

Interesting case

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Interesting case

Case : 41 years old female

Diagnosis : ruptured anterior communicating
arterial aneurysm

Operation : clipping aneurysm

R1 history talking

History

Present illness : 6 hr. PTA ขณะนั่งอยู่มีอาการปวดศีรษะนับพลัน ปวดมากแบบไม่เคยเป็นมาก่อน PS 10/10 ปวดบริเวณหน้าผากข้างซ้ายร้าวไปท้ายทอย ตาพร่ามัว คลื่นไส้อาเจียน มีอาการทำขวาอ่อนแรงชั่วคราว ไม่มีชักเกร็ง ไม่มีอาการชา ไม่มีปากเบี้ยว ไม่ซึม พูดคุยสื่อสารรู้เรื่อง ไม่มีอาการเจ็บแน่นหน้าอก ไม่มีใจสั่น ไม่มีอาการหอบเหนื่อยหรือหายใจลำบาก ไม่มีปัสสาวะมากกว่าปกติ อาการไม่ดีขึ้นจึงมา รพ.

Past history

- ปฏิเสธประวัติโรคประจำตัว
- ปฏิเสธการดื่มสุราและสูบบุหรี่
- ปฏิเสธประวัติการแพ้ยา
- ปฏิเสธประวัติการผ่าตัดมาก่อน
- ปฏิเสธโรคพันธุกรรมในครอบครัว

R1 Physical examination and investigation

Physical examination

- **Vital sign** : BT 37 °c BP 111/72 mmHg PR 93 bpm RR 18 /min
- BW 51 kg Height 160 cm. BMI 19.90 kg/m²
- **General appearance** : A young Thai male, good consciousness
good orientation
- **HEENT** : not pale conjunctivae , anicteric sclerae , no dry lip/dry tongue

Physical examination

- **CVS** : no jugular venous distention, pulse full and regular, no displaced PMI , no heaving, no thrill , normal S₁ S₂ no S₃ gallop, no murmur
- **RS** : normal chest contour and expansion , no tachypnea, no wheezing , no crepitation
- **Neuro** : E₄V₅M₆, pupil 3 mmRTLBE ,no facial pulsy, motor gr V/V all extremities, sensory intact, BBK- negative, Clonus sign – negative, stiffneck- positive

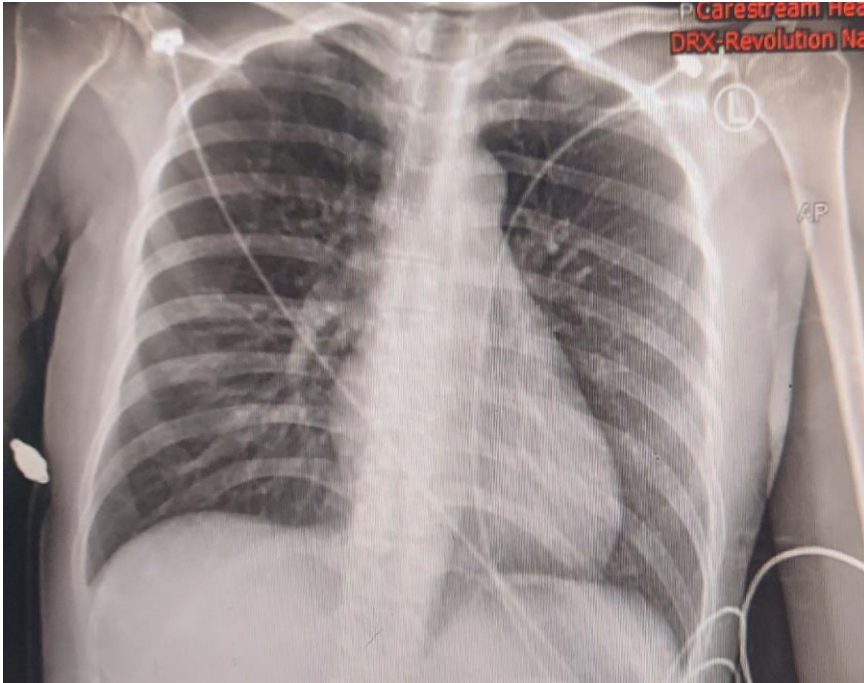
Airway assessment

- 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

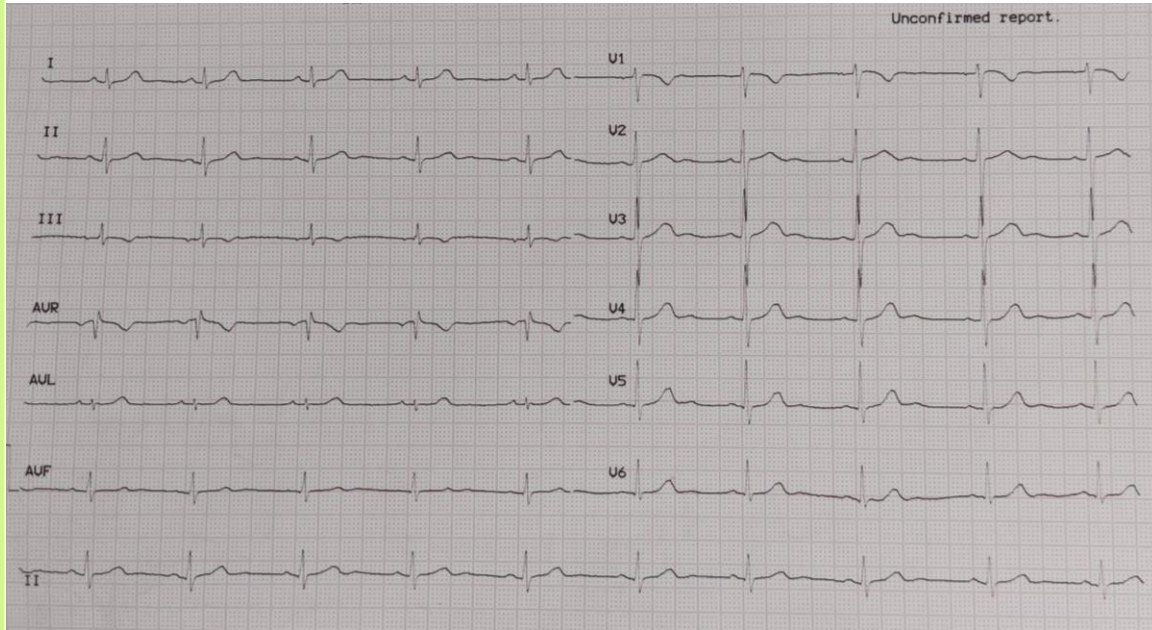
- **CBC** : Hb 12.2 g/dl Hct 37.3 % Platelet 231,000 /ul
- **Electrolyte** : Na 140 mEq/L K 4.59 mEq/L Cl 104 mEq/L HCO₃ 26.2 mEq/L
Ca 8.85 mEq/L Mg 2.16 mEq/L PO₄ 2.5 mEq/L
- **BUN** 5 mg/dl **Cr** 0.65 mg/dl **GFR** 110 ml/min/1.73m²
- **Coagulogram** : **aPTT** 21.8 **PT** 10.9 **TT** 12.8 **INR** 0.93
- **CBG** 112 mg%

Chest x-ray



- No parabrachial cuffing
- No cardiomegaly
- No significant interstitial or alveolar infiltration
- No pleural effusion
- no increase of peripheral pulmonary vessel
- No prominent pulmonary out flow tract

EKG



NSR rate 60-70 bpm

no ST elevation or depression

no QT prolongation

no abnormal Q wave

CT brain non contrast



Diffused subarachnoid hemorrhage

in basal cistern, sylvian fissure

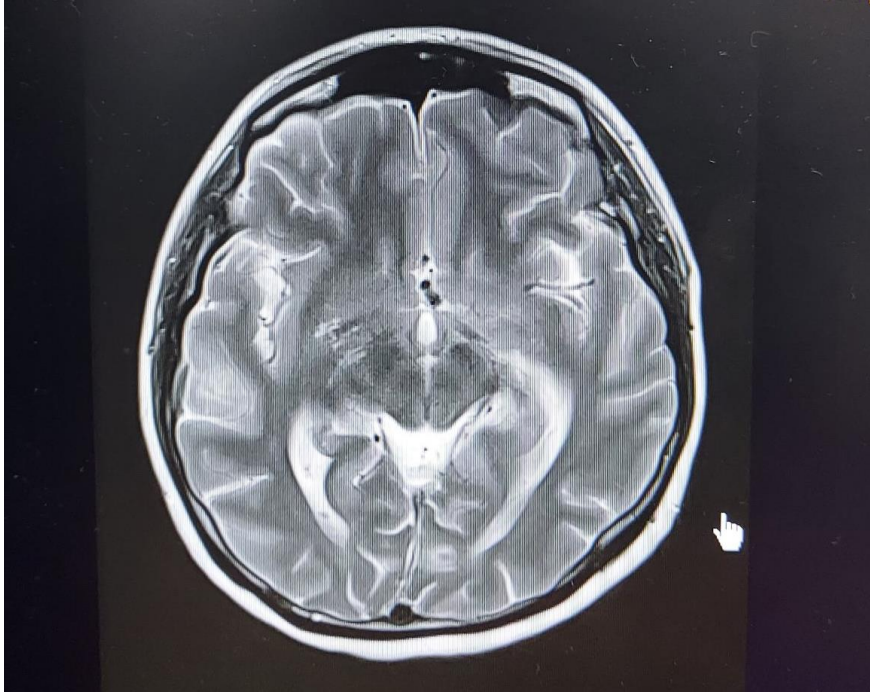
both cerebral sulci

intraventricular hemorrhage

in trigones of both lateral ventricles

3rd-4th ventricles

MRI brain



diffused subarachnoid hemorrhage

in basal cistern, sylvia fissure

both cerebral sulci

intraventricular hemorrhage

in trigones of both lateral ventricles

3rd-4th ventricles

CT cerebral vascular



Ruptured anterior communicating
arterial aneurysm between left A1,2 region
subarachnoid blood clot 4 mm size

