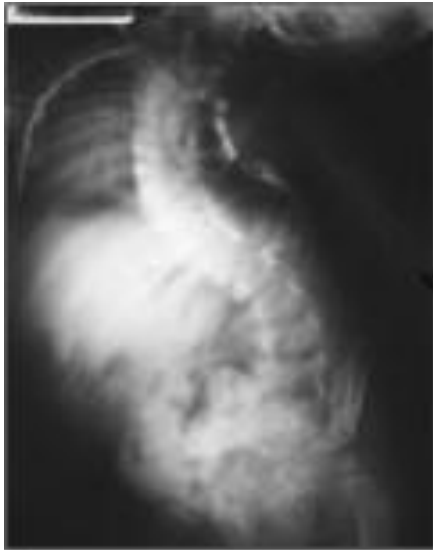
Estimated time for return of lung function after stop smoking

Elimination of nicotine	12 h
Elimination of carboxyhemoglobin	1–3 days
Return of ciliary function	6–7 days
Decrease of sputum production	6–8 weeks
Normalization of immune system	>8 weeks

Cardiovascular system

- Hypoxemia → ↑ pulmonary vasoconstriction → ↑ PVR → ↑ PA pressure
- Associated with PVR and pulmonary hypertension
- May result RVH and right ventricular failure

Respiratory system



↓ Low Lung Volumes

- Hypoxemia
- Poor Sleep
- Cor pulmonale

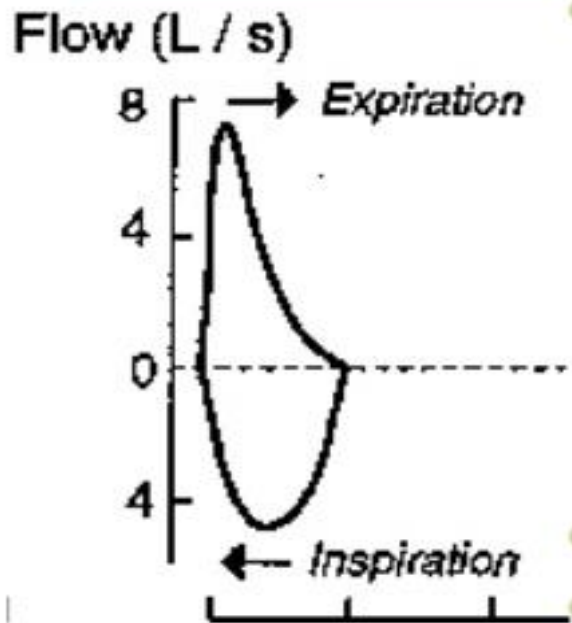
↓ Chest Wall Distensibility and Excursion

- ↑ Work
- Tachypnea

↓ Respiratory Muscle Force and Movement

- ↓ Poor Growth
- Exercise Tolerance
- Respiratory Failure

Restrictive Lung Disease



- Characterized by diminished lung volume due to:
 - change in alteration in lung parenchyma (interstitial lung disease)
 - disease of pleura, chest wall (e.g. scoliosis), or neuromuscular apparatus (e.g. muscular dystrophy)
- Decreased TLC, FVC
- Normal or increased: FEV_1/FVC ratio

Respiratory system

- **Difficult airway** (c-spine/upper thoracic)
- **Restrictive pattern** ↓TLC ↓FRC ↓VC [60%-80% of predicted]
- **FEV1/FVC** : normal
- During exercise the ventilation is adequate but ↓TV and ↑RR
- Decrease inspiratory muscle working due to chest wall deformity

Neurological system

Preexisting neurologic deficits

: increased risk for developing spinal cord injury during surgery

Document preoperative neurologic function

: avoid confusion about postoperative neurologic complications

Surgical factor

1

scoliosis correction

2

positioning

3

Neurophysiologic monitoring

Scoliosis correction

Intraoperative blood loss

Number of segments fuse (>6)

Prolong operative time

Degree of Cobb angle > 50°

Need for osteotomies

Moderate third space loss

Replaced with balanced salt solution at a rate 5-7 ml/kg/hr.

Deliberate controlled hypotension

Antifibrinolytic

Caution in older adult, CVD, risk for ischemic complication, POVL

Yao & Artusio's Anesthesiology: Problem-Oriented Patient Management: scoliosis, 9th edition

Prone position



Fig. 34.15 Prone position with Wilson frame. Arms are abducted less than 90 degrees whenever possible, although greater abduction may be better tolerated while prone. Pressure points are padded, and the chest and abdomen are supported away from the bed to minimize abdominal pressure and to preserve pulmonary compliance. Soft head pillow has cutouts for eyes and nose and a slot to permit endotracheal tube exit. Eyes must be checked frequently.

