대한마취통증의학회
The Korean Society of Anesthesiologists

102ND

KOREANESTHESIA 2025

The 102nd Annual Scientific Meeting of the Korean Society of Anesthesiologists

NOV 6 (THU) - NOV 8 (SAT) | PARADISE CITY Convention Center, Incheon, Korea

Refresher Course

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대한마취통증의학회
The Korean Society of Anesthesiologists

Refresher Course Program

Nov 6 (Thu) 09:00 ~ 17:00

Refresher Course 1
Preoperative Evaluation and Preparation

Date / Time	Nov 6 (Thu) / 09:00-10:30	
Room	Hall 3	
Language	Korean	
Chair(s)	Young Duck Shin *(Chungbuk National University, Republic of Korea)* Tae Hun An *(Chosun University, Republic of Korea)*	
Speaker(s)	09:00 - 09:20	**Preoperative evaluation of patients with cardiac disease** Sung Yeon Ham *(Yonsei University, Republic of Korea)*
	09:20 - 09:40	**Preoperative evaluation of patients with respiratory disease** Jeong-Hyun Choi *(Kyung Hee University, Republic of Korea)*
	09:40 - 10:00	**Preoperative evaluation of patients with liver or renal disease** Ji-Yoon Jung *(Konyang University, Republic of Korea)*
	10:00 - 10:20	**NPO guideline for adults and children** Hee Young Kim *(Pusan National University Yangsan Hospital, Republic of Korea)*
	10:20 - 10:30	Q&A

Refresher Course 2
POCUS

Date / Time	Nov 6 (Thu) / 11:00-12:30	
Room	Hall 3	
Language	Korean	
Chair(s)	Younjin Kim *(Ewha Womans University, Republic of Korea)* Seongtae Jeong *(Chonnam National University, Republic of Korea)*	
Speaker(s)	11:00 - 11:20	**Lung ultrasound in Anesthesiology : from option to essential competency** Kyu Nam Kim *(Hanyang University, Republic of Korea)*
	11:20 - 11:40	**Gastric ultrasound** Hyun-Jung Shin *(Seoul National University, Republic of Korea)*
	11:40 - 12:00	**Airway ultrasound** Sung-Ae Cho *(Sungkyunkwan University, Republic of Korea)*
	12:00 - 12:20	**Transthoracic echocardiography** Tae Kyong Kim *(Seoul National University, Republic of Korea)*
	12:20 - 12:30	Q&A

Refresher Course 3
Practical Pain Management

Date / Time	Nov 6 (Thu) / 13:30-15:00	
Room	Hall 3	
Language	Korean	
Chair(s)	Jiseon Son *(Jeonbuk National University, Republic of Korea)* Doosik Kim *(Kosin University, Republic of Korea)*	
Speaker(s)	13:30 - 13:50	**Common C-arm-guided blocks in pain clinics** Ji Won Choi *(Sungkyunkwan University, Republic of Korea)*
	13:50 - 14:10	**Useful ultrasound-guided block for pain clinics** Eunsoo Kim *(Pusan National University, Republic of Korea)*
	14:10 - 14:30	**Pain management of CRPS patients** Hyun-Jung Kwon *(University of Ulsan, Republic of Korea)*
	14:30 - 14:50	**Interventional management of cancer pain** Junmo Park *(Kyungpook National University, Republic of Korea)*
	14:50 - 15:00	Q&A

Refresher Course 4
Anesthesia for Specific Surgery

Date / Time	Nov 6 (Thu) / 15:30-17:00	
Room	Hall 3	
Language	Korean	
Chair(s)	Seung Ho Choi *(Yonsei University, Republic of Korea)* Aeryoung Lee *(Jeju National University, Republic of Korea)*	
Speaker(s)	15:30 - 15:50	**Anesthetic considerations in ruptured and unruptured cerebral aneurysm surgery** Minsoo Kim *(Kangwon National University, Republic of Korea)*
	15:50 - 16:10	**Updates on anesthetic management for Cesarean section** Yoon Ji Choi *(Korea University, Republic of Korea)*
	16:10 - 16:30	**Updates on anesthetic management for robotic surgery** Jun-Young Park *(University of Ulsan, Republic of Korea)*
	16:30 - 16:50	**Updates on anesthetic management for VATS** Wonjung Hwang *(The Catholic University, Republic of Korea)*
	16:50 - 17:00	Q&A

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Refresher Course 1

Preoperative Evaluation and Preparation

Chair(s)	Young Duck Shin *(Chungbuk National University, Republic of Korea)* Tae Hun An *(Chosun University, Republic of Korea)*
1	**Preoperative evaluation of patients with cardiac disease** Sung Yeon Ham *(Yonsei University, Republic of Korea)*
2	**Preoperative evaluation of patients with respiratory disease** Jeong-Hyun Choi *(Kyung Hee University, Republic of Korea)*
3	**Preoperative evaluation of patients with liver or renal disease** Ji-Yoon Jung *(Konyang University, Republic of Korea)*
4	**NPO guideline for adults and children** Hee Young Kim *(Pusan National University Yangsan Hospital, Republic of Korea)*

Preoperative evaluation of patients with cardiac disease

Sung Yeon Ham
Yonsei University, Republic of Korea

Learning Objective

1. Understand the key cardiovascular conditions that impact anesthetic risk and perioperative planning.
2. Identify essential components of preoperative cardiac assessment.
3. Apply current guidelines to optimize perioperative care for patients with cardiac disease undergoing noncardiac surgery.

Introduction

The anesthesia preoperative evaluation, which is the clinical foundation for guiding perioperative patient management, reduces perioperative morbidity and enhances patient outcome. The fundamental purpose of preoperative evaluation is to obtain pertinent information regarding the patient's medical history, formulate an assessment of the patient's perioperative risk, and develop a plan for any clinical optimization. The pre-anesthesia evaluation should include a focused clinical examination, documentation of comorbid illness, reduction of patients' anxiety through education, assurance that preexisting medical conditions are optimally managed, selective referrals to medical specialists, ordering of preoperative investigations, initiation of interventions intended to decrease risk, discussion of aspects of perioperative care, arrangements for appropriate postoperative care, and recommendations to delay or cancel the surgical procedure, if deemed appropriate. Cardiovascular complications are serious perioperative adverse events and account for 45% of deaths within 30 days after major noncardiac surgery. Several evidence-based preoperative cardiovascular assessment guidelines have been published, including the 2024 American College of Cardiology (ACC) and American Heart Association (AHA) guidelines, 2022 European Society of Cardiology (ESC) guidelines, and 2017 Canadian Cardiovascular Society (CCS) guidelines.

Key recommendations (2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline)

In patients with known CVD being considered for NCS, a validated risk-prediction tool can be useful to estimate the risk of perioperative MACE. (COR 2a, LOE B-NR)

• Hypertension

In most patients with hypertension planned for elective NCS, it is reasonable to continue medical therapy for hypertension throughout the perioperative period. (COR 2a, LOE C-EO)

In patients undergoing elective elevated-risk surgery who have cardiovascular risk factors for perioperative complications and recent history of poorly controlled hypertension (systolic blood pressure [SBP] ≥180 mm Hg or diastolic blood pressure [DBP] ≥110 mm Hg before the day of surgery), deferring surgery may be considered to reduce the risk of perioperative complications. (COR 2b, LOE C-LD)

In select patients on chronic renin-angiotensin-aldosterone system inhibitors (RAASi) for hypertension undergoing elevated-risk NCS, omission 24 hours before surgery may be beneficial to limit intraoperative hypotension. (COR 2b, LOE B-R)

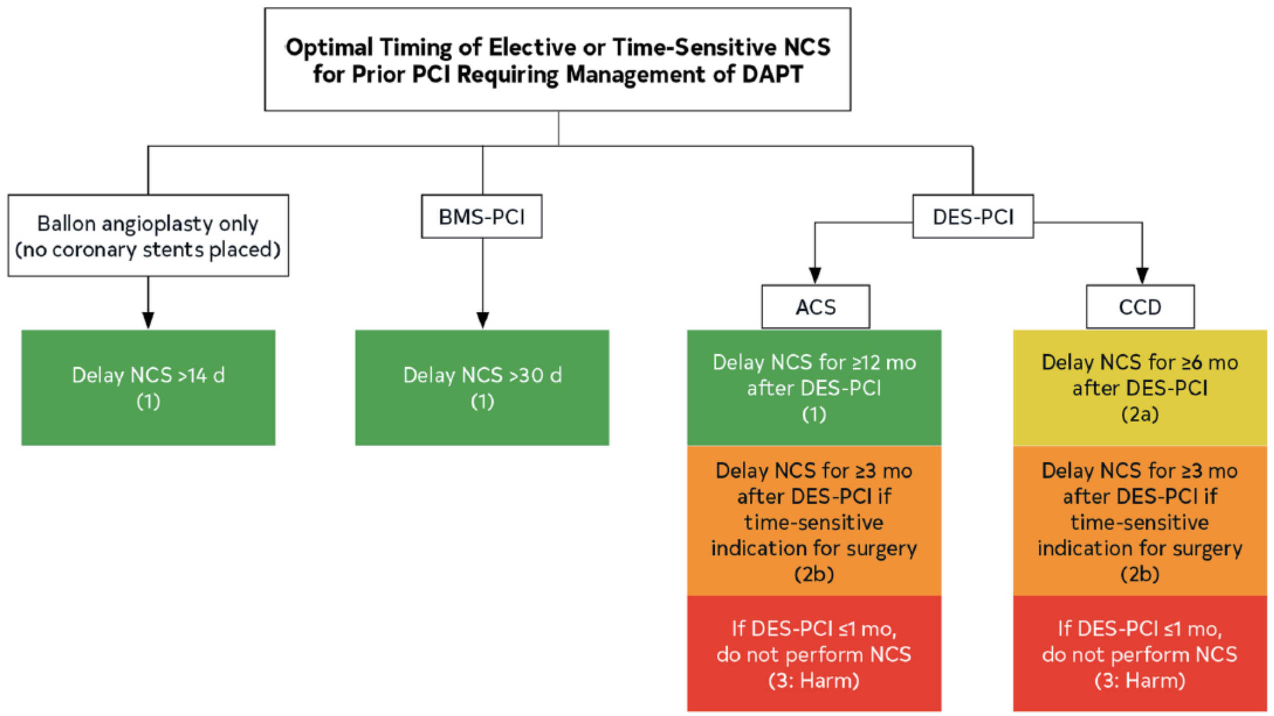
• Ischemic Heart Disease

In patients with ACS being considered for elective NCS, coronary revascularization as appropriate and deferral of surgery is recommended to reduce perioperative cardiovascular events. (COR 1, LOE C-LD)

In patients with CCD and hemodynamically significant left main coronary artery stenosis ≥50% who are planning elective NCS, coronary revascularization and deferral of surgery is reasonable to reduce perioperative cardiovascular events. (COR 2a, LOE C-LD)

• Coronary Stents

- Timing of NCS After PCI



- **Perioperative Antiplatelet Management Post PCI**

In patients with prior PCI undergoing NCS, it is recommended to continue aspirin (75-100 mg), if possible, to reduce the risk of cardiac events. (COR 1, LOE B-R)

In patients with CAD who require time-sensitive NCS within 30 days of PCI with BMS or <3 months of PCI with DES, DAPT should be continued unless the risk of bleeding outweighs the benefit of the prevention of stent thrombosis. (COR 1, LOE B-NR)

In patients with prior PCI in whom OAC monotherapy must be discontinued before NCS, aspirin should be substituted when feasible in the perioperative period until OAC can be safely reinitiated. (COR 1, LOE B-NR)

In select patients after PCI who have a high thrombotic risk, perioperative bridging with intravenous antiplatelet therapy may be considered <6 months after DES or <30 days after BMS if NCS cannot be deferred. (COR 2b, LOE B-NR)

- **Perioperative Antiplatelet Management in Patients Without Prior PCI**

In patients with CCD without prior PCI undergoing elective NCS, it may be reasonable to continue aspirin in selected patients when the risk of cardiac events outweighs the risk of bleeding. (COR 2b, LOE B-R)

In patients with CAD but without prior PCI who are undergoing elective noncarotid NCS, routine initiation of aspirin is not beneficial. (COR 3, LOE B-R)

• Heart Failure

In patients with HF undergoing elective NCS, sodium-glucose cotransporter-2 inhibitors (SGLT2i) should be withheld for 3 to 4 days* before surgery when feasible to reduce the risk of perioperative metabolic acidosis. (COR 1, LOE C-LD)

*Canagliflozin, dapagliflozin, and empagliflozin should be stopped ≥3 days and ertugliflozin ≥4 days before scheduled surgery.