projection inferior and superior to left A1,2

Normal the rest brain and CTA of brain and
neck

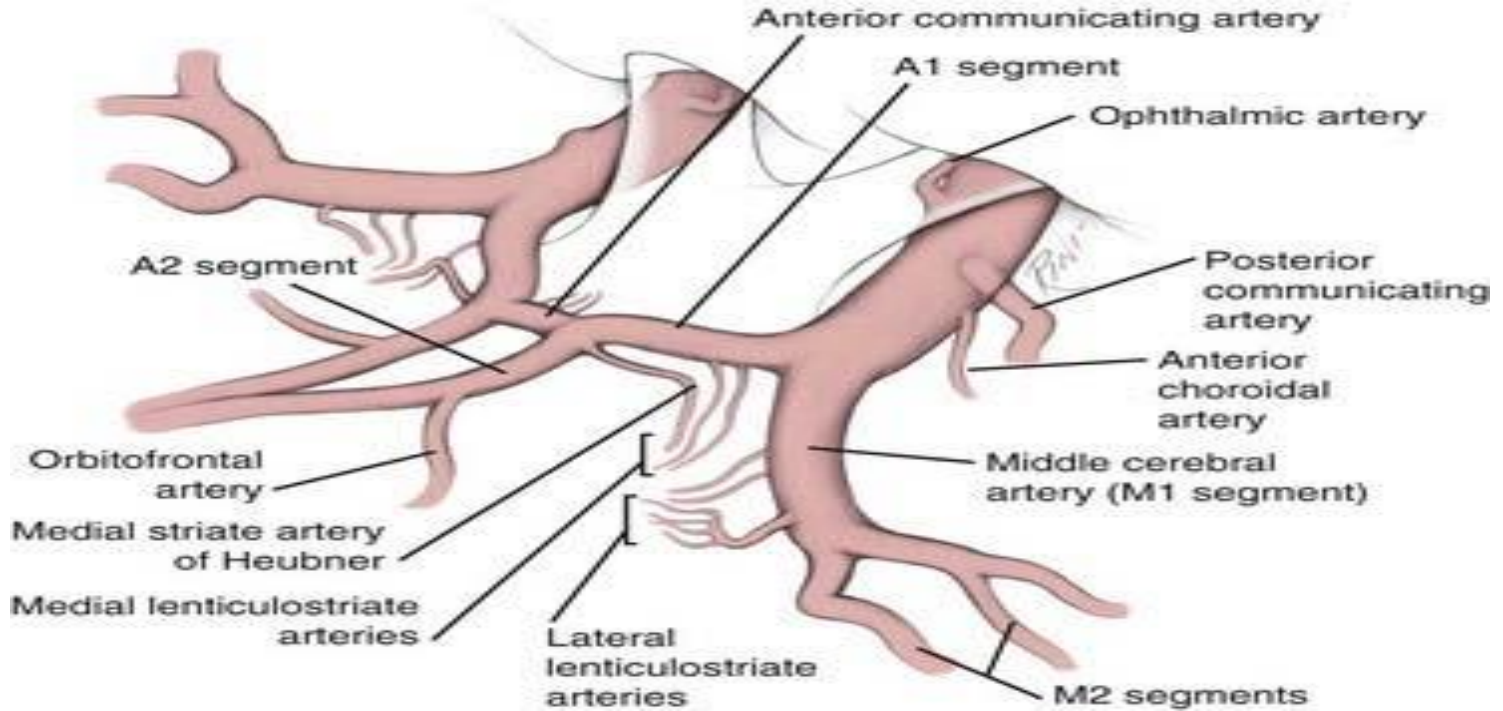
MRA brain

Ruptured anterior communicating arterial aneurysm between left A1,A2

size aneurysm 4 mm at left A1,A2 and anterior communicating patency of flow

via anterior communicating artery , normal CTA both carotid

Vascular anatomy



R1 Problem list and ASA classification

Problem list

Ruptured anterior communicating arterial aneurysm
between left A1,A2 (modified Hunt and Hess class II)

ASA Class II

R2 Preoperative evaluation and preparation

Preoperative evaluation

1

Patient factor

2

Surgical factor

3

Anesthetic factor

Patient factor

- Clinical grading scales of SAH and predictor of cerebral vasospasm
- Systemic complication

Severity of SAH

Table 13.1 Modified Hunt and Hess Clinical Grades for Patients with Subarachnoid Hemorrhage*

Grades	Criteria
0	Unruptured aneurysm
I	Asymptomatic or minimal headache and slight nuchal rigidity
II	Moderate to severe headache, nuchal rigidity, but no neurologic deficit other than cranial nerve palsy
III	Drowsiness, confusion, or mild focal deficit
IV	Stupor, mild or severe hemiparesis, possible early decerebrate rigidity, vegetative disturbance
V	Deep coma, decerebrate rigidity, moribund appearance

Relation of cerebral vasospasm to SAH

Table 13.3a Fisher Grades for Computed Tomography Findings in Subarachnoid Hemorrhage

Grade	CT Finding(s)
1	No blood detected
2	Diffuse thin layer of subarachnoid blood (vertical layers < 1 mm thick)
3	Localized clot or thick layer of subarachnoid blood (vertical layers \geq 1 mm thick)
4	Intracerebral or intraventricular blood with diffuse or no subarachnoid blood

Severity of SAH

Table 13.2 World Federation of Neurological Surgeons' Grades for Patients with Subarachnoid Hemorrhage

Grade	Glasgow Coma Scale Score	Motor Deficit
I	15	Absent
II	14–13	Absent
III	14–13	Present
IV	12–7	Present or absent
V	6–3	Present or absent

Systemic complication

- **Neurological system :** cerebral vasospasm, cerebral ischemia, re-bleeding, hydrocephalus
- **Cardiovascular system:** Takotsubo cardiomyopathy, cardiac arrhythmias, myocardial injury and dysfunction, ECG abnormality , increased cardiac enzyme, systemic hypertension