Neurologic complication in scoliosis surgery

- Distraction of the cord and straightening of the deformity compresses the spinal cord
- Disruption of arterial blood supply of the cord
- The spinal cord and nerve roots may be injured directly by hooks or instrumentation

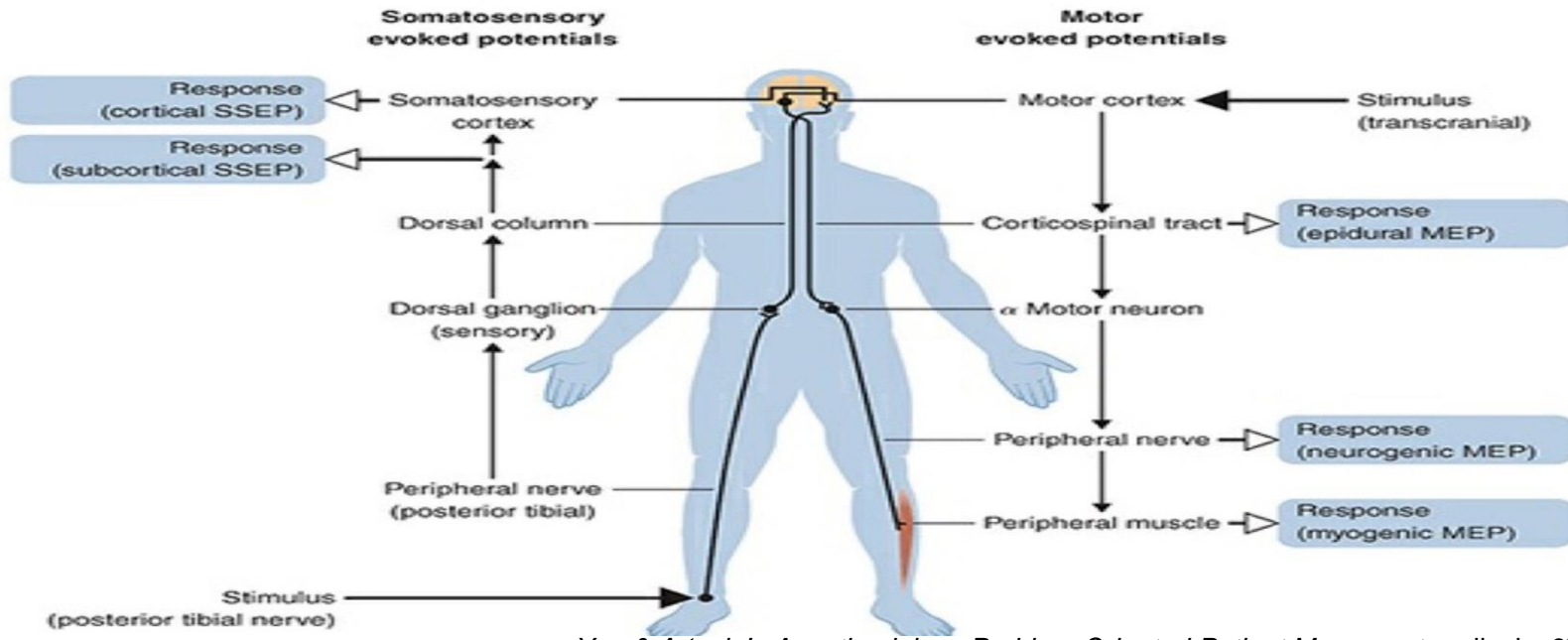
Wake up test

- Assess the integrity of spinal motor pathways
- Lightening the depth of anesthesia sufficiently to allow the patient to follow commands
- Switch of inhalation & muscle relaxant
- Maintain on opioid
- The patient is instructed to grip hand , and then asked to move feet and toe