In patients with compensated HF undergoing NCS, it is reasonable to continue guideline-directed management and therapy (GDMT) (excluding SGLT2i) in the perioperative period, unless contraindicated, to reduce the risk of worsening HF. (COR 2a, LOE C-LD)

• Valvular Heart Disease

- **Aortic Stenosis**

Patients with severe AS should be evaluated for the need for aortic valve intervention before elective NCS to reduce perioperative risk. (COR 1, LOE C-LD)

In patients with suspected moderate or severe AS who are undergoing elevated-risk NCS, preoperative echocardiography is recommended before elective NCS to guide perioperative management. (COR 1, LOE C-EO)

In asymptomatic patients with moderate or severe AS and normal LV systolic function as assessed by echocardiography within the past year, it is reasonable to proceed with elective low-risk NCS. (COR 2a, LOE C-LD)

- **Mitral Stenosis**

Patients with severe mitral stenosis (MS) should be evaluated for the need for mitral valve (MV) intervention before elective NCS. (COR 1, LOE B-NR)

In patients with severe MS who cannot undergo MV intervention before NCS, perioperative invasive hemodynamic monitoring is reasonable to guide management to reduce the risk of cardiovascular complications. (COR 2a, LOE C-EO)

In patients with severe MS who cannot undergo MV intervention before NCS, perioperative heart-rate control (eg, beta blockers, calcium channel blockers [CCBs], ivabradine, digoxin) may be considered to prolong diastolic filling time and decrease perioperative cardiovascular complications. (COR 2b, LOE C-LD)

- **Chronic Aortic and Mitral Regurgitation**

In patients with suspected moderate or severe valvular regurgitation, preoperative echocardiography is recommended before elective NCS to guide perioperative management. (COR 1, LOE C-EO)

In patients with VHD who meet indications for valvular intervention based on clinical presentation and severity of regurgitation, the need for valvular intervention should be considered before elective elevated-risk NCS to reduce perioperative risk. (COR 1, LOE C-EO)

In asymptomatic patients with moderate or severe MR, normal LV systolic function, and estimated PA systolic pressure <50 mm Hg, it is reasonable to perform elective NCS. (COR 2a, LOE C-LD)

In asymptomatic patients with moderate or severe aortic regurgitation and normal LV systolic function (LVEF >55%), it is reasonable to perform elective NCS. (COR 2a, LOE C-LD)

• Atrial Fibrillation

In patients with rapid AF identified in the setting of NCS, it is reasonable to treat potential underlying triggers contributing to AF and rapid ventricular response (eg, sepsis, anemia, pain). (COR 2a, LOE C-LD)

In patients with new-onset AF identified in the setting of NCS, initiation of postoperative anticoagulation therapy can be beneficial after considering the competing risks associated with thromboembolism and perioperative bleeding. (COR 2a, LOE C-LD)

• Cardiovascular Implantable Electronic Devices

Patients with cardiovascular implantable electronic devices (CIED) having elective NCS should have a management plan developed before surgery if electromagnetic interference (EMI) is anticipated, including identification of the type of CIED (eg, pacemaker, implantable cardioverter-defibrillator [ICD], implantable monitor), manufacturer, and model. (COR 1, LOE B-NR)

Patients who are pacemaker-dependent having surgeries above the umbilicus with anticipated EMI should have the pacemaker reprogrammed or have a magnet placed on the generator to provide an asynchronous mode to avoid pacing inhibition. (COR 1, LOE B-NR)

Pacemaker-dependent patients with a transvenous ICD undergoing surgery above the umbilicus with anticipated EMI should have the device reprogrammed; if the patient is not pacemaker-dependent, then either reprogramming or a magnet placed on the generator can be used to inhibit tachytherapies or inappropriate shocks. (COR 1, LOE B-NR)

Patients who have a pacemaker or ICD reprogrammed to asynchronous pacing or have tachytherapies programmed off before surgery should have device functioning restored in the postoperative period before hospital discharge. (COR 1, LOE B-NR)

Patients with leadless pacemakers who are pacemaker-dependent having surgeries with anticipated EMI above the umbilicus should have their pacemakers reprogrammed to an asynchronous mode. (COR 1, LOE C-LD)

For patients with subcutaneous ICD having noncardiac or nonthoracic surgery with anticipated EMI above the groin, it is reasonable to reprogram the device or use a magnet to temporarily disable tachytherapies. (COR 2a, LOE C-LD)

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Memo.

Preoperative evaluation of patients with respiratory disease

Jeong-Hyun Choi
Kyung Hee University, Republic of Korea

Learning Objective

1. Postoperative pulmonary complications
2. General preoperative evaluation/management
3. Disease-specific evaluation/management

Postoperative pulmonary complications (PPCs) markedly increase morbidity and mortality, particularly among patients with underlying pulmonary disease, and their incidence varies with surgical type, patient age, smoking status, and comorbidities such as COPD and congestive heart failure. While pulmonary function tests and chest radiographs are essential for lung resection surgery, their use in other procedures should be individualized based on patient risk. Validated risk stratification tools—including the ASA classification, Gupta calculators, and the ARISCAT model—are instrumental in predicting PPCs and guiding perioperative planning.

Effective prevention hinges on preoperative optimization of respiratory conditions through appropriate inhaled therapies, short courses of systemic corticosteroids when indicated, structured respiratory exercises, and robust smoking cessation efforts, alongside correction of anemia and hypoalbuminemia. The choice and duration of anesthesia also meaningfully influence risk, with regional anesthesia preferred over general anesthesia when feasible and efforts made to minimize operative time. Ultimately, comprehensive and tailored preoperative evaluation and intervention are key to improving surgical outcomes and reducing PPC incidence.

References

1. Hyo Jin Lee, M.D. and Hyun Woo Lee, M.D, Comprehensive Strategies for Preoperative Pulmonary Risk Evaluation and Management, Tuberc Respir Dis 2025;88:90-10
2. Fotis Sampsonas, Markela Antonogiannaki, Stylianos Vittorakis, et al., Preoperative evaluation of the respiratory system: A narrative review based on Hellenic Thoracic Society guidelines, Pneumon 2023;36(3):18
3. Gilda Diaz-Fuentes, Hafiz Rizwan Talib Hashmi and Sindhaghatta Venkatram, Perioperative Evaluation of Patients with Pulmonary Conditions Undergoing Non-Cardiothoracic Surgery, HealtH ServiceS inSigHtS 2016:9(S1)

Memo.

Preoperative evaluation of patients with liver or renal disease

Ji-Yoon Jung
Konyang University, Republic of Korea

Learning Objective

1. To understand the pathophysiological changes associated with impaired hepatic and renal function.
2. To understand the preoperative evaluation and anesthetic considerations in patients with liver or kidney disease.
3. To apply appropriate strategies for safe anesthetic management tailored to organ dysfunction.

신기능과 간기능 저하 환자의 수술 전 평가는 단순한 실험실 수치 확인에 그치지 않고, 기능적 예비력과 전신적 대사 상태를 통합적으로 평가하는 과정이다.

기저 질환 및 약물 대사 특성을 고려하는 것이 수술 후 합병증 예방과 예후 개선에 핵심적이다.

1. 신기능 환자의 수술 전 평가

신기능 저하 환자에서는 수술 전 철저한 신기능 평가와 신장 보호 전략이 필수적이다.

수술 전 평가는 혈액검사(serum creatinine, eGFR, BUN, 전해질, Hematocrit), 소변검사(단백뇨, 혈뇨, 최근 소변량), 영상검사(신장초음파, CT/MRI)와 임상지표(체액상태, 혈압조절, 이뇨제 사용 여부), 위험인자(만성 신질환 단계, 투석 여부, 동반질환)를 포함한다. 수술 후 급성신부전 예방을 위해 정상 혈액량과 신혈류 유지, 혈관내 용적 감소·패혈증·약물(ACEi, NSAIDs 등) 주의가 중요하다.

말기신부전 환자는 수술 전 날 또는 당일 혈액투석을 시행하여 체액상태를 조절한다. 투석 후 체중 변화를 확인하여 과다 혹은 부족한 체액 상태를 교정하고, 심전도, 심초음파를 통해 심장기능을 평가한다.

마취제 선택 시 흡입마취제는 신혈류에 대한 영향이 적으나, 세보플루란의 저유량 사용 시 Compound A 축적 가능성이 있다는 동물실험 보고가 있다. 프로포폴과 에토미데이트는 신기능에 거의 영향을 주지 않으며, 케타민은 저혈량 상태에서 상대적으로 신혈류를 보존할 수 있다. 신경근차단제 중 cisatracurium, atracurium은 신기능과 무관하게 대사되어 신부전 환자에서 안전하다. 반면, vecuronium, rocuronium은 작용시간이 연장될 수 있다. 이 외에 신독성을 유발할 수 있는 약제의 사용에 주의해야 한다.

신기능 저하 환자의 마취관리 목표는 적절한 혈류유지, 약물 축적의 최소화, 전해질 이상 교정이며, 이를 통해 수술 후 신부전 발생의 위험을 최소화하여야 한다.

2. 간기능 환자의 수술 전 평가

간은 대사, 단백질합성, 약물분해, 담즙형성 등의 기능을 가진 기관으로, 간기능 저하는 수술 중, 후 약물 대사 및 혈역학적 불안정성에 큰 영향을 미친다. 간은 이중 혈류(문맥 75%, 간동맥 25%)를 통해 심박출량의 약 25–30%를 공급받는다.

수술 전 평가는 기본 혈액검사(AST, ALT, ALP, GGT, bilirubin, albumin, PT/INR)를 통해 손상 정도와 합성능을 확인하고, 임상지표(황달, 복수, 간성뇌증, 정맥류 출혈 등)를 통해 보상/비보상 상태를 판단한다. 예후 평가는 Child–Pugh score(albumin, bilirubin, INR, ascites, encephalopathy)와 MELD score(bilirubin, creatinine, INR, Na□)를 사용하며, 영상검사(간초음파, CT/MRI, Fibroscan)를 통해 구조적 이상 및 문맥압 항진 여부를 확인한다.

급성 간질환은 수술을 연기하고 내과적 안정화 후 시행하는 것이 원칙이며, 간경변 환자는 동반질환 (신기능저하, 폐고혈압, 심기능부전 등)과 출혈위험 (혈소판감소, 응고장애)을 함께 평가해야 한다. 저나트륨혈증, 저칼륨혈증, 저마그네슘혈증은 부정맥을 유발할 수 있어 사전 교정이 필요하다.

간경변 환자는 문맥고혈압, 복수, 응고장애, 간신증후군 등의 합병증을 동반하며, 약물 반응이 예측 불가하다. 분포용적이 증가하여 신경근차단제의 초기 용량은 늘려야 하나, 유지용량은 감소시켜야 한다. cisatracurium은 간 대사에 영향을 받지 않아 안전하며, rocuronium, vecuronium은 반감기 연장에 유의해야 한다. Opioid는 대사 및 배설 지연으로 수술 후 호흡억제를 유발할 수 있다.

수술 중에는 혈관내 용적 유지가 중요하며 복수 제거 시에는 저혈압과 신부전을 방지하기 위해 적극적 수액보충이 필요하다.

결론적으로 간기능 저하 환자의 수술 전 평가 시 간 기능의 잔존능력, 합병증 여부, 전신상태를 종합적으로 판단해야 한다. 적절한 혈류 유지, 응고장애 교정, 약물 용량 조절, 수액 선택이 환자의 수술 예후에 결정적인 영향을 미친다.

Memo.

NPO guideline for adults and children

Hee Young Kim
Department of Anesthesia and Pain Medicine, Pusan National University

Learning Objective

1. Understand the purpose of preoperative fasting and its role in reducing aspiration risk.
2. Review the current NPO guidelines for adults and children, including recommended fasting times.
3. Recognize recent updates and discussions regarding liberalized clear fluid intake.
4. Apply fasting guidelines to common clinical scenarios in everyday anesthetic practice.

Preoperative fasting, commonly expressed as nil per os (NPO), is one of the most traditional practices in anesthesia. Its primary goal is to reduce the risk of pulmonary aspiration of gastric contents during the induction of anesthesia, thereby enhancing perioperative safety. Historically, patients were instructed to refrain from all oral intake after midnight regardless of the scheduled surgery time. Although this approach was simple and cautious, it was not based on solid physiological or clinical evidence.

In recent decades, the paradigm has shifted from “strict fasting” to “evidence-based fasting.” Growing research has revealed that prolonged fasting does not necessarily reduce aspiration risk but rather increases discomfort, anxiety, dehydration, irritability, and insulin resistance—factors that may negatively affect recovery and patient experience.

Physiologic Background and Rationale

The concern for aspiration arises when gastric contents with a volume greater than approximately 1.5 mL/kg and a pH below 2.5 enter the airway during anesthesia induction. However, multiple studies have demonstrated that allowing clear fluids until two hours before anesthesia does not increase gastric volume or acidity to dangerous levels. Instead, hydration maintains mucosal perfusion, improves hemodynamic stability, and reduces postoperative nausea and vomiting. Thus, modern fasting guidelines aim to balance safety (prevention of aspiration) with comfort and metabolic stability.

Current Evidence and Updated ASA Guidelines (2023)

The 2023 American Society of Anesthesiologists (ASA) Practice Guidelines represent a significant shift toward liberalized and patient-centered fasting policies. The key updates are as follows:

① **Carbohydrate-containing clear drinks**

Allowed up to 2 hours before anesthesia as part of Enhanced Recovery After Surgery (ERAS) protocols. Clinical trials show improved insulin sensitivity, reduced thirst and anxiety, and faster recovery.

② **Protein-containing clear liquids**

Currently, no recommendation is made due to insufficient evidence.

③ **Chewing gum**

Chewing gum has very low evidence and is not recommended. However, Gum chewing before anesthesia is not considered a reason to delay elective procedures, as there is no conclusive evidence of harm.