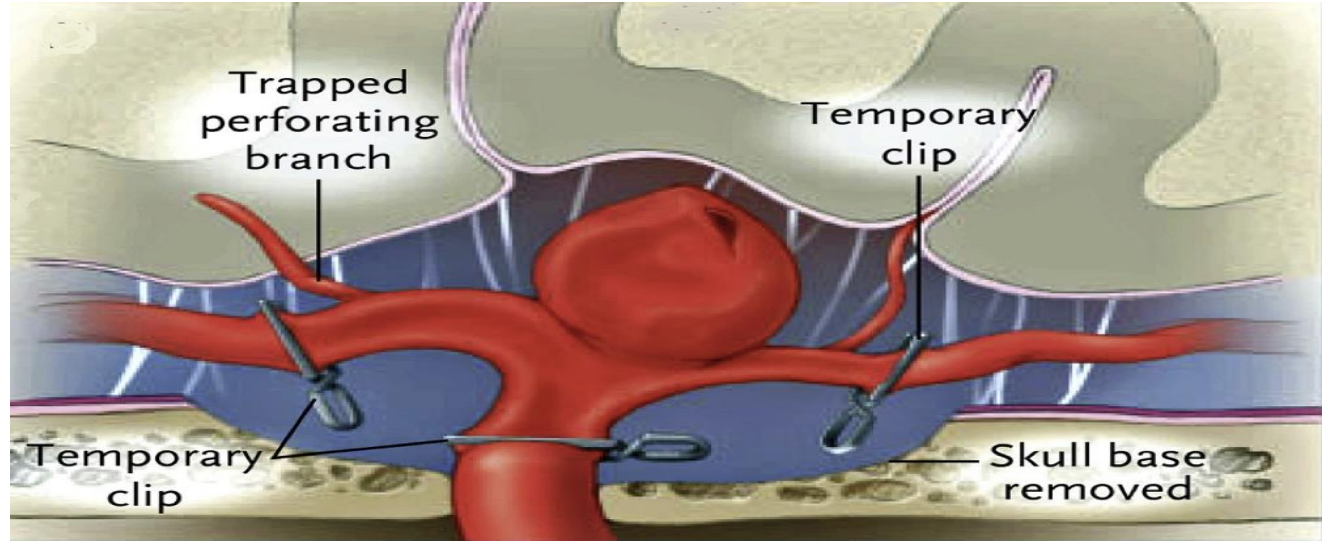
Systemic complication

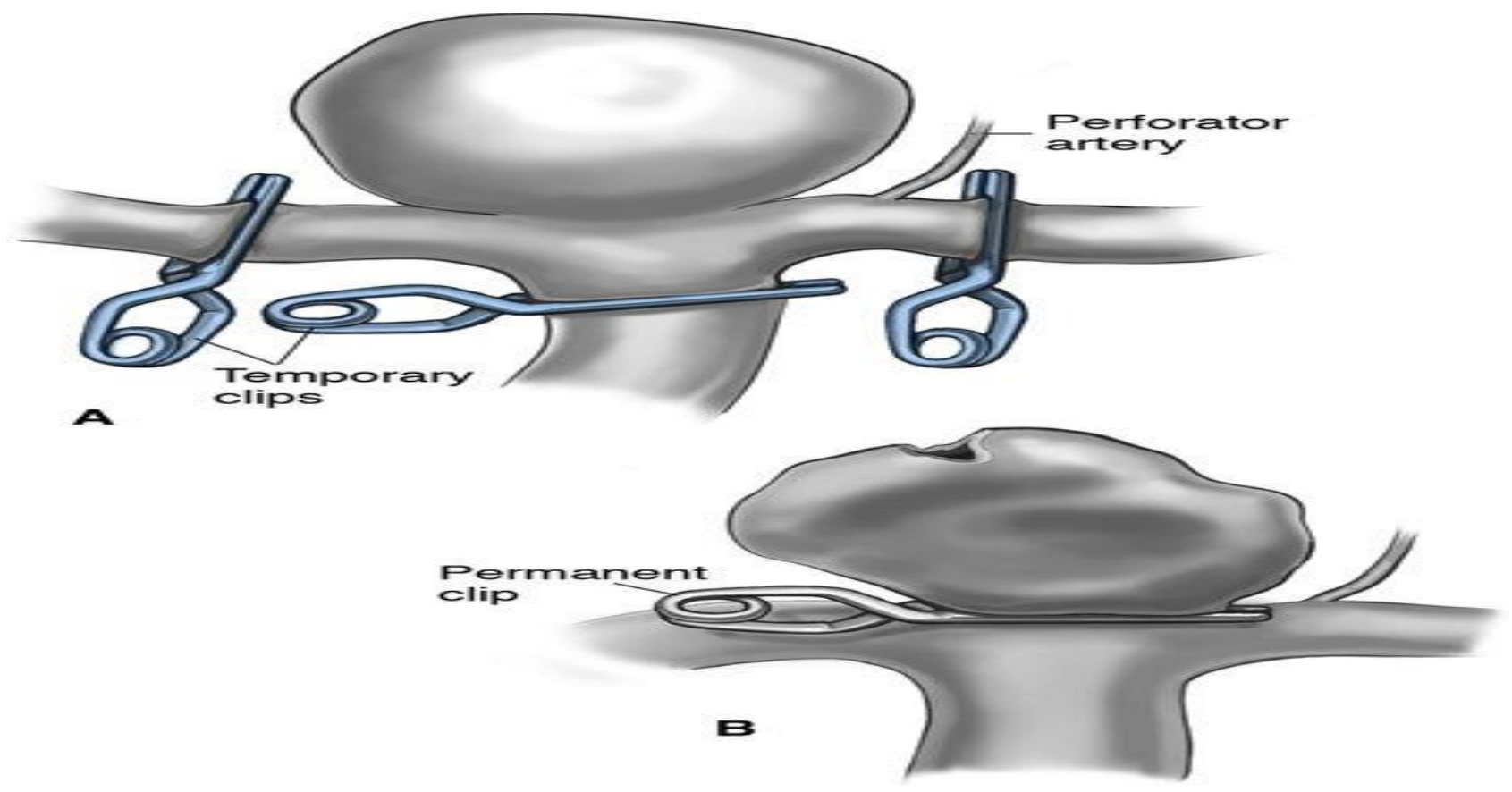
- **Respiratory system** : pulmonary edema, aspiration, hydrostatic pneumonia
- **Electrolyte disturbance** : hyponatremia (cerebral salt wasting, SIADH), hypomagnesaemia, hypokalemia, hypocalcemia

ผู้ป่วยรายนี้ไม่มีภาวะดังกล่าว

Surgical factor

- Surgical technique (*Clipping*)





A

Temporary clips

Perforator artery

Permanent clip

B

Preoperative preparation in this patient

Preoperative preparation

- Prophylaxis cerebral vasospasm
- Rebleeding
- premedication

Prophylaxis of cerebral vasospasm

Nimodipine (CCB) : 60 mg orally or nasogastric tube every 4 hr. (Max dose 360 mg)
(Started in all patients at admission and continued for 21 days)

Continuous infusion Nimodipine is no more effective than orally , higher hypotension

Target blood pressure : aneurysm has been clipped SBP 160-200 mmHg
aneurysm has not been clipped SBP 120- 160 mmHg

Rebleeding

- **Rebleeding** following SAH peaks at the end of first week
- Rebleeding peak at 4% of first 24 hours , level off at 1.5% per day on subsequent day
- **Early operation** *increased risk of postoperative vasospasm*
- **Delaying surgery** does allow brain swelling to decrease
(*both rebleeding and vasospasm can occur during waiting period*)
- **Timing for surgery** was planned within 3 days of SAH

Premedication

- Anxious patient may become hypertensive with greater risk rebleeding

Balance against of respiratory depression (↑ PaCO₂ → ↑ ICP)

- **Patient with good clinical grade**

fentanyl 50-150 mcg or morphine 1-5 mg , and/or midazolam 1-5 mg IV

- Patients should continue to regular dose of nimodipine and dexamethasone

Preoperative management in this patient

- Keep SBP between 90-140 mmHg
- Fentanyl 25 mcg IV prn q 4 hr.
- Head elevated 30° , absolute best rest, ปิดไฟในห้อง
- DTX q 6 hr. keep 80-180 mg%
- Nimodipine (30) 2 tab q 4 hr.

General preparation

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

Specific preparation

- Large bore IV fluid (no 16,18)
- Blood components
(PRC 4 u , FFP 4 u , platelet conc 10 u)
- Pneumatic pump
- ICU for post-op

Intraoperative monitoring

Non invasive

NIBP
5 lead EKG
ETCO₂
Pulse oximeter
Body temperature
Urine output

Invasive

A-line

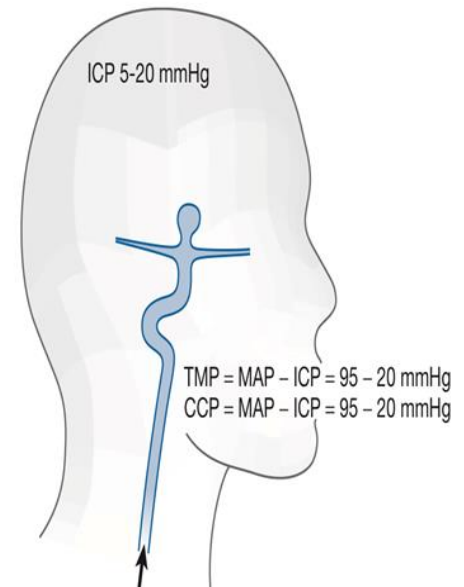
Specific

SSEPs & MEPs

R3 Anesthetic consideration

Anesthetic consideration

- **Avoid rapid changes in MAP & ICP**
(induction and surgical stimulation)
- **Adequate brain relaxation**
(brief hyperventilation, mannitol)
- **Maintenance of cerebral perfusion pressure and collateral blood flow**
- **Rapid wake up**
- **Beware respiratory complications**



Anesthetic factor

- Anesthetic effect on MEPS & SSEP
- Optimal brain relaxation to facilitate surgical access
- Maintain cerebral perfusion pressure
- Maintain normovolemia , normoventilation , normoglycemia
- Preparedness to perform manipulations MAP as the surgeon attempts to clip or control bleeding