Complication of wake up test

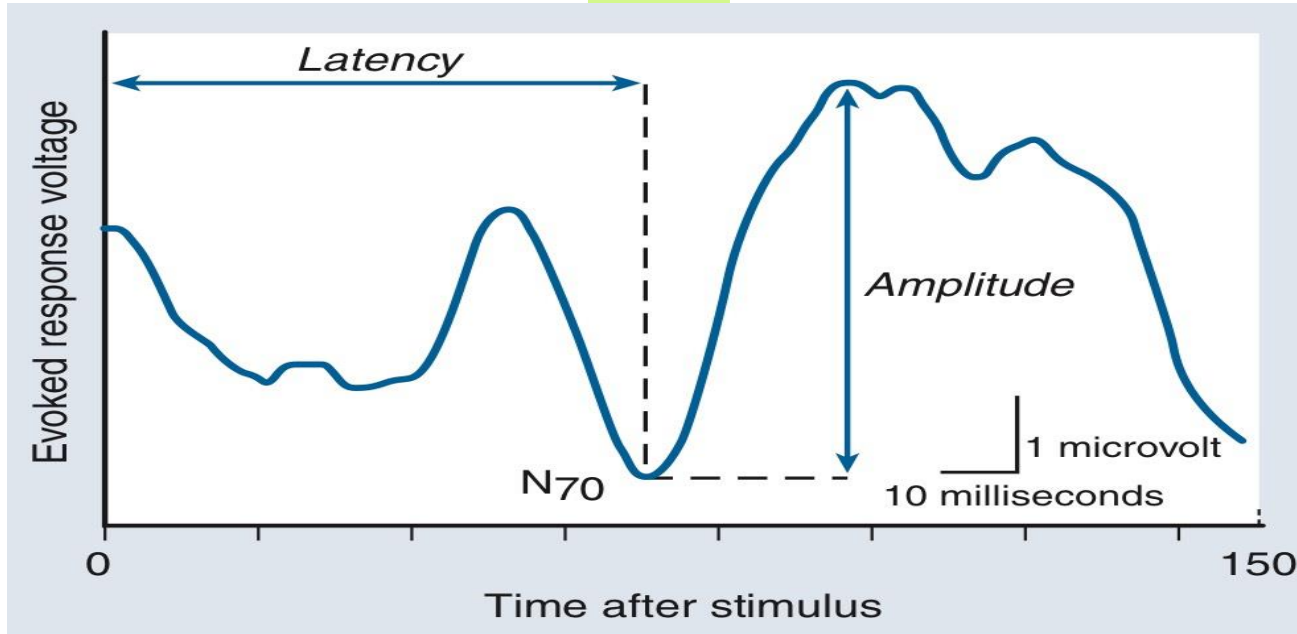
- Extubation in prone position
- Recall of intraoperative event
- Air embolus from open venous sinus during deep inspiration
- Dislodgement of the instrumentation during movement

Neurophysiologic monitoring



Yao & Artusio's Anesthesiology: Problem-Oriented Patient Management: scoliosis, 9th edition

Neurophysiologic monitoring



Cottrell and Patel's neuroanesthesia : evoked potential, 6th:2017

Anesthetic effects on SSEPs

Volatile anesthetics produce a dose dependent increase latency & decrease amplitude.

Inhalation are prominent on cortical responses , with marked depression on amplitude with 0.5-1 MAC

IV anesthetic agents have minimal effects on cortical SSEPs, *except etomidate and ketamine, which increase SSEP signal amplitude*

Dexmedetomidine appear to have minimal effect on SSEPs when combined with opioids successfully used with MEPs

Anesthetic effects on MEPs

- MEPs are **extremely sensitive to inhibitory effects** of volatile anesthetic.
- **0.25-0.5 MAC** can suppress transmission
- **N₂O produces amplitude reduction and latency increases in SSEP or MEPs** when used alone or combined with other inhalation agent or opioid agent
- **Muscle relaxants suppress EMG activity and obliterate MEPs**

Intraoperative neurophysiologic monitoring

Monitoring modality	Monitored region of the cord	Significance
SSEP	Dorsal ascending column	Amplitude reduction > 50% or increased latency > 10%
tcMEP	Motor descending tracts	Amplitude reduction > 50%

Anesthetic effects on MEPs & SSEPs

Alterations in physiologic parameters that alter the sensory and motor EPs

Parameter	Effect
Hypothermia or Hyperthermia	↓
Anemia	↓
Hypotension	↓
Hypoxia	↓
Hypocarbica	↓

Anesthetic effects on MEPs & SSEPs

Agent	Amplitude	Latency
Halothane	↓	↑
Desflurane	↓	↑
Isoflurane	↓	↑
Sevoflurane	↓	↑
Nitrous oxide	↓	↔
Barbiturates	↓	↑
Etomidate	↑	↔
Ketamine	↑	↔
Midazolam	↓	↔
Opioids	↔	↔
Propofol	↔	↔

General preparation

- NPO
- Informed consent
- Anesthetic machine
- Intubation equipment
- Force air warmer
- Warm IV fluids
- Antibiotic
- IV anesthetic drugs

Specific preparation

- Prone equipment
- Large bore IV fluid (no 16,18)
- A-line
- Blood components
(PRC 4 u , FFP 4 u , platelet conc 2 u)
- SSEPs , MEPs
- Lead Apron , thyroid shield
- ICU for post-op