④ **Pediatric fasting**

There is insufficient evidence regarding the benefits and risks to recommend that pediatric patients consume clear liquids up to 1 hour before general anesthesia, regional anesthesia, or sedation, compared to 2 hours before. However, European and Canadian guidelines recommend shortening the clear liquid fasting period for children to 1 hour. However, studies in children are limited, there is insufficient evidence to detect uncommon risks, and clinical controversy persists.

Special Populations and Clinical Application

① Certain patients require individualized consideration:

- Obesity, GERD (Gastroesophageal reflux disease), diabetes: These conditions are associated with delayed gastric emptying, warranting cautious interpretation of fasting times.
- Emergency surgery: Always assume a full stomach and manage accordingly.

② Institutional variation: Many hospitals still enforce stricter fasting rules (“NPO after midnight”), often out of habit rather than evidence. Educating staff and standardizing policies are crucial to improve compliance and patient outcomes.

③ Clinical decision-making should integrate the updated evidence with patient-specific risk factors. Liberalized fasting does not imply negligence—it reflects personalized safety supported by evidence-based medicine.

Conclusion

Preoperative fasting should no longer mean starvation. Evidence strongly supports that allowing clear fluids up to 2 hours before anesthesia is safe and beneficial. Liberal fasting improves patient satisfaction, reduces physiological stress, and contributes to enhanced recovery without increasing aspiration risk. Anesthesiologists play a pivotal role in updating institutional policies and educating surgical teams. The future of fasting guidelines lies in flexibility—balancing safety with humanity.

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Memo.

102ND KOREANESTHESIA 2025
The 102nd Annual Scientific Meeting of the Korean Society of Anesthesiologists

Refresher Course 2

POCUS

Chair(s)	**Younjin Kim** *(Ewha Womans University, Republic of Korea)* **Seongtae Jeong** *(Chonnam National University, Republic of Korea)*
1	**Lung ultrasound in Anesthesiology : from option to essential competency** Kyu Nam Kim *(Hanyang University, Republic of Korea)*
2	**Gastric ultrasound** Hyun-Jung Shin *(Seoul National University, Republic of Korea)*
3	**Airway ultrasound** Sung-Ae Cho *(Sungkyunkwan University, Republic of Korea)*
4	**Transthoracic echocardiography** Tae Kyong Kim *(Seoul National University, Republic of Korea)*

Lung ultrasound in Anesthesiology : from option to essential competency

Kyu Nam Kim
Hanyang University, Republic of Korea

Learning Objective

1. Understand the basic principles of perioperative lung ultrasound and recognize key signs (e.g., Bat sign, A-line, B-line).
2. Apply lung ultrasound to rapidly differentiate major conditions such as pulmonary edema, pleural effusion, atelectasis, and pneumothorax.
3. Familiarize with clinical protocols such as the BLUE and FALLS protocols and their applications in anesthesiology practice.
4. Learn current guidelines and training strategies for acquiring and teaching lung ultrasound competency.

서론

마취통증의학과 의사는 수술실 또는 회복실에서 빈번하게 저산소증에 직면하게 된다. 또한 수술 전 폐질환을 가지고 있는 환자의 경우, 마취 중 환자 안전을 위하여 고도의 감시가 필요하다. 저산소증의 원인을 감별진단하기 위하여 흔히 이학적 검사, 흉부 방사선 및 실험실 검사 등의 통상적인 검사들이 우선적으로 사용되지만, 이들 검사만으로는 정확한 감별진단이 되지 않을 뿐만 아니라 결과 확인에도 일정 시간이 요구되므로 적절한 치료 시기를 놓칠 수 있다. 최근 침상 옆 초음파 (bedside ultrasonography)의 사용은 비침습적 검사로 마취통증의학과 의사가 쉽게 적용할 수 있으며, 신속하고 반복적으로 사용할 수 있는 장점이 있다. 또한 BLUE (Bedside Lung Ultrasonography in Emergency) protocol, FALLS (Fluid Administration Limited by Lung Sonography) protocol 등의 적용은 급성호흡부전의 원인을 정확히 감별하고 환자 순환 상태를 평가할 수 있는 새로운 지표로 사용되고 있다. COVID-19 팬데믹을 통해 폐렴, ARDS 감별에 폐 초음파 검사의 임상적 가치가 더욱 부각되었다. 또한 ERAS (Enhanced Recovery After Surgery) protocol의 일환으로 폐초음파가 perioperative risk stratification과 환자 예후 예측에도 활용되고 있다. 따라서 주술기 동안에 폐 초음파 검사는 마취통증의학과 의사에게 매우 유용하며 반드시 숙지해야 할 검사법이라 할 수 있다.

초음파 탐촉자 (Probe)의 선택

Phase array probe는 3-5 MHz의 주파수를 사용하기 때문에 깊은 투과성을 지니고 있어 alveolar interstitial syndrome (acute respiratory distress syndrome, congestive heart failure), effusion, consolidation을 관찰하는데 유리하다. Linear probe는 8-12 MHz의 주파수를 사용하기 때문에 투과성이 낮은 단점이 있으나 높은 해상도를 보이기 때문에 pneumothorax, real time procedure guidance에 사용된다.

초음파 탐촉자의 위치

초음파 탐촉자는 피부에 90˚의 각도로 화면의 왼쪽이 환자의 머리 방향이 되도록 위치시키며, 모든 검사는 가로 방향이 아닌 세로 방향으로 시행한다. 검사는 양측 폐의 각각 3곳에서 시행한다. (Fig. 1.). 왼쪽 새끼손가락을 쇄골에 위치시키고 손가락 끝은 가슴 중앙에 위치시킨 후에 엄지손가락을 제외하고 두 손의 손가락을 나란히 놓게 된다. 이때 손바닥의 중앙을 각각 upper, lower anterior point로 명명한다. Lower anterior point에서 수평으로 그린 선과 posterior axillary line을 이은 선의 교차점을 posterolateral alveolar or pleural syndrome (PLAPS) point로 명명하며, 이 곳에서 effusion이나 consolidation을 관찰할 수 있다.

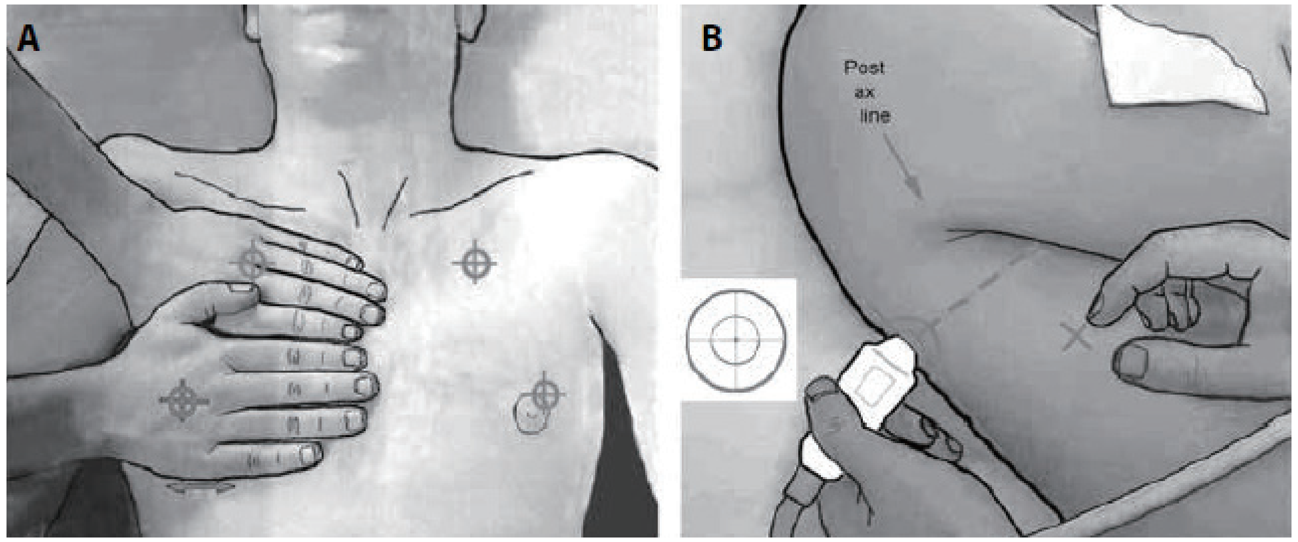

Fig. 1. Areas of investigation showing the standardized examination lung ultrasound point; (A) Upper, lower anterior point. (B) Posterolateral alveolar or pleural syndrome (PLAPS) point.

The Ten Basic Sign

1. The bat sign

기본적으로 관찰할 수 있는 폐 초음파의 영상으로, 2개의 갈비뼈와 pleural line이 관찰되는 모습이 박쥐의 모습처럼 보여서 bat sign이라고 명명한다 (Fig. 2.).

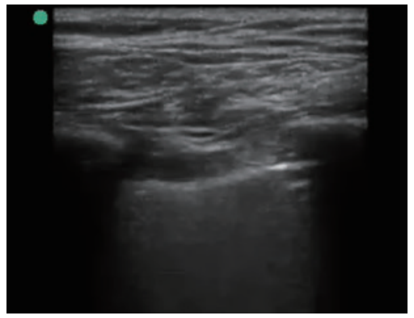

Fig. 2. The pleural line and the upper and lower ribs make a permanent landmark.

2. The lung sliding and seashore sign

Visceral pleura와 parietal pleura 사이에는 정상적으로 소량의 물이 존재하며, 이로 인하여 호흡에 따라 pleural line이 움직이는 것을 관찰할 수 있다. Lung sliding이 관찰된다면 visceral-parietal pleural interface 가 정상이라는 것을 확인할 수 있다. Lung sliding 이미지를 M-mode로 관찰하면 seashore sign을 관찰 할 수 있다. Pleural line 위쪽의 subcutaneous tissue는 움직임이 없어 직선으로 보이지만 Pleural line 아래쪽은 호흡에 따른 폐 조직의 움직임으로 인하여 모래사장 같은 형상을 보인다 (Fig. 3.).

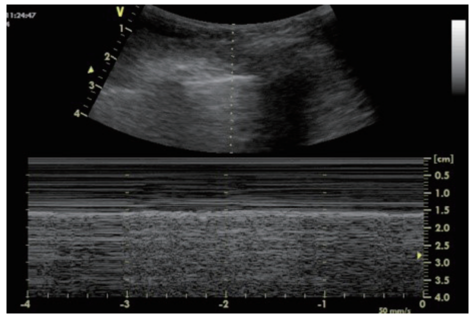

Fig. 3. M-mode reveals the seashore sign, which indicates that the lung moves at the level of the chest wall.

3. The A-line

정상 폐에서 Pleural line 아래 쪽에 관찰되는 선을 A-line 이라고 하며 이는 Pleural line으로부터의 다중반사(reverberation)로 인한 air artifact이다. A-line은 흉막과 pleural line까지의 거리와 동일한 간격을 가지고 반복적으로 관찰되는 정상적인 폐 초음파 소견이다 (Fig. 4. A).

4. The B-line

Alveoli의 공기와 interlobular septum의 물이 혼재되어 생기는 잔상으로 다음과 같은 특성을 보인다 (Fig. 4. B). ① Plural line에서 시작된다. ② Long vertical hyperechoic line 이다. ③ 초음파 영상 끝까지 끊김없이 관찰된다. ④ 혜성 꼬리 모양(comet tails)으로 관찰된다. ⑤ A-line을 지우며 관찰된다. ⑥ Lung sliding과 함께 움직인다.

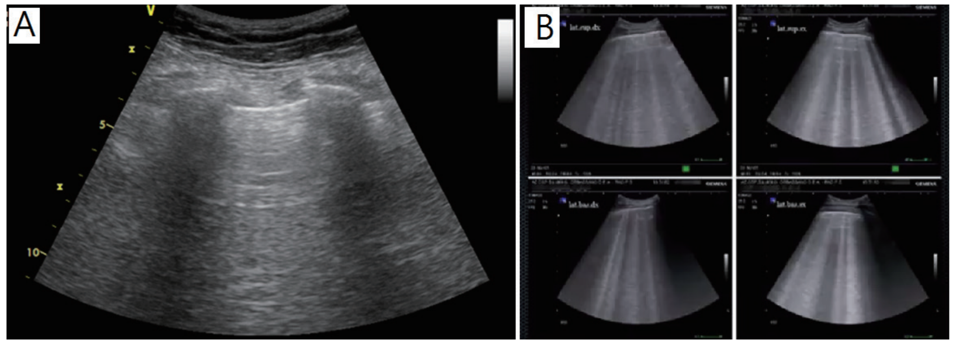

Fig. 4. (A) Hyperechoic horizontal artifact arising from the pleural line. A-line is generated by subpleural air. (B) Interstitial syndrome; the presence of B-line.

5. The Quad sign

Pleural effusion이 있는 경우 posterolateral alveolar or pleural syndrome (PLAPS) point에서 관찰된다. Pleural line과 shadow of rib, lung line이 만나면서 생기는 사각형을 관찰 할 수 있다 (Fig. 5. A).