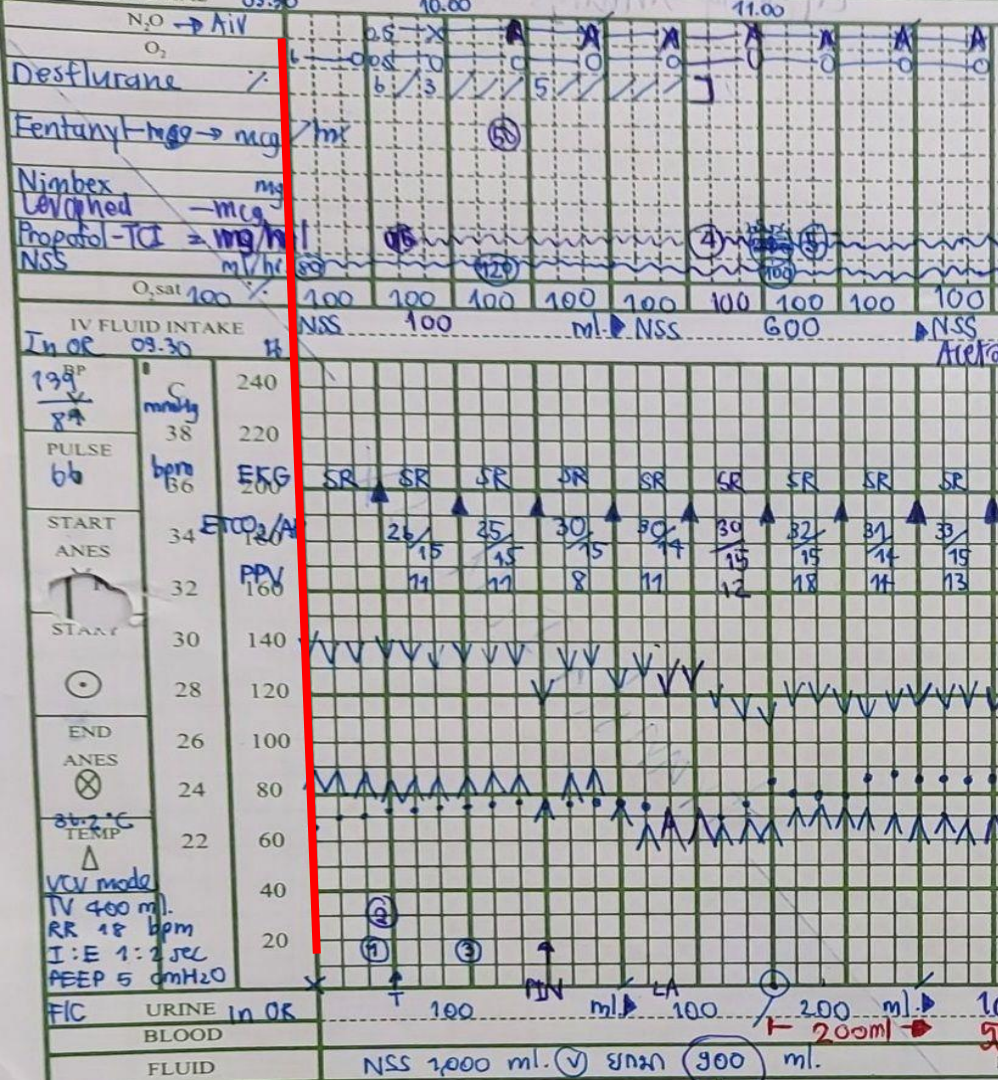
Intraoperative

Choice of anesthesia

GA with ETT with controlled ventilation

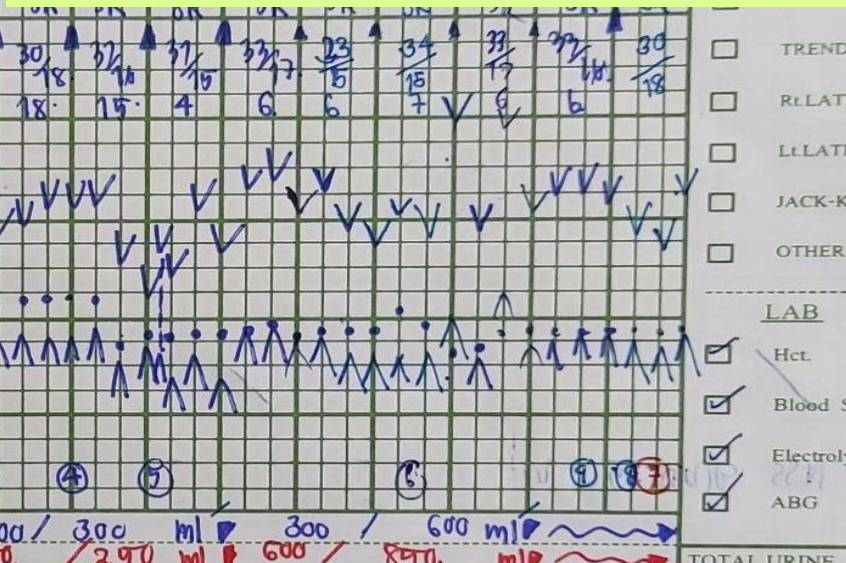
Goal of Induction of anesthesia

- Prevent rupture of aneurysm (laryngoscopy & intubation)
- Preservation of cerebral perfusion
- Prevention of increase ICP



Patient in OR At 9.30 AM

- Monitor : NIBP, 5-lead EKG, O₂sat, EtCO₂, body temperature, urine output
- V/S : BT 36.2 C° BP 139/85 mmHg
HR 66 mmHg, O₂sat 100%



CONSENT YES NO

VISIT

DN

E

TOMY

G

TRENDEL

R/L LATERAL

L/L LATERAL

JACK-KNIFE

OTHER

LAB

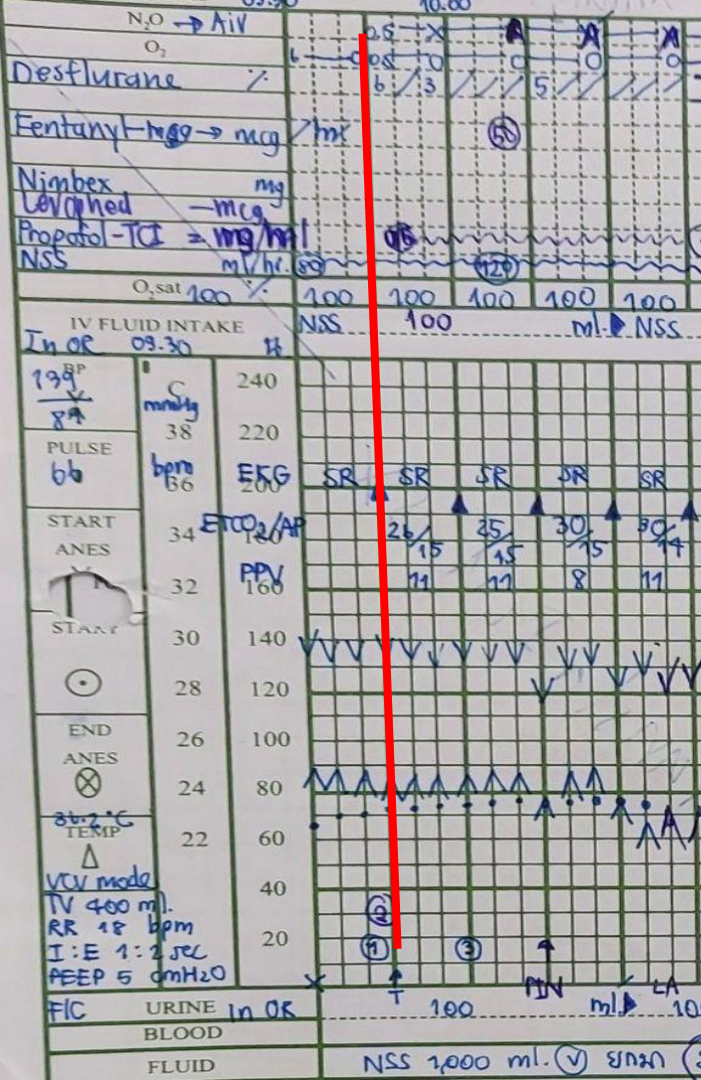
Hct.

Blood Sugar

Electrolyte

ABG

TOTAL URINE OUTPUT 1100 ml



At 9.10 AM

- Access A-line No.22 at Lt RA (before induction)
- preoxygenation 5 min
- Induction agent : Propofol 40 mg
- Intubation agent : cisatracurium 10 mg

Intubation at 9.15 AM

- Increase depth of anesthesia
(blunt hemodynamic by inhalation)
- ETT no.7.5 depth 22 cm. (LV gr 1 by macintosh no.3)
(before ETT SBP 80-90 mmHg, after ETT SBP 110-120 mmHg)
- Maintenance : Air:O₂:Desflurane,0.5:0.5:up to 6%
- Large bore IV no 16 at Rt hand , no 16,18 at Lt hand
- 0.9% Nacl IV 80 ml/hr.
- Propofol TCI IV 2 mcg/ml
- Cefazolin 2 gm IV stat
- monitor body temperature