Intraoperative monitoring

Non invasive

NIBP
EKG
ETCO₂
Pulse oximeter
Core temperature
Urine output

Invasive

A-line
SSEPs & MEPs

R3 Anesthetic consideration

Anesthetic consideration

- Provide and *anesthetic that suitable for spinal cord monitoring* while providing analgesia and amnesia
- Propofol is *commonly used sedative component of TIVA* when SSEPs or MEPs are monitored
- Low dose propofol infusion and opioid base IV anesthesia
- Intravenous midazolam should be *given before induction for anxiolysis and amnesia*

Cottrell and Patel's neuroanesthesia : evoked potential, 6th:2017

Anesthetic technique for MEPs & SSEPs

*Ultrashort acting opioid + low dose inhaled anesthetic or TIVA
+ monitor BIS*

Inhalation agent

- Volatile agent and NO *reduce amplitude and increase the latency* of potential in a *dose dependent*
- Spine surgery can be accomplished with the *use of 0.5 MAC of desflurane or sevoflurane*

Muscle relaxant

- NMBAs impair or prevent MEPs and EMG monitoring
- No effect on SSEPs and ABR
- Partial NMB reduce the amplitude of motor unit potentials and change ability to detect nerve irritation
- Preferable to avoid NMB when possible during EMG and MEPs monitoring

Management of acute evoked potential signal change

- Rule out surgical and equipment-related factor; communicate with surgeon and neuromonitoring team
- Reposition the patient (maintain neutral alignment of spinal column)
- Correct hypotension, metabolic abnormality, severe anemia, hypo-hyperthermia
- Raise MAP > 85 mmHg to increase spinal cord perfusion
- Turn off inhalation agent and switch to TIVA

Prone position

- **Avoid abdominal compression**, allowing for free movement of abdomen and reducing vena caval compression
- **Avoid thoracic compression** to *facilitate ventilation and reduce excessive airway pressure*
- **Provide adequate support for head and face**
- **Maintain normal positioning** of the extremities to *avoid compression or stretching of peripheral nerves*
- **Provide liberal padding**, avoiding pressure sores

Fluid management and blood transfusion

- **Fluid management**

- GDFT protocol
- Balanced isotonic crystalloid solution

- **blood transfusion**

- Restrictive transfusion strategy (Hb < 8 g/dL)

Minimize blood transfusion techniques

- **Minimize intraabdominal pressure**

- ↑ Abdominal pressure → ↑ vertebral venous plexus → ↑ venous bleeding

- **Acute normovolemic hemodilution**

- Goal of ANH is to reduce the patient's Hct to 30% prior to surgery
- **Reduced RBC mass but a normal vascular volume**

hypothermia

Monitor core temperature (CBT $> 36^{\circ}\text{C}$)

- Reliable : **nasopharynx**, tympanic membrane, esophageal temperature
- PA catheter (gold standard)

Coagulopathy and acid-base imbalance

Prevention

- Warm IV fluid, Air warming device

Complication of spine surgery

- **Venous air embolism**
 - Unexplained hypotension
 - A precipitous fall in the End tidal CO₂
 - Increase in the end tidal nitrogen concentration

Treatment VAE

- Flooding the surgical field with saline
- Controlling sites of air entry
- Repositioning the patient with the surgical site below the right atrium
- Aspiration of air form central venous catheter
- Cessation of NO₂
- 100% O₂ supplement
- IV fluid and inotropic agent

Vision loss

- Rare complication associated spine injury
- Optic neuropathy, retinal artery occlusion, cerebral ischemia
- Associated with complex instrumented fusion, significant sustained intraoperative hypotension, anemia, excessive blood loss, prolonged surgery