6. The Sinusoid sign

Pleural effusion이 있는 경우에 visceral pleura가 폐의 움직임에 따라서 parietal pleura를 향해 이동하는 것을 M-mode로 관찰한 것이다 (Fig. 5. B). Pleural effusion이 있는 경우에만 특이적으로 관찰되는 sign이다.

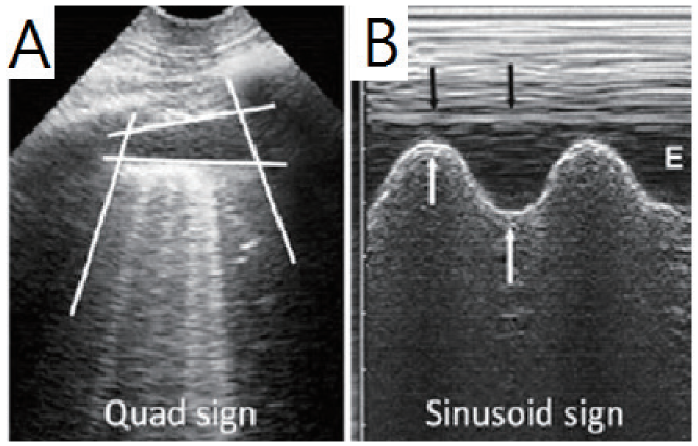

Fig. 5. (A) Quad sign; the visceral pleural (lung line) together with the parietal pleura (pleural line)

7. The Tissue-like sign

Massive consolidation이 있는 경우 폐 조직이 심하게 압축되어 폐 조직에 공기가 통하지 않게 되므로 마치 비장과 같은 장기처럼 관찰되는 경우를 의미한다. 마찬가지로 posterolateral alveolar or pleural syndrome (PLAPS) point에서 관찰된다 (Fig. 6. A).

8. The Shred sign

Consolidation이 있는 경우에 lung line이 사라지고 환기된 폐 조직과 consolidation의 경계가 만나서 관찰되는 sign이다 (Fig. 6. B.).

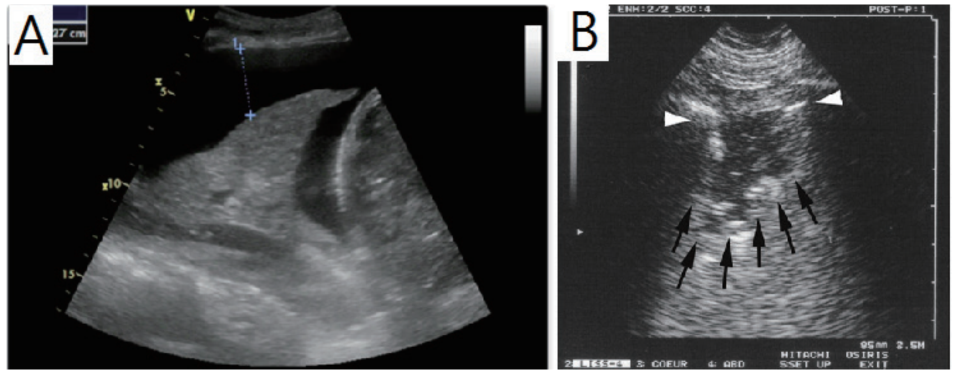

Fig. 6. (A) A massive consolidation of the lobe and no aerated lung tissue is present. The pattern is tissue-like, similar to the spleen. (B) A consolidation generates a shredded, fractal boundary between the consolidation and the aerated lung.

9. The stratosphere sign

Lung sliding 이 없는 경우에 이를 M-mode로 관찰하였을 때 확인할 수 있는 sign이다 (Fig. 7. A). Pleural line 위쪽의 subcutaneous tissue와 pleural line 아래쪽의 폐 조직의 움직임이 모두 없어서 직선을 보이게 되며 Barcode sign으로도 명명된다. 이는 pneumothorax에서 특징적으로 관찰된다.

10. The lung point

Pneumothorax에서 특징적으로 관찰되는 sign으로 정상적으로 호흡이 이루어지는 영역과 pneumothorax의 경계를 M-mode로 관찰하면 정상적인 호흡으로 폐 조직의 움직임이 관찰되는 seashore sign과 pneumothorax로 인하여 폐 조직의 움직임이 없는 stratosphere sign을 함께 관찰할 수 있다. Seashore sign과 stratosphere sign의 경계를 lung point로 명명한다 (Fig. 7. B).

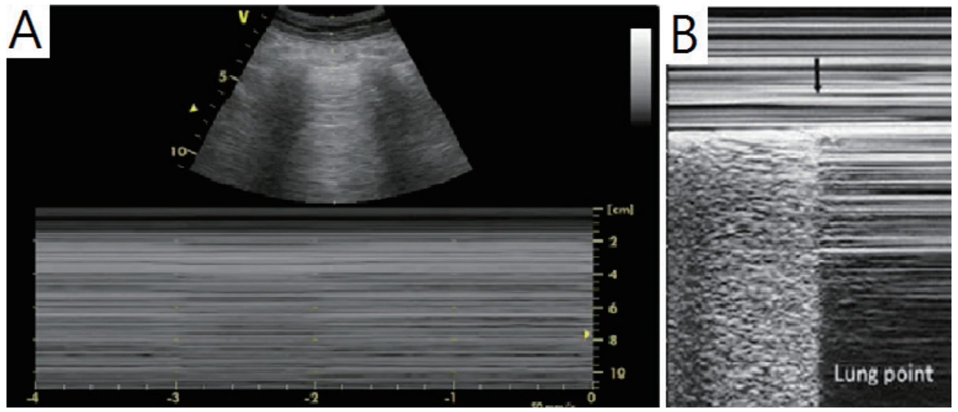

Fig. 7. (A) On M-mode, the abolition of lung sliding is visible through the stratosphere sign and indicates total absence of motion. (B) On M-mode, the left hand side of the image shows lung patterns and the right hand side shows the stratosphere sign.

Summary of the Ten Basic Sign

Lung condition	Sign
Normal lung	The bat sign The A-line The Lung sliding
Interstitial syndrome	The B-line
Pleural effusion	The quad sign The sinusoid sign
Consolidation	The tissue-like sign The shred sign
Pneumothorax	Abolished lung sliding The stratosphere sign The lung point

임상적용

폐초음파는 다양한 임상 상황에서 유용하게 적용된다:

1. 수술 중: 일측폐환기(one-lung ventilation) 확인, Trendelenburg 자세에서 폐부종 평가.
2. 회복실/ICU: 호흡부전 감별, 폐색전증 보조 진단.
3. 심장수술/고위험 환자: 체액 반응성 평가 및 hemodynamic monitoring.
4. COVID-19 및 감염성 폐질환: CT 대체 또는 보조 도구로 활용.

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Memo.

Gastric ultrasound

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Learning Objective

1. Master Gastric Anatomy and Scanning Technique
2. Differentiate Gastric Contents and Interpret Findings
3. Assess Aspiration Risk and Apply Findings Clinically

I. Introduction

Pulmonary aspiration of gastric contents remains a rare yet potentially catastrophic complication in anesthesia. While traditional Nil Per Os (NPO) guidelines have been the cornerstone of prevention, their rigid application often leads to unnecessary fasting periods, patient discomfort, and surgical delays.

Point-of-Care Ultrasound (POCUS) of the stomach offers an innovative, non-invasive solution by providing a real-time, quantitative assessment of gastric contents (fluid and solids). This enables anesthesiologists to move beyond blanket guidelines and adopt an individualized fasting and risk stratification strategy.

This Refresher Course will integrate the latest evidence, including the recent American Society of Anesthesiologists (ASA) consensus recommendations on patients using GLP-1 receptor agonists, to establish a practical framework for the application of gastric POCUS in various perioperative settings.

II. Detailed Curriculum and Clinical Application

This session is structured to provide a comprehensive understanding of gastric POCUS, from basic technique to complex clinical decision-making.

1. Foundational Technique and Quantitative Analysis

- **Anatomy and Basic Imaging:** Identifying key anatomical landmarks (gastric antrum) using the curvilinear or phased array probe. Optimizing image quality for accurate interpretation.
- **Standardized Scanning:** Mastering the standard positioning (supine and right lateral decubitus) and scanning protocols for standardized, reproducible measurements.
- **Quantitative Assessment of Gastric Volume**
- **Qualitative Assessment of Gastric Contents**

2. POCUS-Driven Clinical Decision Making

This section focuses on utilizing POCUS findings to guide immediate clinical action:

- **ASA Consensus on GLP-1 Agonists (Latest Update):** Analyzing the specific challenges posed by delayed gastric emptying in patients on anti-diabetic and weight-loss medications (GLP-1 agonists). Using POCUS to confirm gastric status and inform the decision to Proceed, Delay, or implement Full Stomach Precautions, irrespective of the patient's reported last dose.
- **Emergency and Trauma Cases:** Rapid POCUS assessment in patients with an Unanticipated Full Stomach, facilitating a safe and timely decision on advanced airway management.
- **Enhanced Recovery After Surgery (ERAS):** Utilizing POCUS to safely liberalize clear fluid intake before surgery, optimizing patient comfort and accelerating recovery within ERAS protocols.

3. Pitfalls, Limitations, and Protocol Integration

- **Technical Challenges:** Identifying common pitfalls, such as misinterpreting bile or duodenal contents, and tips for optimizing probe pressure and patient positioning to avoid false readings.
- **Limitations:** Discussing situations where POCUS may be less reliable, including morbid obesity, gastroparesis, and anatomical variations.
- **Protocol Development:** Strategies for integrating gastric POCUS into institutional preoperative assessment protocols and teaching the technique to residents and

III. Conclusion

Gastric POCUS has evolved from a novel technique to an indispensable component of the anesthesiologist's skillset, enabling a precision medicine approach to NPO management. By providing objective, real-time data, POCUS empowers clinicians to significantly reduce unnecessary fasting while simultaneously enhancing patient safety by accurately identifying high-risk individuals. This course offers the practical knowledge and confidence required to fully adopt this transformative technology in daily clinical practice.

Airway ultrasound

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Learning Objective

1. Airway POCUS의 목적을 이해한다.
2. Airway POCUS 로 기도평가를 수행할 수 있다.
3. 응급상황에서 의사결정에 활용한다.

A linear high-frequency transducer (about 10–15 MHz) is standard for the anterior neck, while a curvilinear probe (about 2–5 MHz) can help in deep or obese necks [1]. Interpretation centers on the air-mucosa interface. This interface appears as a bright line with ring-down or comet-tail artifacts and a posterior dirty shadow. The patient is placed supine with the head in neutral to slight extension [2]. Light probe pressure is preferred to avoid tissue deformation. Repeating measurements and reporting the median generally improves reliability.

In the transverse view, the TACA technique (Thyroid cartilage - Air-mucosa line - Cricoid cartilage - Air-mucosa line) is a practical way to map anterior neck anatomy [3]. Position the transducer transversely over the expected thyroid cartilage until its triangular contour is visible. Then slide caudally to the first air-mucosa line. This level corresponds to the cricothyroid membrane, which lies between the inferior border of the thyroid cartilage and the superior border of the cricoid cartilage. Moving further caudally reveals the cricoid cartilage, typically a hypoechoic C-shaped structure with a posterior acoustic shadow.

In the midline sagittal view, sequential laryngotracheal cartilages form a “string of pearls” appearance [3]. After the cricoid cartilage is identified, the cricothyroid membrane is recognized between the inferior border of the thyroid cartilage and the superior border of the cricoid cartilage.

Airway POCUS also provides several reproducible indices that are interpreted with bedside tests [4,5]. Common measures include the distance from skin to hyoid bone (DSH), the distance from skin to epiglottis (DSE), the hyomental distance ratio (HMDR = extended/neutral), and tongue metrics such as thickness, cross-sectional area, or volume.

For confirmation of endotracheal tube placement, a transverse transtracheal scan at the suprasternal notch offers rapid confirmation. A tracheal tube typically produces a single bright air-mucosa line, whereas esophageal intubation produces the double-tract sign [1,6]. Ultrasound functions as an adjunct, and capnography remains essential.

Regarding CICO preparation, the major contribution of airway ultrasound occurs before the crisis. Ultrasound-guided pre-marking of the cricothyroid membrane has been associated with faster and more precise front-of-neck access in difficult anatomy [1,7–9].

Conclusion

Airway point-of-care ultrasound can be used throughout the airway pathway. It supports pre-operative identification of key anatomy, helps predict difficult direct laryngoscopy, allows rapid confirmation after intubation, and contributes to preparation for can’t-intubate-can’t-oxygenate rescue. Ultrasound-guided identification has been reported to be more accurate than palpation, particularly in obesity, pregnancy, or altered neck anatomy and pre-marking before induction is often recommended to facilitate front-of-neck access when needed. Ultrasound can also clarify the relative position of the esophagus and nearby vessels for procedures.