-Ventilator setting : VCV mode TV 400 ml
PEEP 5 cmH₂O RR 18/min I:E 1:2

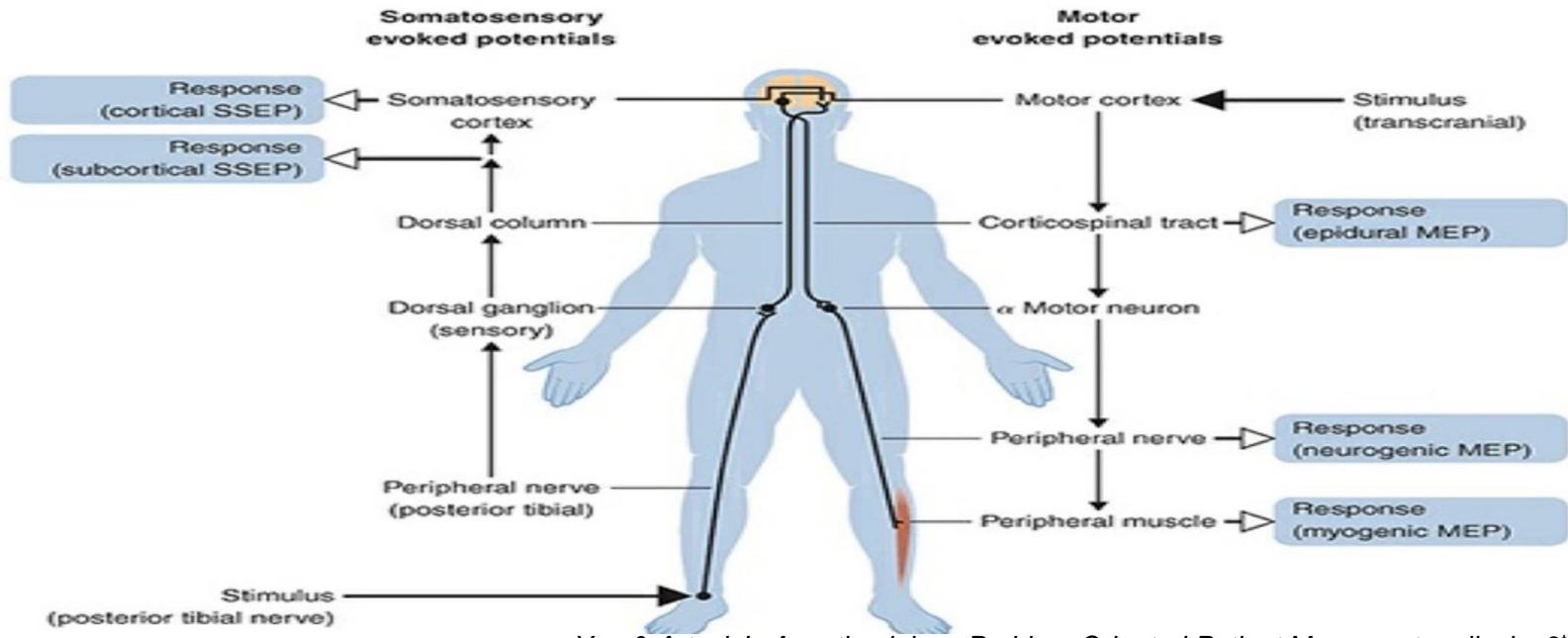
Maintenance anesthesia

Anesthetic technique for MEPs & SSEPs

Total intravenous anesthesia and omission of muscle relaxants

Goal of CPP 60-80 mmHg

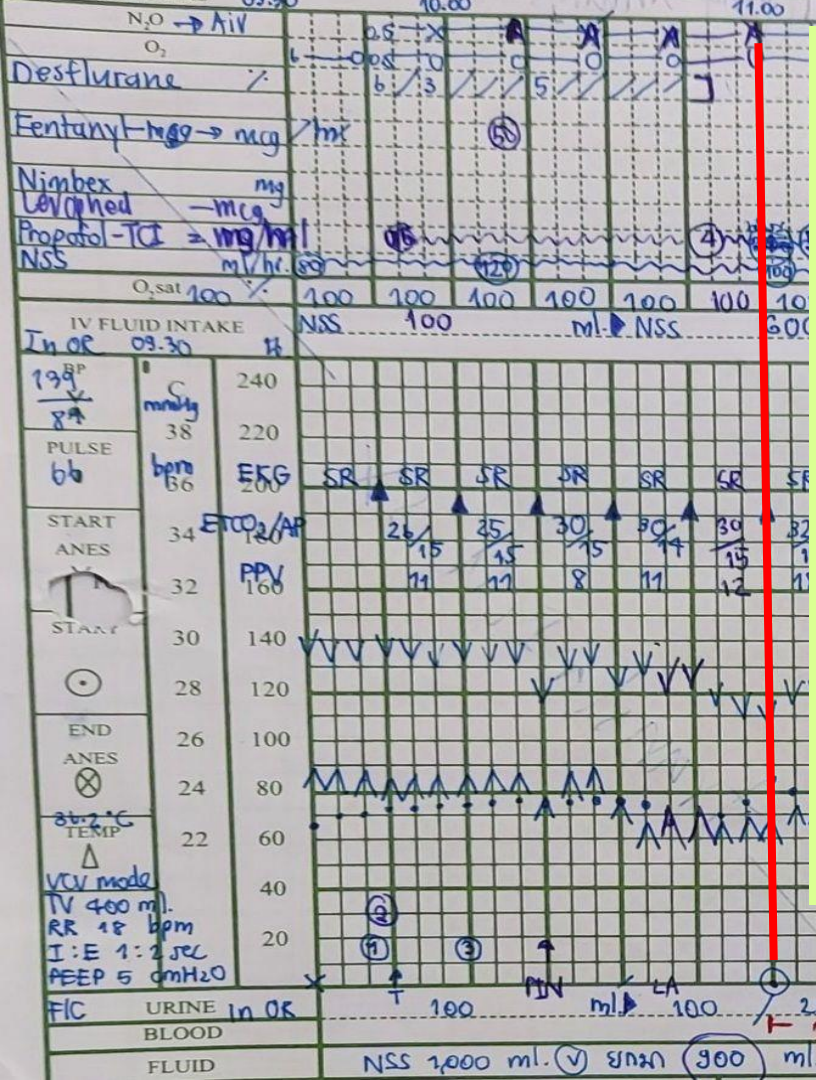
Neurophysiologic monitoring



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

Physiologic effect on sensory evoked response

Physiologic effect	amplitude	latency
hypoxemia	↓	↔
hyperthermia	↑	↔
hypothermia	↓	↑
anemia	↓	↑



At 10.15 AM

- supine position with head elevate 30°
- Fentanyl 50 mcg before pining
- MEPS & SSEP