Operation

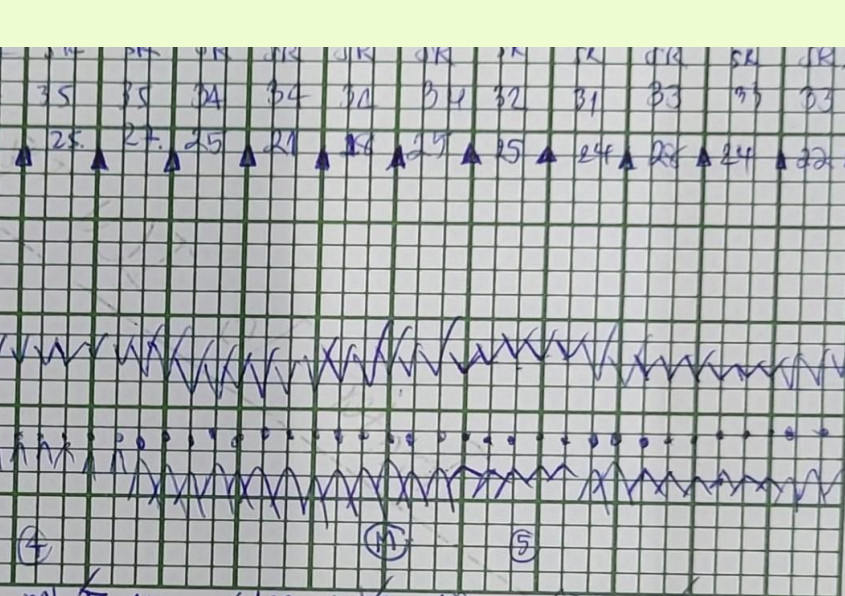
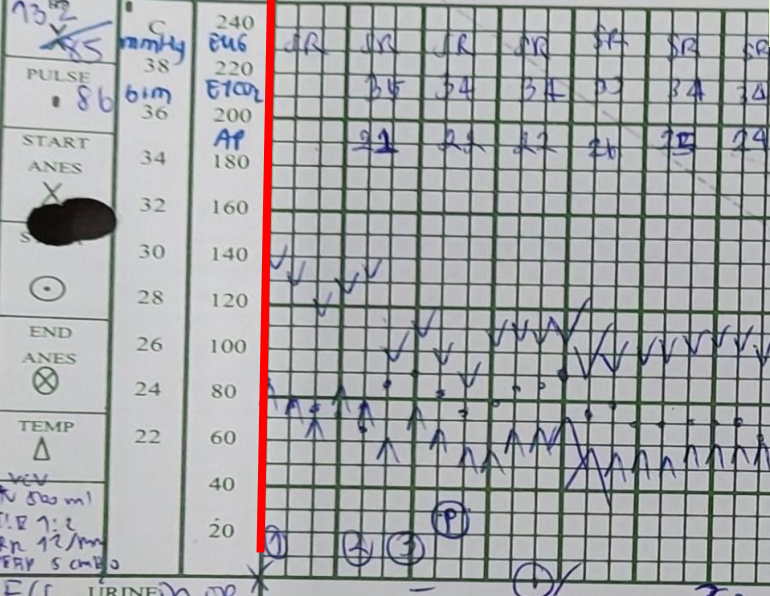
Anesthetic technique: GACETT
 Remark: MHA penicillin 3000000
 Service: ortho

Patient in OR At 10.00 AM

- Monitor : NIBP, EKG, O2sat
- V/S : BP 132/85 mmHg , HR 86 mmHg, O2sat 100%

AGENTS/TIME	0:00	10:00	15:00	20:00	25:00	30:00	35:00	40:00	45:00	50:00	55:00	60:00
N ₂ O												
O ₂												
Propofol (100) ml/hr												
Ephedrine												