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Transthoracic echocardiography

Tae Kyong Kim
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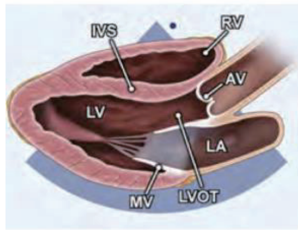
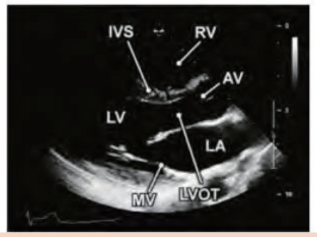
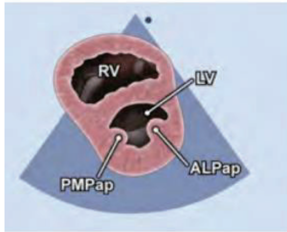
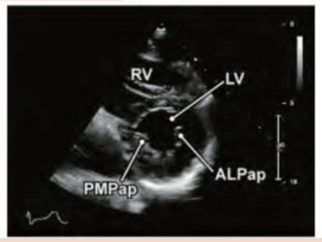
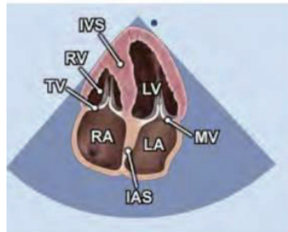
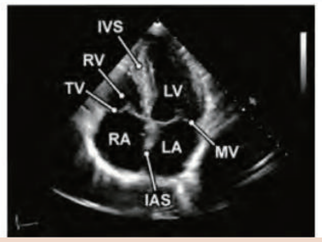
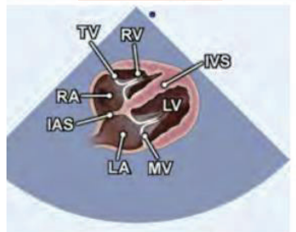
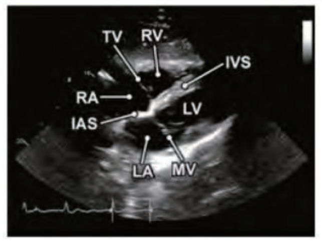
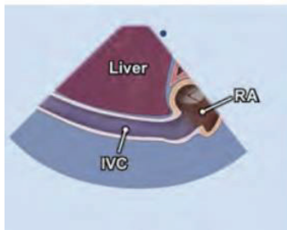
Learning Objective

By the end of this lecture, participants will understand the clinical role of POCUS – basic TTE in perioperative care, be able to obtain the four standard views (PLAX, PSAX, A4C, Subcostal), and recognize core findings related to cardiac function, fluid status, and pericardial or pulmonary pathology that guide immediate management.

POCUS for Anesthesiologists: Basic TTE Views

Transthoracic echocardiography (TTE)는 주술기 환자의 심장 구조와 기능을 평가하는데 핵심적인 역할을 하며, 특히 혈역학적 불안정 상황에서 가장 중요한 진단 도구 중 하나이다. POCUS 형태로 적용되는 Basic TTE views (PLAX, PSAX, A4C, Subcostal)를 통해 심실 기능 저하, 저혈량, 심낭삼출 및 폐색전증과 같은 원인을 빠르게 감별할 수 있어 임상 현장에서 즉각적인 치료 결정을 내리는 데 도움을 준다. 따라서 이러한 Basic TTE views 를 익히는 것은 환자 안전을 높이고, 응급 상황에서 독립적으로 임상 판단을 내릴 수 있는 핵심 역량을 갖추는 과정이라 할 수 있다.

Table. Basic TTE views

Anatomic image	2D TTE image	Acquisition image	Structures to demonstrate
PLAX left ventricle			
		Parasternal window PLAX view Left sternal border, transducer orientation toward right shoulder, beam positioned perpendicular to left ventricle	LA MV LV LVOT AV IVS RV
PSAX (level of papillary muscles)			
		Parasternal window PSAX view Tilt inferiorly from the MV	RV IVS PMPap ALPap LV
A4C			
		Apical window 4C view Move to patient's left side, identify apical impulse, align orientation toward bed	LA MV LV IVS RV TV RA IAS
SC 4C			
		SC window 4C view Patient supine Transducer at subxiphoid position, orientation index marker pointing toward the patient's left shoulder Held inspiration	LV MV RV TV IAS IVS RA LA
SC long axis IVC			
		SC window IVC view Long axis on patient's body	Long axis IVC

102ND KOREANESTHESIA 2025
The 102nd Annual Scientific Meeting of the Korean Society of Anesthesiologists

Refresher Course 3

Practical Pain Management

Chair(s)	Jiseon Son *(Jeonbuk National University, Republic of Korea)* Doosik Kim *(Kosin University, Republic of Korea)*
1	**Common C-arm-guided blocks in pain clinics** Ji Won Choi *(Sungkyunkwan University, Republic of Korea)*
2	**Useful ultrasound-guided block for pain clinics** Eunsoo Kim *(Pusan National University, Republic of Korea)*
3	**Pain management of CRPS patients** Hyun-Jung Kwon *(University of Ulsan, Republic of Korea)*
4	**Interventional management of cancer pain** Junmo Park *(Kyungpook National University, Republic of Korea)*

Common C-arm-guided blocks in pain clinics

Ji Won Choi
Sungkyunkwan University, Republic of Korea

Learning Objective

1. Advantages and disadvantages/ Benefits and limitations of C-arm guided procedure
2. Intravascular uptake can be confirmed and prevented in the fluoroscopy
3. Epidural, transforaminal injection, and some sympathetic, medial branch block and intraarticular injection → C-arm can be recommended as the first option

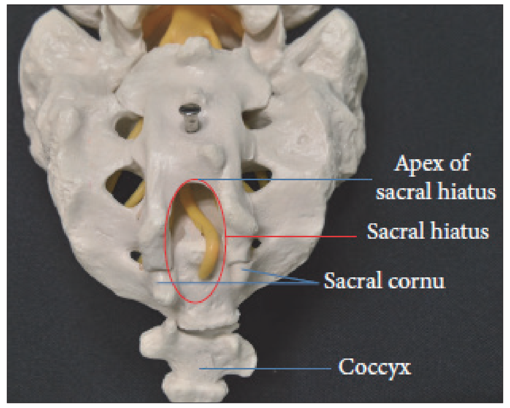
1. Caudal epidural block

1) Introduction

The caudal epidural block involves placing a needle through the sacral hiatus to deliver medications into the epidural space.

The caudal epidural block was first introduced as a landmark-based, blind technique. In children, the successful rate with the blind technique is above 96%. In adults, however, it was only 68–75% even in the experienced hands. With the advent of imaging technology, fluoroscopy and ultrasonography have been increasingly used to guide caudal epidural block.

2) Anatomy



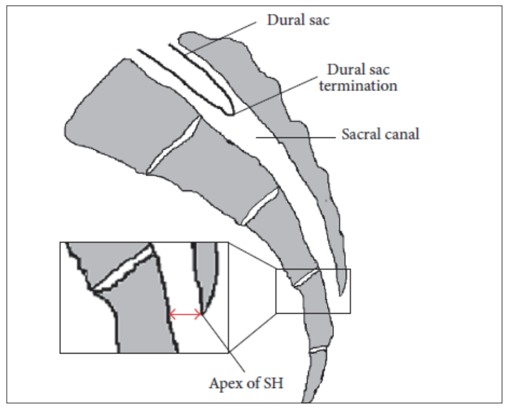


Figure 1: Posterior view of sacrum

Figure 2: Sagittal view of sacrum. SH: sacral hiatus; red double-ended arrow: anterior-posterior diameter of sacral hiatus at its apex.

(2)-1. Sacral Cornua: The sacral cornua are vestigial remnants of the inferior articular processes of the 5th sacral vertebra and presented as two bony prominences at the caudal end of sacrum. Palpating the bilateral sacral cornua is essential to locate the sacral hiatus in the conventional landmark-based technique. However, in a clinical report, sacral cornua were only palpable in 59% of individuals.

(2)-2. Sacral Hiatus. The sacral hiatus, resulting from failure of fusion of lamina and spinous process of lower sacral vertebrae, is the caudal termination of the sacral canal. Posteriorly, the sacral hiatus is covered by the skin, subcutaneous fat, and sacrococcygeal ligament (SCL). During caudal epidural block, inserting a needle into the sacral hiatus is essential to access the sacral canal. The mean anterior-posterior (AP) diameter of sacral hiatus at its apex ranges from4.6 ±2mmto 6.1 ± 2.1mm[6, 7, 9–14] and decreased with age.

(2)-3. Location of the Apex of the Sacral Hiatus. The apex of sacral hiatus is most commonly located at the S4 level (65–68%), followed by the S3 and S5 level (around 15% at each level) and the S1 to S2 level in 3–5% of cases.

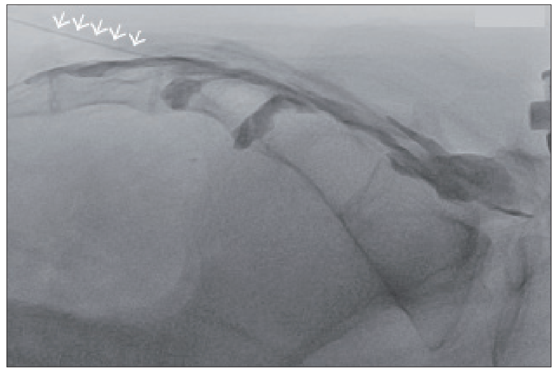
(2)-4. Dural Sac. The dural sac usually terminates between S1 and S2 vertebra, with the majority at S2 [8, 9, 15, 16]. In 1 to 5% of patients, the dural sac terminates at S3 or below. In addition, 1-5% of patients with low back pain or sciatica have a sacral Tarlov cyst, a perineural cyst that communicates with the dural sac and is filled with cerebrospinal fluid (CSF).

(2)-5. Distance between the Dural Sac Termination and the Apex of the Sacral Hiatus. Could be as short as less than 6mm in some individuals.

3) Techniques of Fluoroscopy-Guided Caudal Epidural Block- considered as gold standard

(3)-1. Procedure The patient is usually placed in prone position for fluoroscopy-guided caudal epidural block. In lateral view of fluoroscopy, the sacral hiatus could be identified as an abrupt drop off at the end of S4 lamina [21]. The block needle trajectory can be visualized and navigated accordingly into the sacral canal. By injecting contrast medium under fluoroscopy, the placement of needle tip within

the sacral epidural space can be verified (Figure 3, 4).



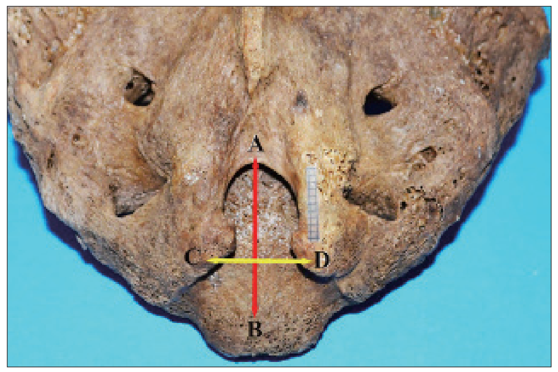


Figure 3: Fluoroscopy-guided caudal epidural block. Proper needle tip placement was verified by observing spread of contrast medium within the epidural space without intravascular uptake. Arrows: needle.

Fig. 4. Reference points of the sacral hiatus. (A point: apex of sacral hiatus, B point: basis of sacral hiatus, C and D points: sacral cornua)

(3)-2. Things to Consideration. Intravascular or intrathecal needle tip placement can be detected. During caudal epidural injection, intravascular injection was reported in 3–14%. The practice of injecting air to verify needle tip position could be abandoned, because the injected air has been reported to cause portal vein air embolism [32] and motor weakness [33] after caudal epidural injection.

2. Sacral Transforaminal Epidural block

1) Introduction

Traditionally, S1 TFESI has been performed using an anteroposterior (AP) view. In 2007, an oblique view technique using the S1 “Scotty dog” was introduced as an alternative approach.

2) Anatomy

The convex dorsal surface of the sacrum has an irregular surface caused by the fusing of the elements of the sacral vertebrae. Dorsally, there is a midline crest called the median sacral crest. Eight posterior sacral foramina allow the passage of four pairs of the primary posterior divisions of the sacral nerve roots (Fig. 118.3). The posterior sacral foramina are smaller than their anterior counterparts. The fifth sacral nerves exit the sacral canal via the sacral hiatus.

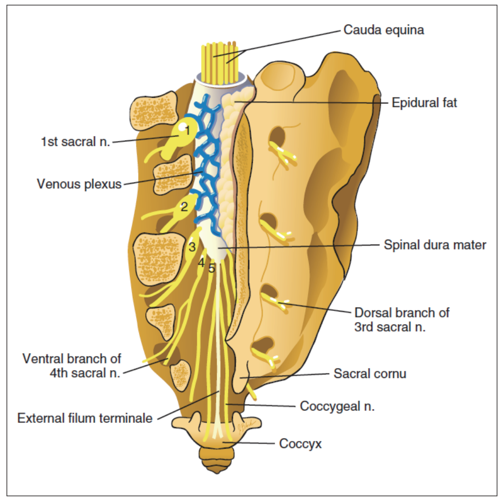


Fig. 118.3 Eight posterior sacral foramina allow the passage of four pairs of the primary posterior divi¬sions of the sacral nerve roots. n., Nerve.