At 11.00 AM : start operation

V/S BT 35.5 C BP 110-130 mmHg/ 60-70 mmHg PR 70-80 bpm
ETCO₂ 30 , PPV 8-12

- Discontinued desflurane & Air:O₂ 0.5:0.5
- Propofol TCI IV 4 mcg/ml

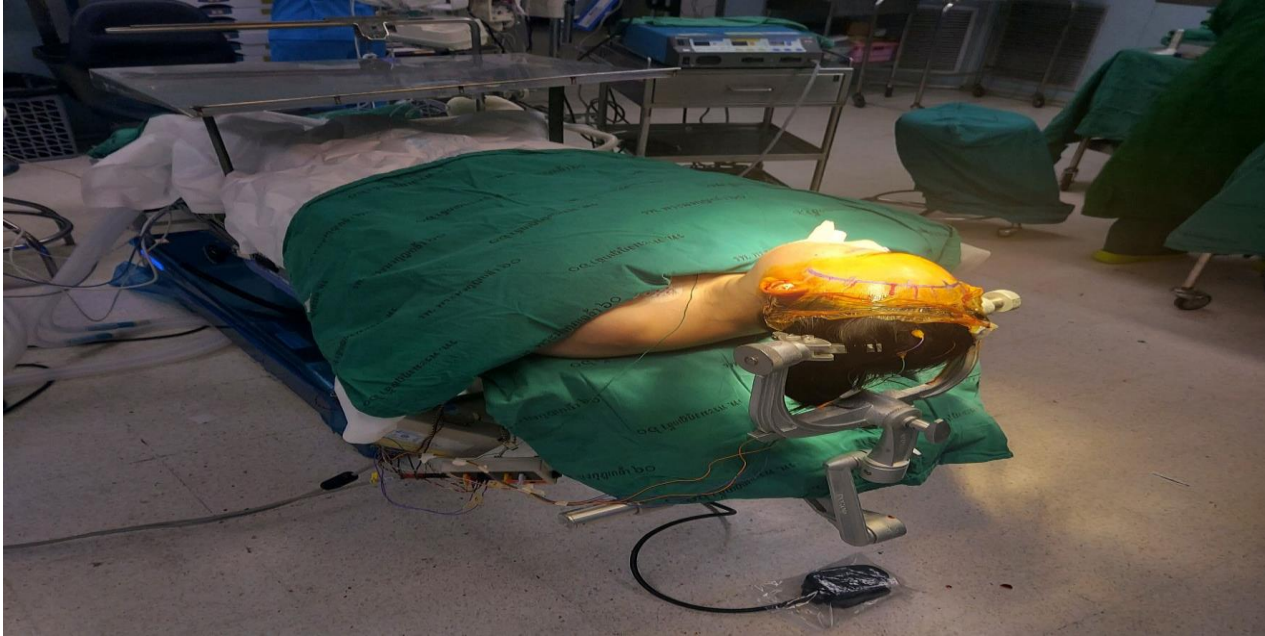
ABG

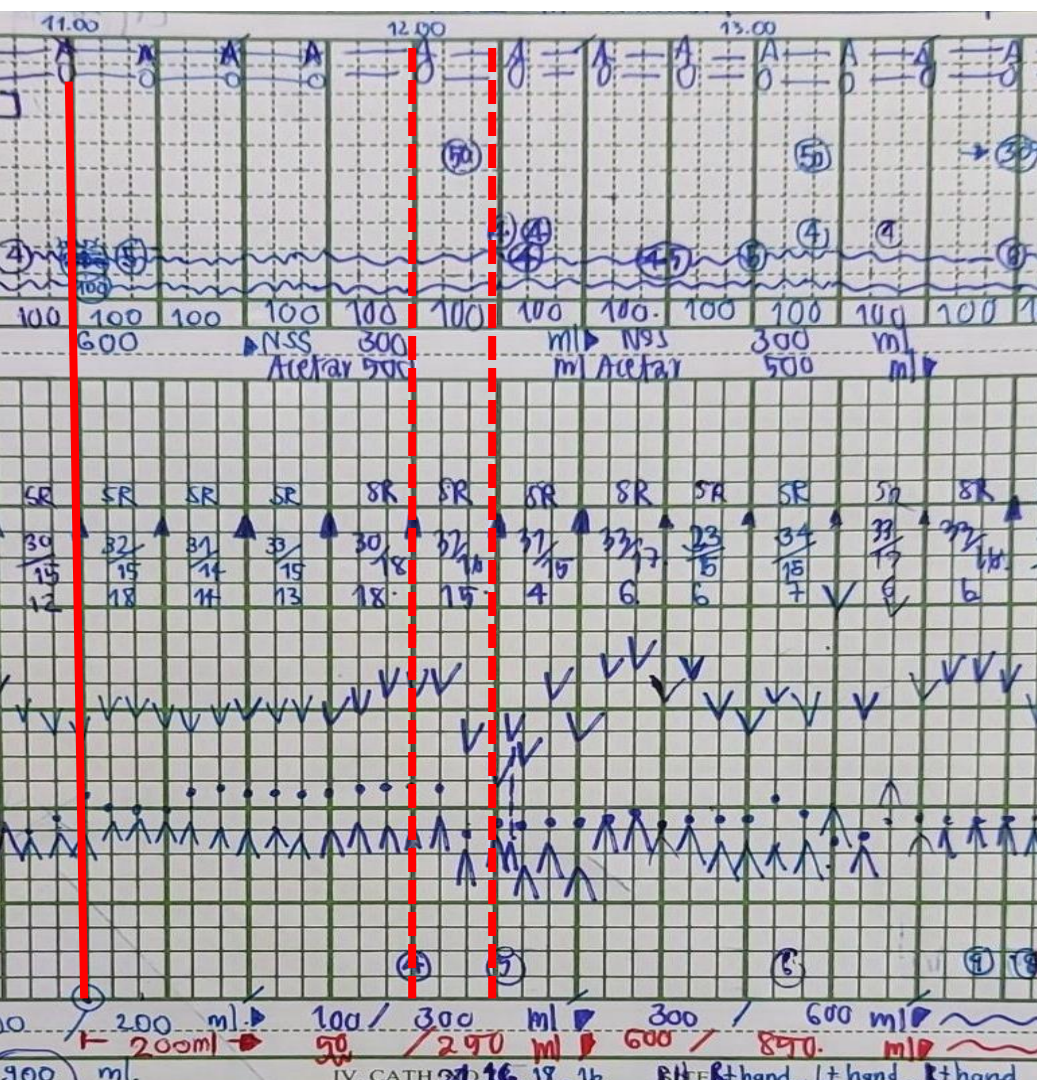
- pH 7.29, pO₂ 241 pCO₂ 39.7 HCO₃ 19.4
- Hb 11.2 g/dl, Hct 33%
- Na 137 K 3.5 Ca 1.17
- DTX 118 mg%

Positioning

- **Location** and **size of the aneurysm** determine the position of patient
- **Anterior circulation aneurysms** : **frontal temporal (pterional incision)** in **supine**
- **Proper position of head and neck** : **avoid jugular venous obstruction, avoid lateral extension or flexion of head on neck**

Positioning





At 11.00- 12.00 AM

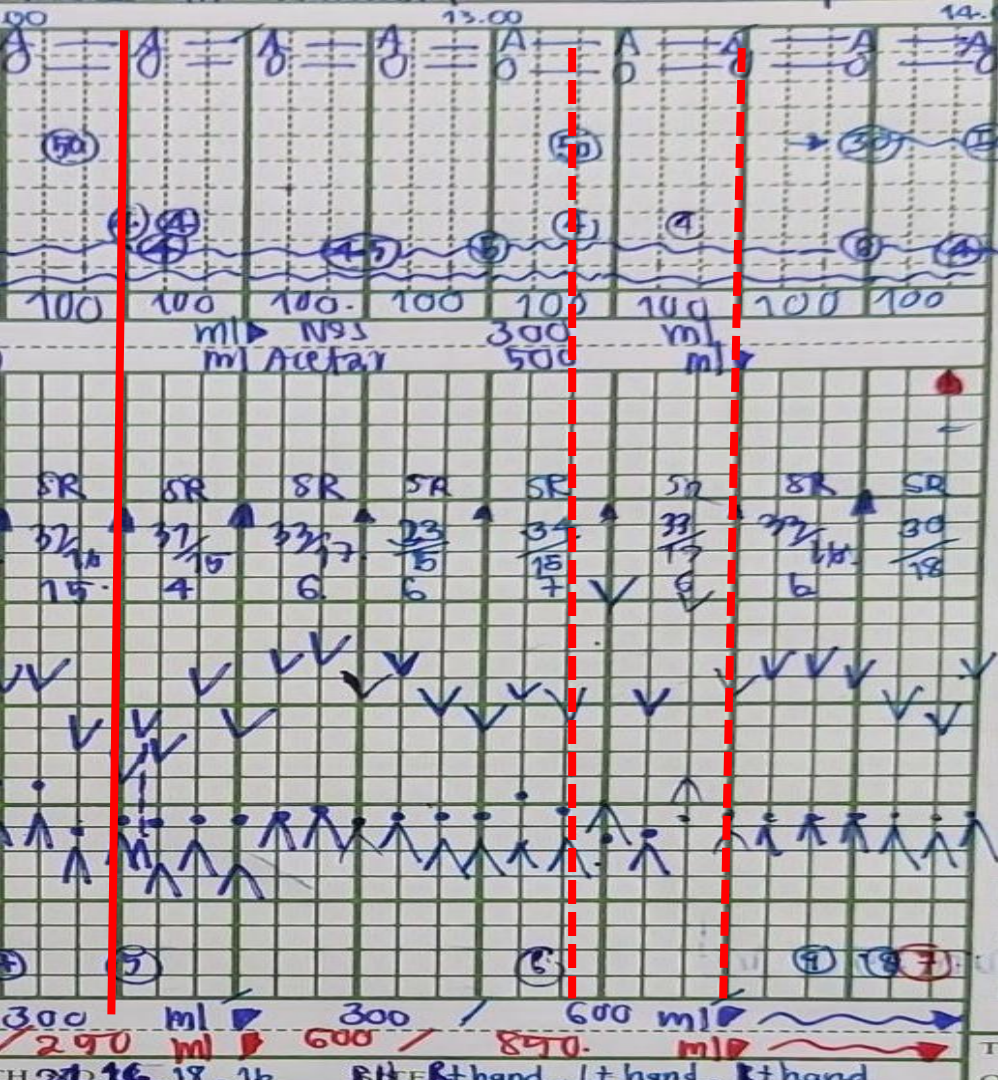
V/S BT 36 C BP 120-130 mmHg/ 70-80 mmHg
 PR 70-80 bpm
 ETCO₂ 30-33 , PPV 13-18, BL 250 ml.

- Acetar IV coloadng 500 ml.
- Propofol TCI IV 5 mcg/ml

At 12.00-12.15 AM :

V/S BT 35 C BP 90-100 mmHg/ 50-60 mmHg
 PR 70-80 bpm
 ETCO₂ 30 , PPV 15

- 20% mannitol 100 ml IV drip x 2 doses
- Fentanyl 50 mcg IV (ผู้ป่วยหายใจ)
- Levophed 8 mcg IV
- Propofol TCI IV 4 mcg/ml



CONSENT
 YES
 NO

At 12.15-13.00 :
 V/S BT 36 C BP 110-130 mmHg/ 60-80 mmHg
 PR 70-80 bpm
 ETCO₂ 32-34 , PPV 6-7

At 13.10-13.30 (temporary clipping aneurysm)

- Levophed 4 mcg IV x 2 doses
 (for adequate collateral blood flow)
- Propofol TCI IV 5 mcg/ml
- Acetar 500 ml IV coloadng