IV FLUID INTAKE in OR at 10:00 AM
 Acetor 700 ml, Acetor 300 +



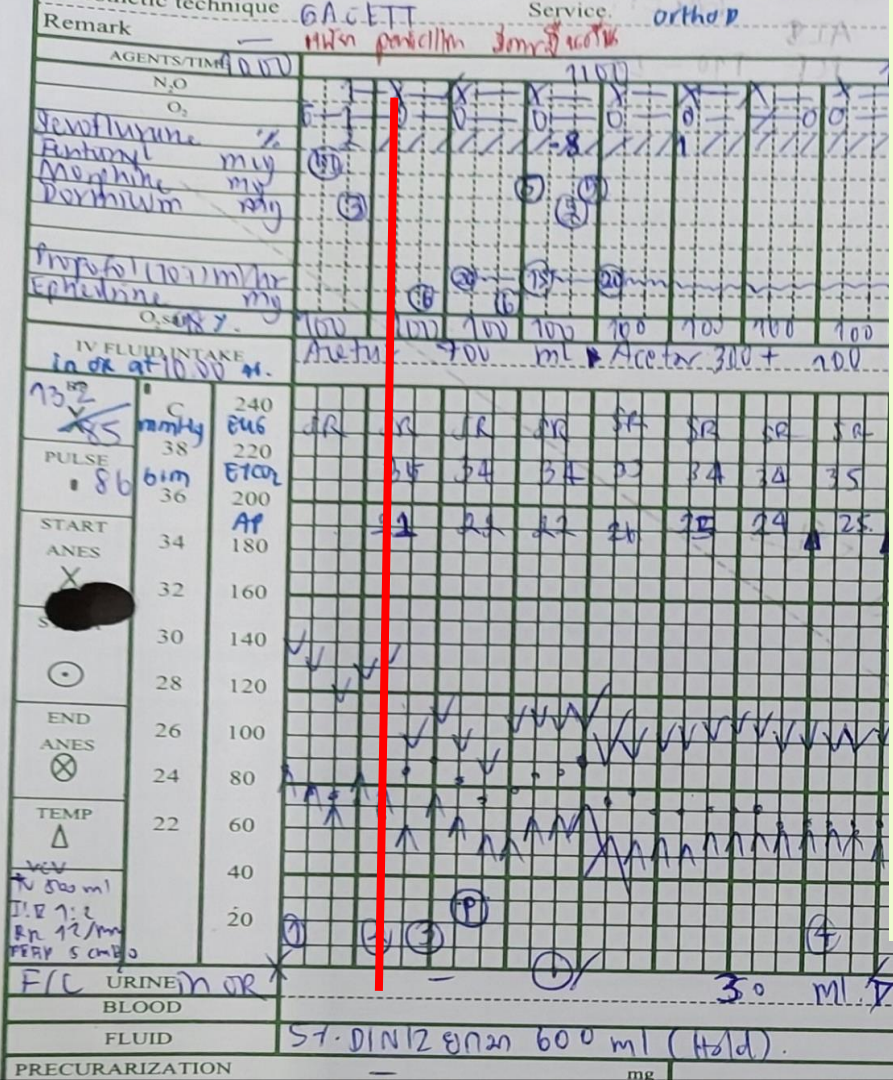
- LITHOTOMY
- SITTING
- TRENDEL
- RELATERAL
- LLATERAL
- JACK-KNIFE
- OTHER

- LAB
- Hct
 - Blood Sugar
 - Electrolyte
 - ABG

URINE/BLOOD: 30 ml / 10 / 40 ml / 10 / 50 ml
 FLUID: 57-DIN 2820 600 ml (H2O)

IV. CATH. NO: 22.16.18
 SITE: LH 1A RH

TOTAL URINE OUTPUT: 50



At 10.10 AM

- preoxygenation 5 min
- Sedation : midazolam 3 mg
- Induction agent : Propofol 120 mg
- Intubation agent : SCH 100 mg

Intubation at 10.15 AM

- ETT no.7.5 depth 22 cm. (LV gr 1 by macintosh no.3)
- Maintenance : N₂O:O₂:sevo,1:1:up to 1%
- Large bore IV no 16 at Lt arm , no 18 at Rt hand
- Access A-line at Rt RA
- SSEP&MEPS

-Ventilator setting : VCV mode TV 500 ml PEEP 5 cmH₂O RR 14/min I:E 1:2

<input checked="" type="checkbox"/>	ABG
	TOTAL URINE OUTPUT 50 ml

Anesthetic technique		Service	
Remark		orthop	
AGENTS/TIME		11:00	
N ₂ O			
O ₂			
Sevoflurane	%		
Propofol	mg		
Clindamycin	mg		
Propofol (10:1) ml/hr			
Ephedrine	mg		
IV FLUID INTAKE		Acetar 300 + 100	
in OR at 10:00 hr.			
HR	mmHg	SpO ₂	ETCO ₂
38	86	98	34
PULSE	61	200	34
36		180	34
START ANES		160	34
		140	34
		120	34
		100	34
END ANES		80	34
		60	34
TEMP		40	34
		20	34
URINE		30 ml	
BLOOD		10 / 40 ml	
FLUID		50 ml	
PRECURARIZATION		ST. DINIZ 600 ml (Hold)	
		IV. CATH. NO. 22, 16, 18	
		SITE LH, LA, RH	

At 10.35 AM

- Prone position
- Check 7 point (AP- ก่อนคว่ำ/หลังคว่ำ : 22 / 22cmH₂O)
- Monitor temperature
- Propofol (10:1) 20 ml/hr.
- Clindamycin 900 mg IV

At 10.55 AM : start operation

ABG

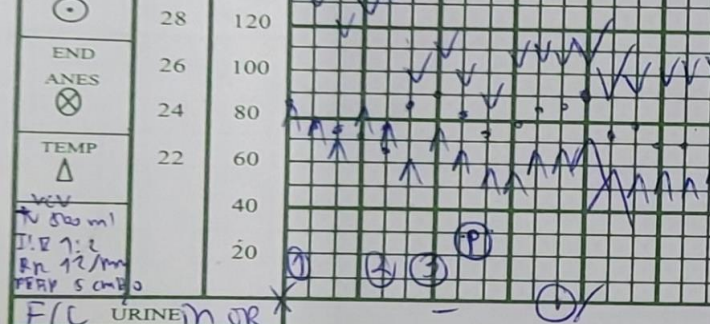
- pH 7.39, pO₂ 311 pCO₂ 37 HCO₃ 22.4
- Hb 12.5 g/dl, Hct 37.4%
- Na 139 K 3.59 Ca 1.18