Fig. 118.11 Posterior three-dimensional computed tomographic recon¬struction of the sacrum showing the S1 sacral foramina (black arrows), the target for the S1 selective nerve root block. (From Blankenbaker DG, Davis KW, Choi JJ. Selective nerve root blocks. Semin Roentgenol. 2004;39[1]:24–36.)

3) Techniques of Fluoroscopy-Guided Sacral Transforaminal Epidural block

(3)-1. Anteroposterior (AP) approach for S1 transforaminal epidural block

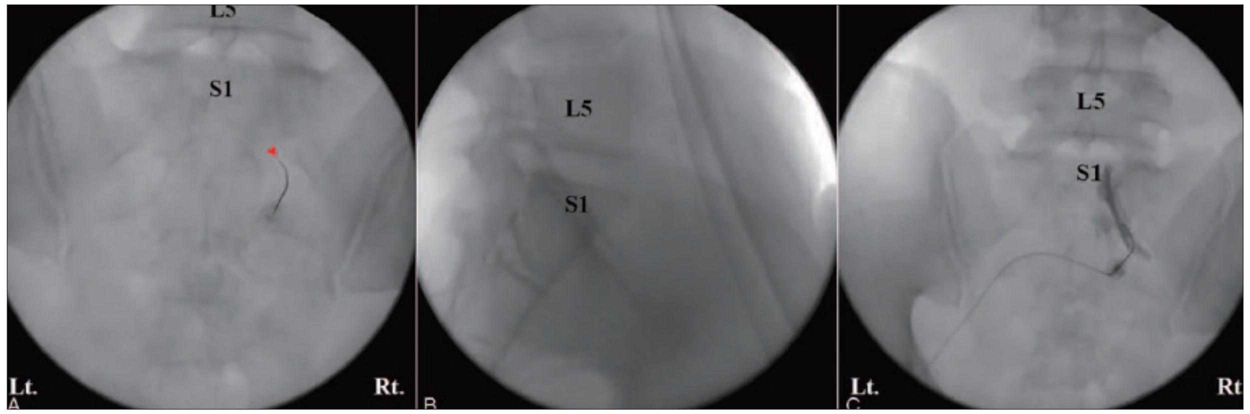


Figure 1: Anteroposterior (AP) approach for S1 transforaminal epidural steroid injection. (A) Placement of needle into S1 foramen in AP view (The arrow head indicates the respective S1 foramen). (B) The lateral view. The needle tip was confirmed to be adjacent to the sacral canal. The contrast flowing along the medial aspect of the superior pedicle of S1. (C) Anteroposterior view with contrast for checking whether intravascular injection occurred.

(3)-2. Oblique “Scotty dog” (OS) approach for S1 transforaminal epidural block

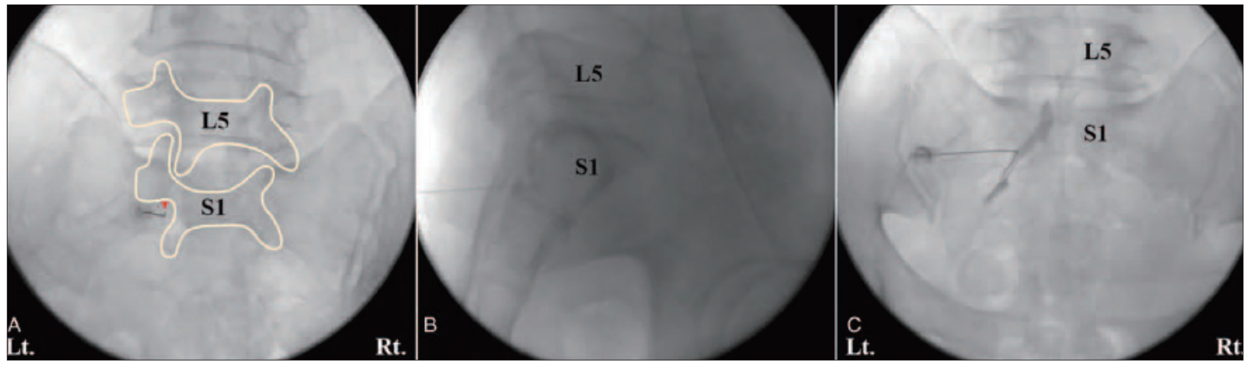


Figure 2: Oblique “Scotty dog” (OS) approach for S1 transforaminal epidural steroid injection. (A) Placement of needle into S1 foramen in oblique view with highlights of the ‘Scotty dog’ formation at L5 and S1 vertebra (The arrow head indicates superomedial landmark of the S1 foramen). (B) The lateral view. The needle tip was confirmed to be adjacent to the sacral canal. The contrast flowing along the medial aspect of the superior pedicle of S1. (C) Anteroposterior view with contrast for checking whether intravascular injection occurred.

(3)-3. Things to Consideration

The incidence of intravascular injection during TFESI is higher for sacral spine (16.5% to 27.8%) compared with lumbar area (6.1% to 17.7%) injections. The epidural venous plexus generally ends at S4 but may descend the entire length of the canal in some patients. Needle trauma to this plexus may result in bleeding, causing postprocedural pain. Subperiosteal injection of drugs also may result in bleeding and is associated with significant pain both during and after injection.

3. Sacroiliac Joint Block

1) Introduction

Sacroiliac joint (SIJ) pathology is a common etiologic cause for 10 – 27% of cases of mechanical low back pain (LBP) below the L5 level. In the absence of definite clinical or radiologic diagnostic criteria, controlled blocks of the SIJ have become the choice assessment method for making the diagnosis of SIJ pain.

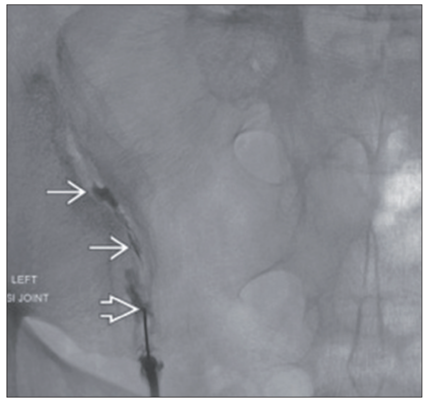
2) Anatomy

The SI joints are the largest axial joints in the body. They are large auricular-shaped, designed primarily for stability. Only the anterior third of the interface between the sacrum and ilium is a true synovial joint. The rest of this interface is comprised of an intricate network of ligamentous connections. There is a small portion of the synovial joint space that extends to the posterior-inferior most extent of this interface between the sacrum and ilium. It is from this point that access for intra-articular injection is gained. Synovial characteristic of SIJ is limited only to the distal third and anterior third.

3) Techniques of Fluoroscopy-Guided Sacroiliac Joint Block

(3)-1. conventional technique

It dictates aligning the anterior and posterior aspect of the joint under fluoroscopic guidance by giving 10 - 20 degree of oblique angulation on the contralateral or affected side.



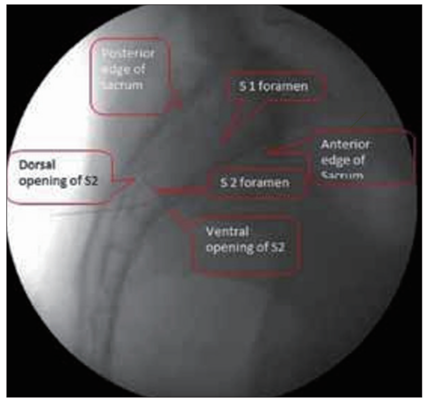
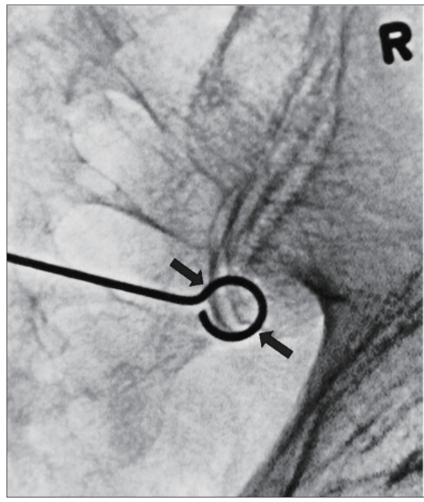
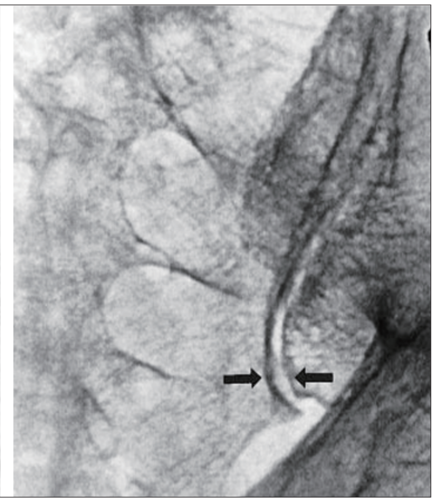


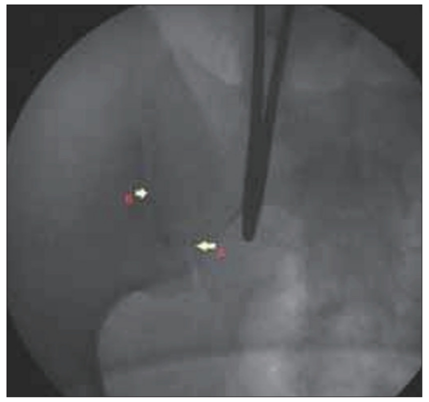
Fig. 1. 130.10 Sacroiliac (SI) joint injection under fluoroscopy.
(Arrows identify contrast within the sacroiliac joint; arrowhead indicates needle tip.)

Fig. 2. On dynamic fluoroscopy in lateral view, fluoroscopic anatomy of SIJ.

(3)-2. Oblique "Scotty dog" (OS) approach for S1 transforaminal epidural block







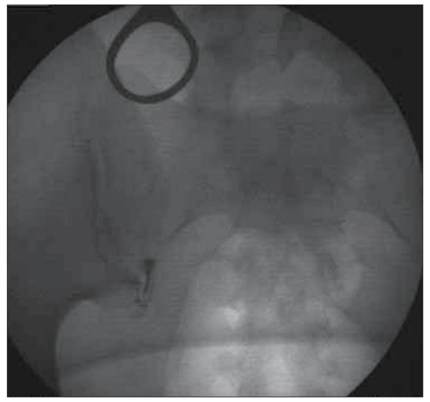
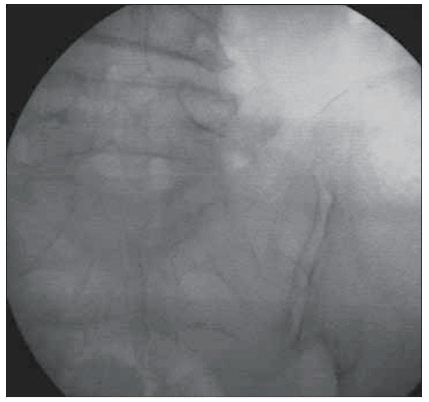


Fig. 1. AP view showing separate A) posterior joint and B) anterior joint.

Fig. 2. Needle with contrast in SI joint



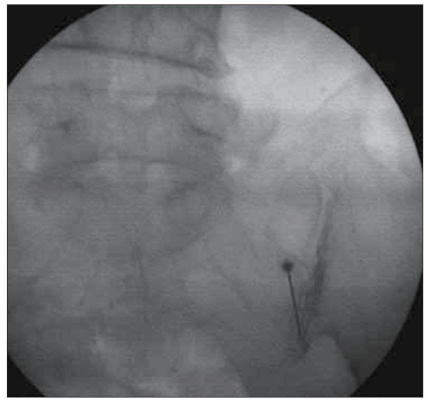


Fig. 3. SI joint seen as single in AP view.

Fig. 4. Needle with contrast in AP view.