LAB

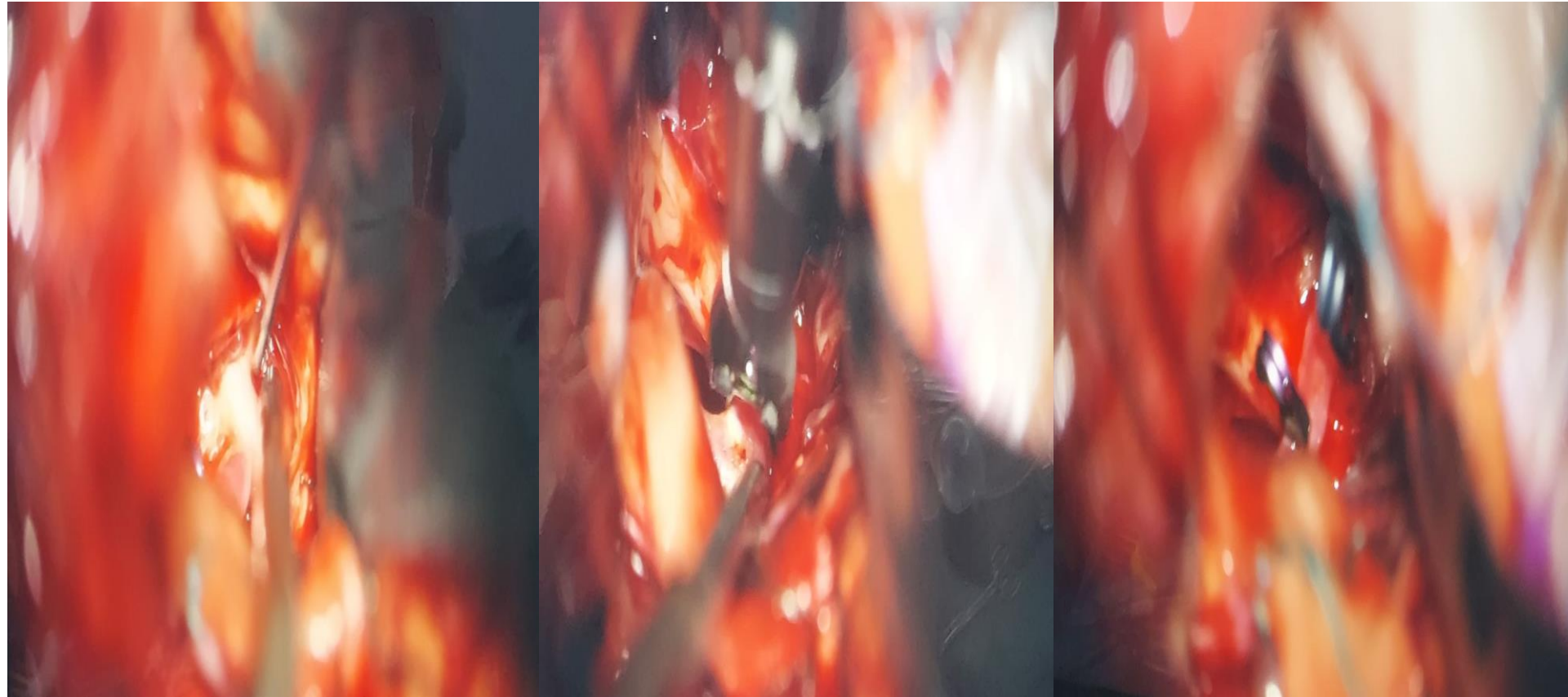
- Hct.
- Blood Sugar
- Electrolyte
- ABG

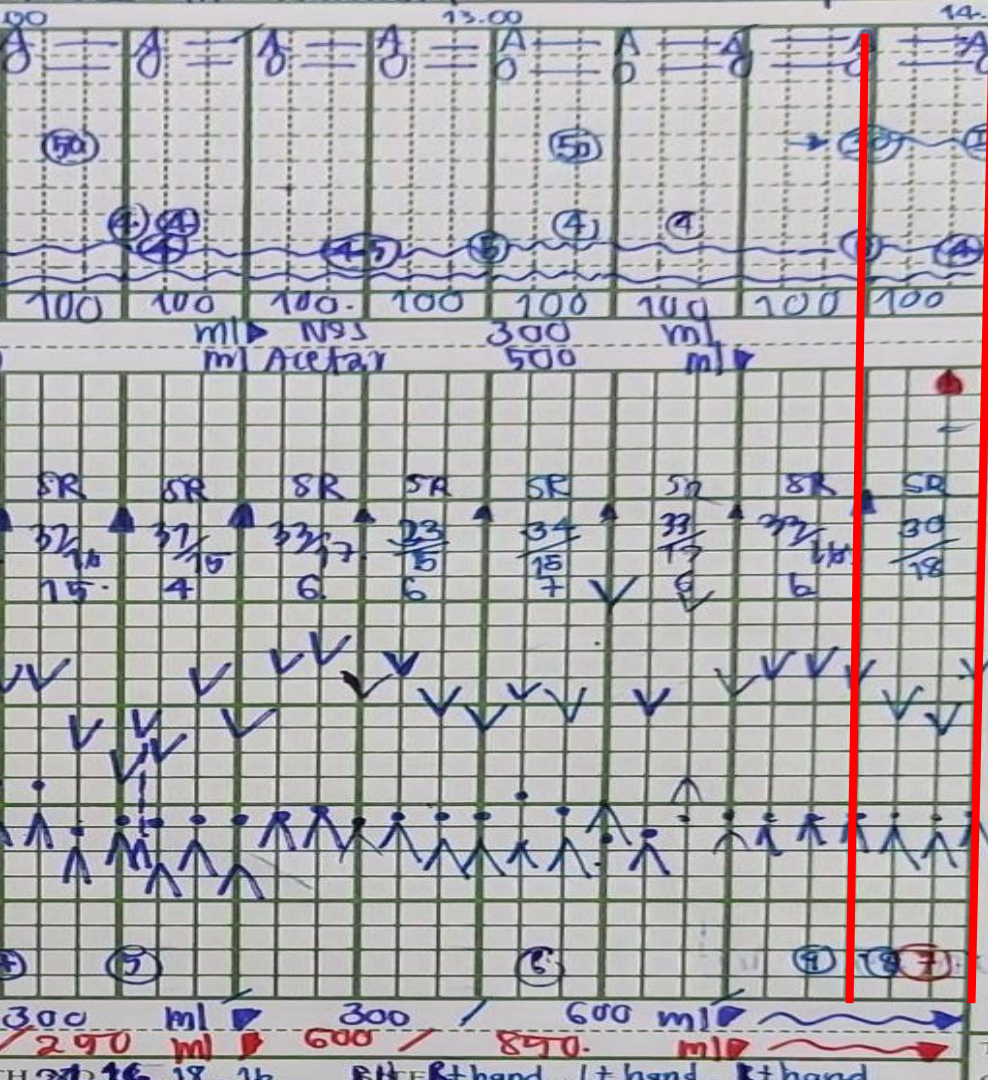
TOTAL URINE
 OUTPUT 1100

Temporary occlusion VS Controlled hypotension

Temporary Occlusion	Controlled Hypotension
Normotension or hypertension	Systemic hypotension
Temporary cessation of flow	Uninterrupted flow
Regional ischemia	Global ischemia
Short duration (10–20 min)	Longer duration
Dependent on collateral vessels	Independent of collateral vessels
Potential vessel damage	No vessel damage
Possibly complete control	Lack of complete control

Clipping aneurysm





At 13.45-14.00 :

V/S BT 36 C BP 120-130 mmHg/ 60-70 mmHg
 PR 70-80 bpm
 ETCO₂ 32-34 , PPV 6-7, **BL 850 ml.**

ABG

pH 7.28, pO₂ 239 pCO₂ 37.7 HCO₃ 18
 Hb 9.2 g/dl, Hct 27%
 Na 136 K 3.9 Ca 1.09
 DTX 94 mg%

- Indocyanine green 12.5 mg IV
- Fentanyl (10:1) IV 3-5 ml/hr.(ผู้ป่วยหายใจ)
- **LPRC 1 U IV drip**