<input checked="" type="checkbox"/>	Electrolyte
<input checked="" type="checkbox"/>	ABG
TOTAL URINE	OUTPUT 50 ml

AGENTS/TIME	0:00	0:10	0:20	0:30	0:40	0:50	1:00	1:10	1:20	1:30	1:40	1:50	2:00	2:10	2:20	2:30	2:40	2:50	3:00	
N ₂ O																				
O ₂																				
Propofol 100 mg																				
Ephedrine																				

IV FLUID INTAKE
 in or at 10:00 AM
 Acetar 700 ml Acetar

73.2	38	240	AR	AR	AR	AR	SA	SA
85	38	220						
86	36	200						
	34	180						
	32	160						
	30	140						
	28	120						
	26	100						
	24	80						
	22	60						
	20	40						



URINE IN OR BLOOD
 30 ml / 10 / 40 ml / 10 / 50 ml
 FLUID: ST-DINIZ 600 ml (Hold)
 PRECURARIZATION: mg

- Operation time 6.5 hr.
- Reverse : neostigmine 2.5 mg + atropine 1.2 mg
 - Narcotic drug : morphine 15 mg, fentanyl 50 µg
 - Analgesic drug : dynastat 40 mg IV influgan 1 gm IV
 - Midazolam 5 mg
 - Ephedrine 12 mg
 - Crystalloid 3000 ml
 - Bleeding 500 ml
 - Urine output 50 ml