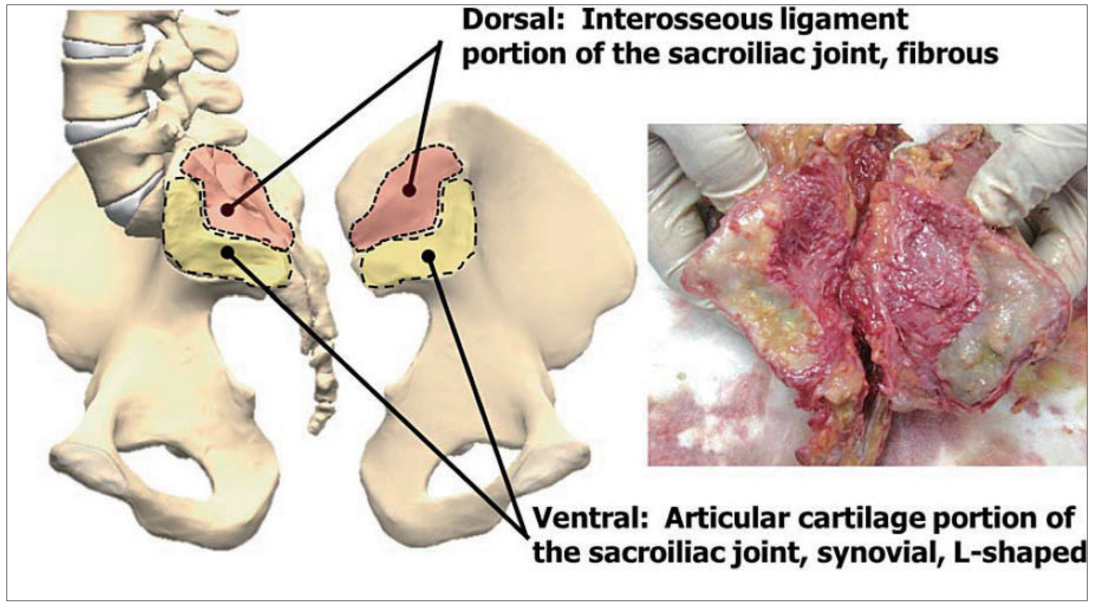


Figure1. Articular surfaces of the sacroiliac joint

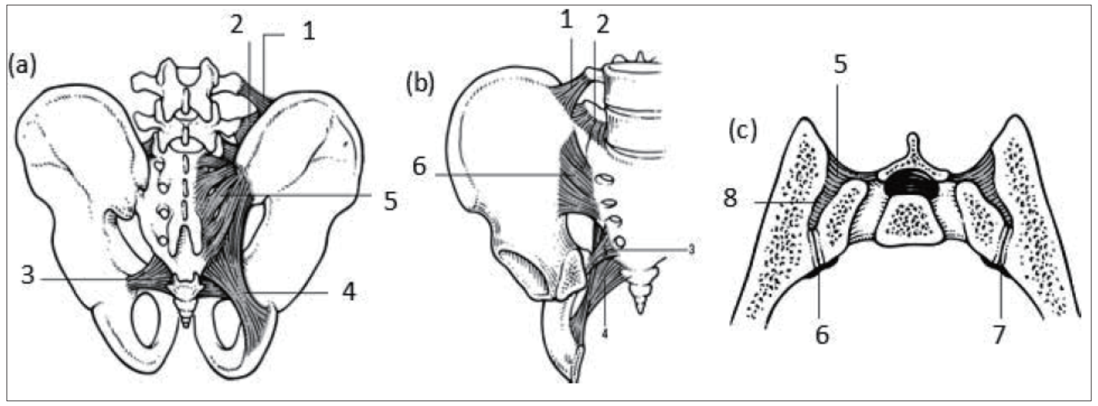
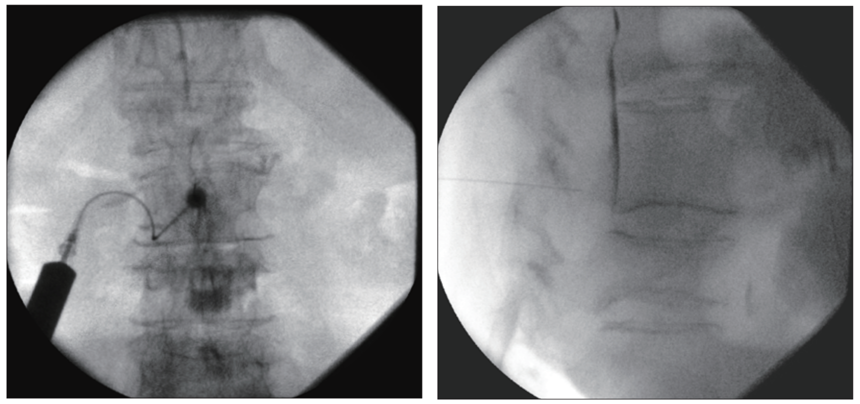
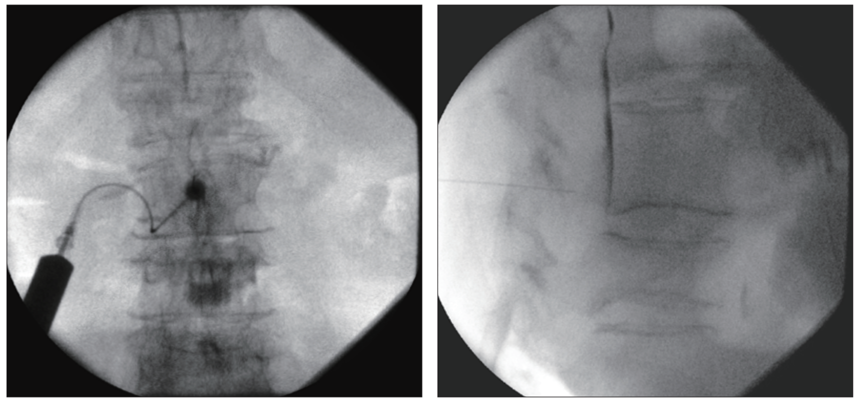


Figure1. (a) Posterior view, (b) anterior view and (c) sacroiliac joint cut in transverse plane.
1, 2: superior and inferior iliolumbar ligaments, respectively; 3:sacrospinous ligament; 4: sacrotuberous ligament; 5: posterior sacroiliac ligaments;6: anterior sacroiliac ligaments; 7: sacroiliac joint; 8: interosseous ligament

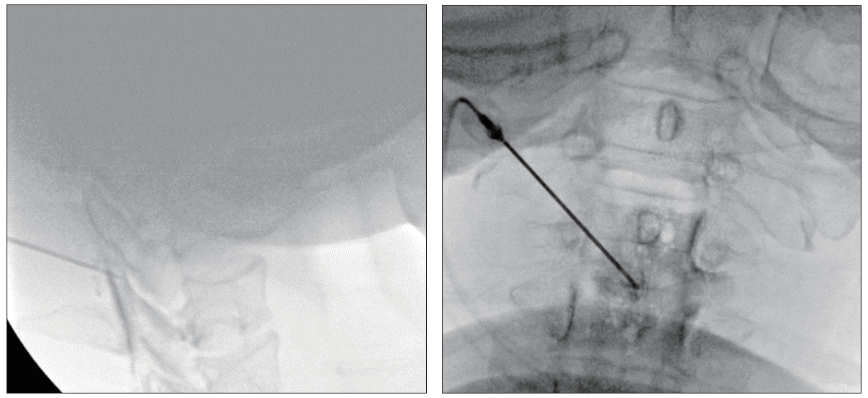
4. Interlaminar Epidural Injection



Intrathecal/subarachnoid pattern in the anteroposterior view. Myelogram with a small contrast volume in the lateral view.



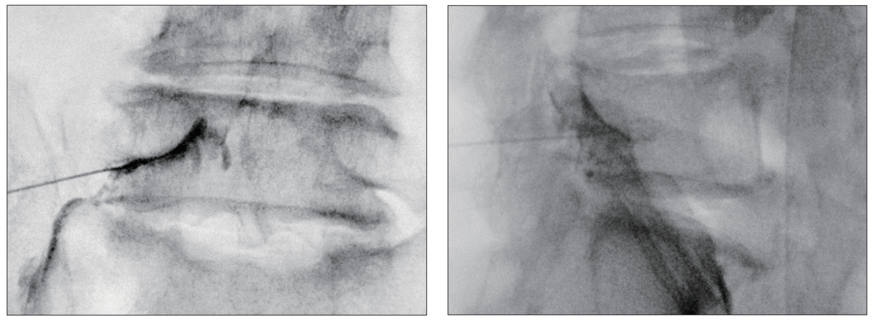
Subdural (intradural) pattern anteroposterior and contralateral oblique view.



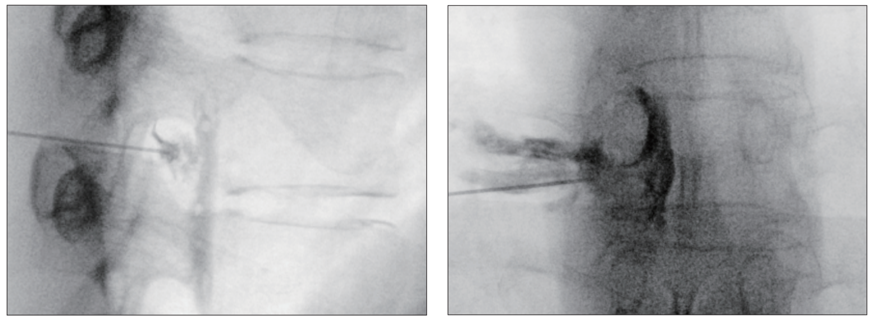
C-ESI, Lat and AP view.

5. Interlaminar Epidural Injection

Transforaminal approach to epidural steroid injection is accomplished with a supraneural (subpedicular or retroneural) needle position. The target resides within the "safe triangle" location. Catastrophic events are thought to be from embolization caused by particulate corticosteroids entering the spinal cord and/or brain arterial supply. For this reason, we advocate strong consideration for using non-particulate steroids since their "noninferiority" has been demonstrated.



STE, L5 Lt



STE, T8, Lt

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Memo.

Useful ultrasound-guided block for pain clinics

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Learning Objective

1. Identify key sono-anatomy for 8 high-yield outpatient pain blocks.
2. Select probe, patient position, needle approach, and safe volumes.
3. Apply safety checklists (anticoagulation, infection control, LA toxicity) and recognize red flags.
4. Know when to prefer ultrasound vs fluoroscopy vs combined guidance.

Department of Anesthesia and Pain medicine, School of Medicine, Pusan National University.

Ultrasound-guided interventions have transformed chronic pain practice by enabling direct visualization of target nerves, fascial planes, and critical vasculature. In a concise 20-minute format, it introduces a cranial-to-caudal sequence of practical, high-yield blocks that can be performed safely and reproducibly in the outpatient pain clinic.

The lecture begins with the rationale for ultrasound in interventional pain management: improved procedural accuracy, reduced anesthetic volumes, lower complication rates, and enhanced patient satisfaction. A simple six-step workflow is presented to standardize practice—(1) identify indication and pain generator; (2) evaluate patient factors; (3) select probe and approach; (4) map vessels and nerves with Doppler; (5) confirm the fascial plane with hydrodissection before injection; and (6) assess clinical and sonographic endpoints. This approach helps inexperienced operators develop consistent, image-based habits applicable to any block.

Proceeding anatomically from head to knee, the lecture highlights essential techniques: supraorbital, sphenopalatine ganglion, and mandibular nerve blocks for trigeminal-related pain; greater occipital nerve block for occipital neuralgia; stellate ganglion block for sympathetic-maintained upper-limb pain; suprascapular nerve block for shoulder pathology; serratus anterior and PECS II blocks for thoracic wall pain; erector spinae plane block for thoracic or lumbar axial pain and post-laminectomy syndromes; ilioinguinal/iliohypogastric block for inguinal neuralgia; and genicular nerve block for chronic knee pain. For each procedure, probe choice, key sono-anatomy, needle trajectory, and recommended injectate volumes are briefly reviewed, along with characteristic pitfalls such as vascular puncture, intraneural injection, and inadequate plane spread.

Safety and reproducibility are emphasized throughout. Attendees learn contraindications, precautions for anticoagulated or diabetic patients, recognition and management of local anesthetic systemic toxicity, and ergonomic principles to maintain needle visualization. Documentation templates and outcome-tracking suggestions are shared to promote continuity of care and audit-ready practice.

The session's guiding principle is simplicity: mastery of fascial plane recognition and adherence to the six-step checklist can transform ultrasound guidance from an intimidating skill into a daily clinical habit. Participants will leave with a clear mental map of approachable, evidence-based blocks that expand therapeutic options while minimizing risk—an essential skillset for the modern pain clinic.

Memo.

Pain management of CRPS patients

Hyun-Jung Kwon
University of Ulsan, Republic of Korea

Learning Objective

1. To understand the neurobiological and psychosocial mechanisms underlying pain in complex regional pain syndrome (CRPS).
2. To review evidence-based pharmacological and non-pharmacological strategies for CRPS pain management.
3. To integrate multidisciplinary approaches that target both symptom relief and functional recovery.

Complex regional pain syndrome (CRPS) is a prototypical chronic primary pain disorder characterized by disproportionate regional pain with sensory, vasomotor, sudomotor, and motor-trophic abnormalities. Now classified as ICD-11 MG30.04, it represents a nociplastic pain condition sustained by maladaptive central and peripheral mechanisms rather than ongoing tissue damage. Current evidence highlights multiple interacting domains, including peripheral inflammation (elevated cytokines and neuropeptides), autoimmune activation through pathogenic antibodies, central sensitization with altered thalamocortical connectivity, vasomotor dysregulation via adrenergic hypersensitivity, and psychological factors such as catastrophizing and body perception disturbance.

Management of CRPS requires a comprehensive, mechanism-based, and multidisciplinary approach. According to the Royal College of Physicians and recent Lancet Neurology recommendations, the therapeutic framework includes patient education, pharmacologic management, physical rehabilitation, and psychological therapy. Pharmacologic options—paracetamol, NSAIDs, gabapentinoids, antidepressants, and bisphosphonates—aim to facilitate functional rehabilitation rather than complete analgesia. Ketamine infusion may provide transient benefit, whereas long-term opioid use and sympathetic blocks show limited efficacy.

Early and active rehabilitation remains the cornerstone of care, emphasizing desensitization, graded mobilization, and cortical retraining through graded motor imagery or mirror therapy. Cognitive-behavioral and acceptance-based psychological interventions help reduce fear, catastrophizing, and disability, supported by patient and family education about pain neurobiology and recovery expectations. Neuromodulation techniques such as spinal cord or dorsal root ganglion stimulation can be considered for refractory cases but have uncertain long-term efficacy.