CONSENT

YES

NO

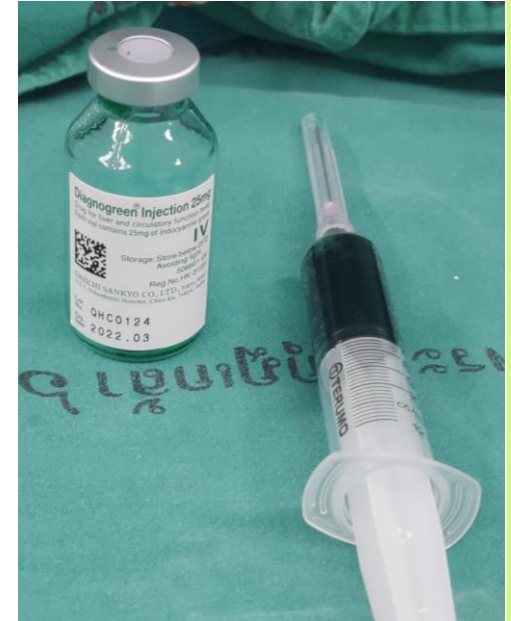
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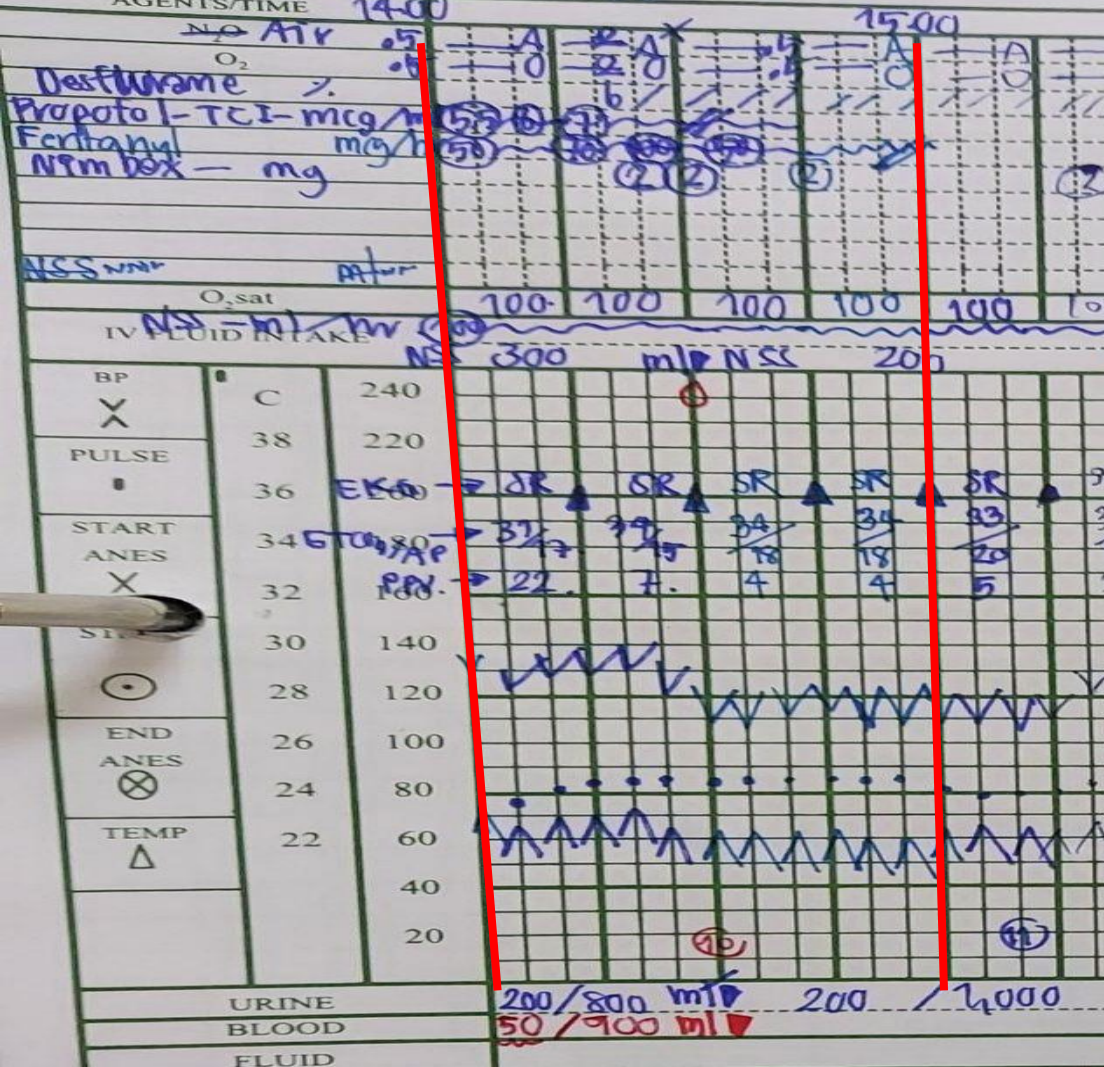
ABG

TOTAL URINE OUTPUT 1100

Intraoperative catheter angiography and indocyanine green videoangiography

- Confirm the proper placement of clip and patency of vessel
- **Indocyanine green : simple aneurysms**
(False negative in complex aneurysm)
- **Intraoperative catheter angiography (gold standard)**
: complex aneurysm





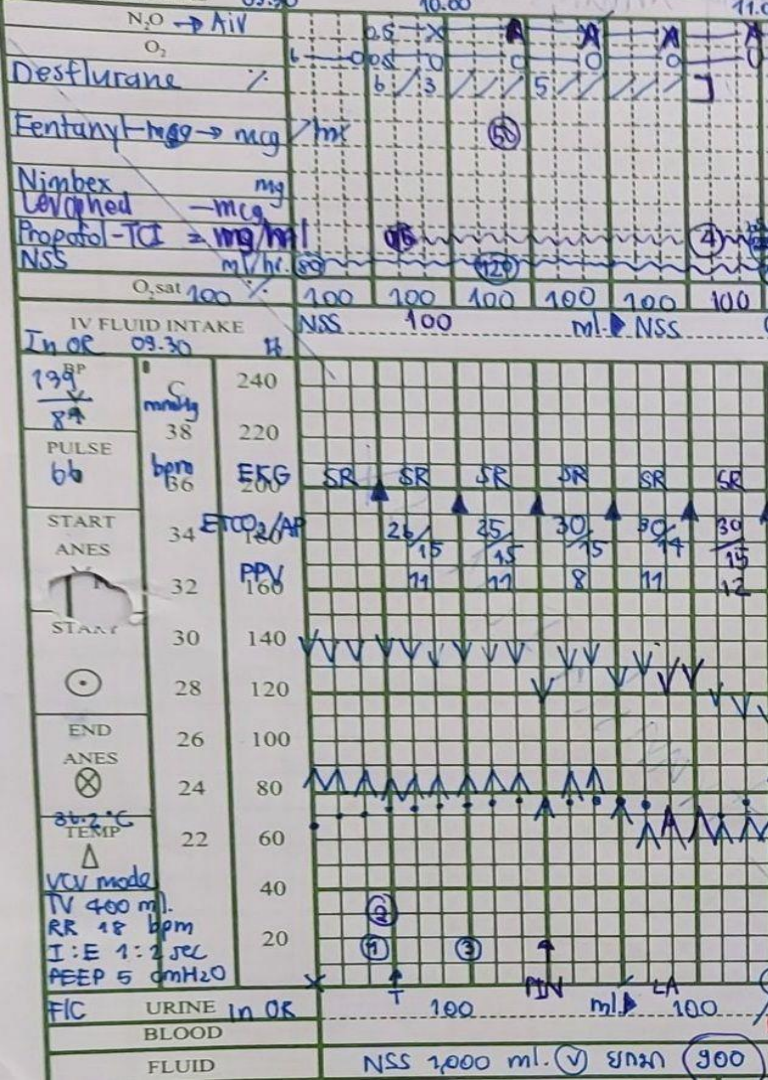
AT 14.00-15.00 (neuromonitoring ending)

- Propofol TCL cessation
- Fentanyl IV drip cessation
- Desflurane up to 6%
- Cisatracurium 2 mg IV
- FFP 1 U IV drip

ABG

pH 7.31, pO₂ 212 pCO₂ 37.9 HCO₃ 18.7
 Hb 9.4 g/dl, Hct 28.3%
 Na 140 K 3.19 Ca 1.05

At 16.30 (operation done)



Emergence

- Reverse : neostigmine 2.5 mg + atropine 1.2 mg
- 2% xylocaine 75 mg IV (blunt airway reflex)
- Narcotic drug : fentanyl 300 µg
- Propofol TCI 470 mg
- levophed 16 mcg
- Fluid summary 4334 ml
(Crystalloid 3600 ml, PRC 253ml, FFP 281 ml, mannitol 40 mg)
- Bleeding 900 ml
- Urine output 1100 ml
- Operation time 7 hr.

Postoperative

Post operative consideration

- Early neurological assessment
- Decision regarding diagnostic imaging and therapeutic
- Pulmonary disease and cardiogenic shock are common after SAH
- Controlled blood pressure (*keep SBP 130-150 mmHg*)
- Maintain normovolemia, normoglycemia, normal Hb (*8-10 g/dL*)
- TCD for follow up vasospasm

Post operative day1 (at ICU)

- **S** : ผู้ป่วยตื่นดี พูดคุยรู้เรื่อง ทำตามสั่งได้ ไม่มีไข้ แผลไม่ซึม การมองเห็นปกติ ปวดแผล ps 3/10
ปัสสาวะออกดี ไม่มีเสียงแหบ ไม่ชักเกร็ง
- **O** : V/S BT 36.8 °c BP 110/80 mmHg PR 78 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*
I/O : 600ml/3 hr. , RD : 150 ml, Hct 37%
- **A+P** : **Left craniectomy for clipping AcomA aneurysm PO day 0**
 - fentanyl 50 mcg iv prn q 4hr.
 - 0.9% Nacl iv 80 ml/hr.
 - nimodipine (30) 2 tab q 4 hr., keep SBP 140-160 mmHg
 - dilantin 750 mg iv in 30 min then 100 mg iv q 8 hr.

Post operative day 3 (At ward)

- **S** : ผู้ป่วยตื่นดี ไม่มีไข้ แผลไม่ซึม ไม่ปวดแผล **ถามตอบรู้เรื่อง ปัสสาวะออกดี ไม่มีอาการชาที่ขา หายใจปกติไม่ หอบเหนื่อย**
- **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** : **Left craniectomy for clipping AcomA aneurysm day 3**
 - Step diet, HOB 30°
 - consult neuro med for TCD **ประเมิน vasospasm**
 - ส่ง PMR เพื่อกายภาพ
 - นัด MRA & MRI brain
 - D/C วันรุ่งขึ้น

Thank you