JACK-KNIFE

OTHER

LAB

Hct

Blood Sugar

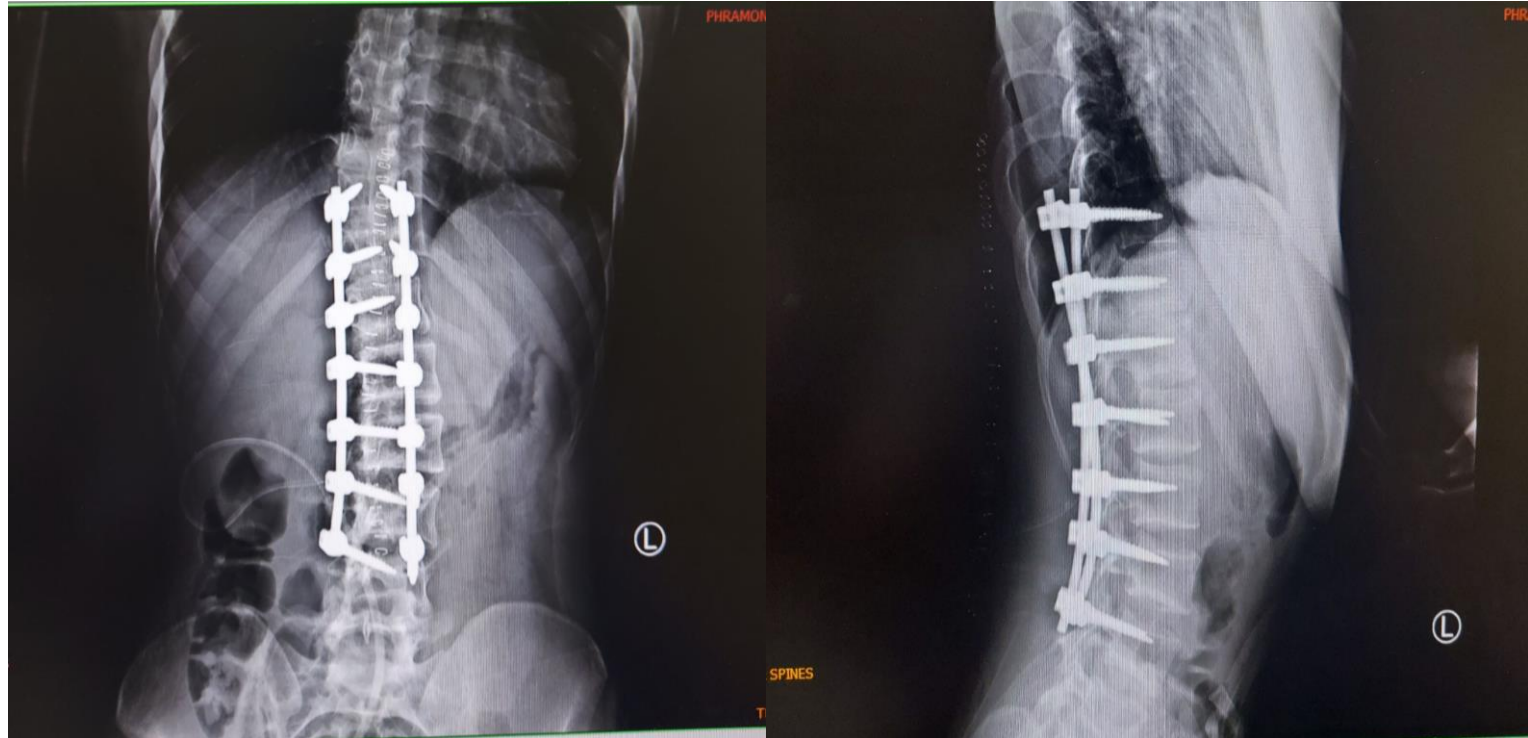
Electrolyte

ABG

TOTAL URINE OUTPUT 50 ml

IV. CATH. NO. 22, 16, 18 SITE LM, LA, RH

Post operative T-L spine film



Post operative day1 (at ICU)

- **S** : ผู้ป่วยตื่นดี ไม่มีไข้ แผลไม่ซึม การมองเห็นปกติ ปวดแผล ps 8/10 ปัสสาวะออกดี ไม่มีเสียงแหบ ระบายคอเล็กน้อย อาเจียนเป็นน้ำลาย 1 ครั้ง
- **O** : V/S BT 36.8 °c BP 113/75 mmHg PR 78 bpm RR 18 /min
Heart : normal S₁ S₂, no murmur
RS : *clear, no adventitious sound*
Neuro : E4V5M6, pupil 3 mmRTLBE, *motor gr V/V, sensory intact all*
I/O : 4,775/2,230 , RD : 750 ml, Hct 37%
- **A+P** : **AIS S/P PDS with posterior lumbar fusion at T10-L4 PO day 0**
 - Morphine 4 mg IV q 6 hr., Acupan 20 mg IV q 8 hr., Dynastat 40 mg IV q 12 hr.
 - Record I/O keep > 50 ml/2 hr
 - Hct q 8 hr keep > 30%

Post operative day2 (At ward)

- **S** : ผู้ป่วยตื่นดี ไม่มีไข้ แผลไม่ซึม ปวดแผล ps 6/10 ปัสสาวะออกดี ไม่มีอาการชาที่ขา หายใจปกติไม่หอบเหนื่อย
- **O** : V/S BT 36.3 °c BP 106/75 mmHg PR 79 bpm RR 16 /min
Neuro : E4V5M6, pupil 3 mmRTLBE, motor gr V/V, sensory intact all
I/O : 1703/1650 , RD : 250 ml
- **A+P** : **AIS S/P PDS with posterior lumbar fusion at T10-L4 PO day 1**
 - Step diet
 - กระตุ้น ambulate & ใช้ Triflow
 - Morphine 3 mg IV prn q 4 hr., Acupan 60 mg IV drip in q 24 hr.
ketolac 30 mg IV q 8 hr.

Post operative day 3

- **S** : ผู้ป่วยตื่นดี ไม่มีไข้ แผลไม่ซึม ปวดแผล ps 3/10 ปัสสาวะออกดี ไม่มีอาการชาที่ขา หายใจปกติไม่หอบเหนื่อย
- **O** : V/S BT 36.3 °c BP 116/75 mmHg PR 80 bpm RR 16 /min
Neuro : E4V5M6, pupil 3 mmRTLBE, motor gr V/V, sensory intact all
RD : 170 ml
- **A+P** : AIS S/P PDS with posterior lumbar fusion at T10-L4 PO day 2
 - Off IV & F/C
 - ฝึกเดินด้วย walker & ดูด triflow
 - Morphine 3 mg IV prn q 4 hr., ketolac 30 mg IV q 8 hr.

Post operative day 7

- **S** : ผู้ป่วยตื่นดี ไม่มีไข้ แผลไม่ซึม ไม่ปวดแผล บัสสาวะออกดี ไม่มีอาการชาที่ขา หายใจปกติไม่หอบเหนื่อย เดินได้ปกติ
- **O** : V/S BT 36.3 °c BP 106/75 mmHg PR 79 bpm RR 16 /min
Heart : normal S₁ S₂, no murmur
RS : clear, no adventitious sound
Neuro : E4V5M6, pupil 3 mmRTLBE, motor gr V/V, sensory intact all
- **A+P** : **AIS S/P PDS with posterior lumbar fusion at T10-L4 PO day 7**
-D/C นัด F/U OPD ortho 23/11/63

Thank you