Preventive strategies—early mobilization and vitamin C supplementation after fractures—can reduce CRPS incidence. Although most patients improve within one year, up to one-third experience persistent pain and functional limitation, highlighting the need for early, coordinated intervention. Ultimately, CRPS management should target not only pain relief but also restoration of function and psychosocial reintegration through a biopsychosocial and interdisciplinary framework.

Memo.

Interventional treatment of cancer pain

Junmo Park
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Learning Objective

1. Interventional treatment can be considered in the earlier stage of cancer pain management when pain is not adequately controlled by pharmacologic therapy alone or when improvement of quality of life is required.
2. According to the pathophysiology of cancer pain, appropriate interventional procedures—such as sympathetic blocks and neurolysis, percutaneous cementoplasty, and neuraxial techniques—can be selected and performed.
3. Safe and effective intervention requires comprehensive knowledge of anatomy, imaging techniques, proper indications, and complication management, along with well-trained procedural skills.

1. 암성통증에 대한 중재적 치료의 기본 원칙

암성통증 관리에 가장 중추적 역할을 하는 것은 마약성 진통제를 포함한 약물요법이지만, 약 10~20%의 환자에서는 약물만으로 통증이 조절되지 않아 중재적 치료가 필요하다. 또한, 통증 관리 이외에도 환자의 기능의 유지나 향상을 통한 삶의 질 향상을 위해 중재적 치료가 요구되기도 한다.

최근 pain physician들에 의해 새롭게 제시되고 있는 기존의 3단계 WHO 진통제 사다리에 중재적 및 최소 침습적 치료법들이 4단계로 포함된 4단계 WHO 진통제 사다리가 최근 주목받고 있다. 4단계 WHO 진통제 사다리에서는 3단계 WHO 진통제 사다리에서 말하는 단계적 적용이 아닌 암성통증 환자를 치료할 경우에는 환자의 삶의 질 향상에 필요하다고 생각되는 경우에는 4단계의 조직 적용도 고려할 것을 권유하고 있다.

암성통증 치료에 이용되는 대표적인 중재적 치료 방법에는 교감신경 블록과 신경박리술, 경피적 시멘트성형술(골성형술)과 함께 neuraxial techniques 등이 있다.

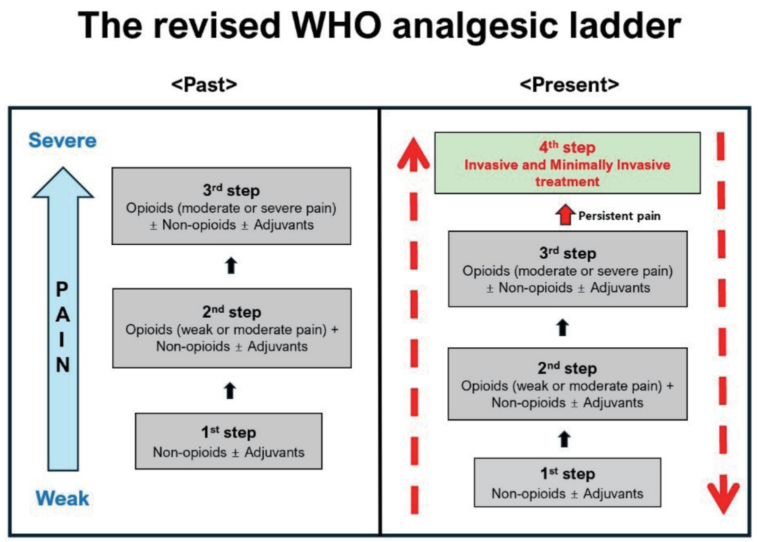

그림1. 개정된 4단계 WHO 진통제 사다리

Pugh TM et al. *Front Pain Res (Lausanne)*. 2021;2:688511

2. 교감신경 블록과 신경박리술 (Sympathetic blocks and neurolysis)

교감신경 블록은 복부나 골반내 장기에 발생한 악성종양과 관련된 내장통 완화에 효과적이다. Celiac plexus B, splanchnic nerve plexus B, inferior mesenteric plexus B, superior & inferior hypogastric plexus B, ganglion impar B 등이 가장 흔하게 이용되는 교감신경 블록들이다. Celiac plexus B과 splanchnic nerve plexus B은 특히 췌장암으로 인한 통증에, inferior mesenteric plexus B은 배꼽 아래, 골반 위의 편측 또는 양측 하복부 통증에, superior & inferior hypogastric plexus B은 골반내 장기의 악성 종양으로 인한 통증에, ganglion impar B은 회음부 통증에 효과적이라고 알려져 있다. 출혈성 소인이 있거나 시술 부위 감염이 있는 등과 같은 경우는 시술에 대한 금기에 해당되고, 일과성 저혈압이나 설사 같은 합병증의 발생 위험이 있다

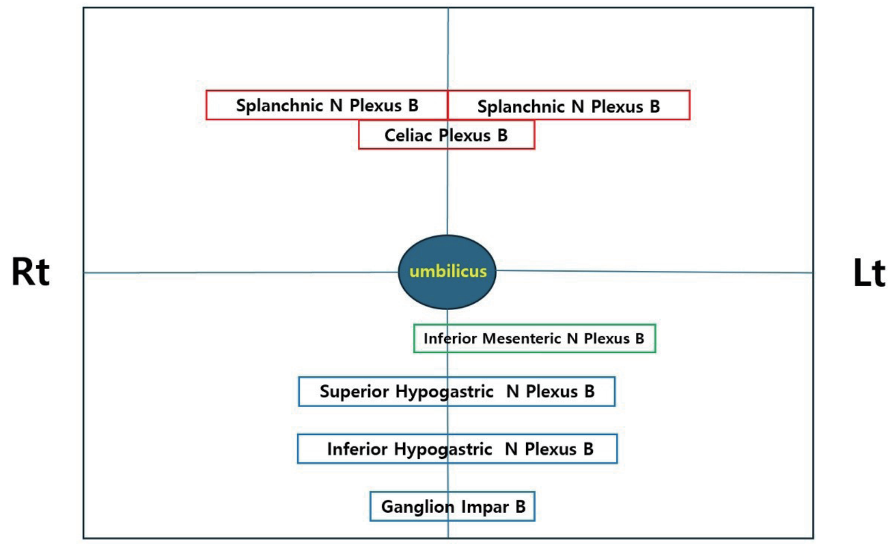

그림2. 복부와 골반의 암성통증에 사용되는 교감신경 블록

3. 경피적 시멘트성형술 (Percutaneous cementoplasty/osteoplasty)

경피적 시멘트성형술은 병적 골절이나 전이성 골질환 환자에서 골시멘트 주입을 통한 뼈의 구조적 안정화를 통해 통증 완화를 얻는 중재적 치료 방법으로 경피적 척추성형술(Percutaneous vertebroplasty)이 널리 알려져 있고 그 이외에도 sternum, ilium, rib, femur 등 여러 부위에서 시행이 가능하다. 약물 치료와 가장 다른 점은 암성통증 감소 효과가 뛰어날 뿐만 아니라 환자의 기능을 유지 및 향상시키는 데에 크게 기여할 수 있어 환자의 삶의 질 향상 뿐만 아니라 환자의 자존감 유지 및 향상시키는 데에 크게 기여할 수 있다는 장점을 가진다. 골시멘트 누출에 의한 신경 손상이나 폐색전, 감염 등과 합병증 발생의 위험이 있어 이에 주의가 필요한 시술이다.

적응증	금기	상대적 금기
Painful osteoporotic fractures that persist despite conservative drug treatment for more than 2 weeks Secondary pain caused by bone tumors such as aggressive hemangioma, giant cell tumor, and bone cyst Secondary pain to extensive osteolysis due to multiple myeloma, lymphoma, or metastases Painful fractures associated with osteonecrosis (Kummell's disease) Vacuum phenomenon within the vertebrae Painful Schmorl's node Paget disease Chronic traumatic fractures that do not heal	Fractures that improve with drug treatment Spinal cord compression Serious bleeding disorders and coagulation disorders that cannot be corrected Osteomyelitis, discitis, active systemic infection Allergy to bone cement or other filling materials >5 or diffuse bone metastases Fracture of the posterior column Unstable vertebral fracture	Vertebra plana Extension of the tumor into the spinal canal Secondary neurological damage due to posterior extrusion of fracture fragments
Spinal cord compression with neurological deficit → Operative decompression and posterior spinal stabilization		

표1. 경피적 척추성형술의 적응증, 금기, 상대적 금기 (K et al. Semin Intervent Radiol 2010)

4. Neuraxial Techniques

Epidural patient-controlled analgesia (PCA), intrathecal drug infusion pump, spinal cord stimulation(SCS) 등이 암성통증 치료에 이용되는 대표적인 neuraxial techniques이다. 심한 약물 부작용이나 약물에 대한 내성, 광범위한 통증, 난치성 신경병증성 통증 등에서 적용 가능하다. Epidural PCA의 경우 극심한 통증을 호소하는 경우가 많은 암성통증 환자들의 경우 본인이 직접 약물 투여가 가능하게 해 주어 환자의 자존감 유지에 많은 도움을 줄 수 있고, intrathecal drug infusion pump의 경우에는 이론적으로 경구나 정맥 투여와 비교했을 때 약 300배와 100배의 뛰어나 효과를 볼 수 있다고 알려져 있어 극소량의 약물 사용으로 인해 약물에 의한 부작용이 거의 없다는 장점이 있다. SCS의 경우에는 암성통증의 특성상 아직까지 치료에 적극적으로 사용되고 있지는 않다.

5. 결론

암성통증 환자에서 약물치료만으로 조절되지 않는 난치성 통증의 경우, 여러 중재적 치료법을 조기부터라도 적절히 활용하면 통증 완화는 물론 기능 향상과 삶의 질 개선이 가능하다. 각 시술은 적응증, 금기, 합병증을 신중히 평가해 적용해야 하며, 다학제적 접근과 환자 맞춤형 전략이 중요하다.

Memo.

102ND KOREANESTHESIA 2025
The 102nd Annual Scientific Meeting of the Korean Society of Anesthesiologists

Refresher Course 4

Anesthesia for Specific Surgery

Chair(s)	Seung Ho Choi *(Yonsei University, Republic of Korea)* Aeryoung Lee *(Jeju National University, Republic of Korea)*
1	**Anesthetic considerations in ruptured and unruptured cerebral aneurysm surgery** Minsoo Kim *(Kangwon National University, Republic of Korea)*
2	**Updates on anesthetic management for Cesarean section** Yoon Ji Choi *(Korea University, Republic of Korea)*
3	**Updates on anesthetic management for robotic surgery** Jun-Young Park *(University of Ulsan, Republic of Korea)*
4	**Updates on anesthetic management for VATS** Wonjung Hwang *(The Catholic University, Republic of Korea)*

Anesthetic considerations in ruptured and unruptured cerebral aneurysm surgery

Minsoo Kim
Kangwon National University, Republic of Korea

Learning Objective

Anesthetic management for cerebral aneurysm surgery, whether ruptured or unruptured, requires a delicate balance of maintaining adequate cerebral perfusion while avoiding an increase in the aneurysm's transmural pressure.

Key considerations include strict hemodynamic control, providing brain relaxation, and ensuring a smooth recovery.

The specific risks and patient status dictate the primary focus.

Anesthetic management for cerebral aneurysm surgery requires precise control of cerebral and systemic physiology to optimize surgical conditions and minimize the risk of ischemic or hemorrhagic complications. The primary goals are to maintain stable hemodynamics, preserve cerebral perfusion, and ensure rapid postoperative neurologic assessment. During induction, smooth attenuation of sympathetic responses is essential to prevent abrupt increases in transmural pressure across the aneurysmal wall. Intraoperatively, careful titration of anesthetic depth, fluid balance, and ventilation helps maintain adequate cerebral perfusion pressure and optimal brain relaxation for microsurgical exposure. The choice between intravenous and inhalational anesthesia should consider neurophysiologic monitoring requirements, surgeon preference, and institutional experience. Continuous communication between anesthesiologist and neurosurgeon is critical, particularly during temporary clipping, brain retraction, or controlled hypotension. Advanced monitoring tools such as somatosensory evoked potentials, motor evoked potentials, and processed EEG can aid in detecting cerebral ischemia early and guiding anesthetic adjustments. Postoperatively, prompt awakening and accurate neurologic evaluation are key to identifying potential surgical or vascular complications. A well-coordinated anesthetic strategy that integrates hemodynamic stability, neuroprotection, and multidisciplinary teamwork plays a pivotal role in achieving optimal outcomes in cerebral aneurysm surgery.

Keywords: cerebral aneurysm, anesthesia, hemodynamic stability, neuroprotection, intraoperative monitoring

Memo.

Updates on anesthetic management for Cesarean section

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Learning Objective

1. Recent Trends in Regional Anesthesia for Cesarean Section
2. Recent Trends in General Anesthesia for Cesarean Section
3. Postoperative Pain Management after Cesarean Section

I. Regional Anesthesia (Neuraxial Block)

1. Neuraxial Anesthesia: The Gold Standard

Neuraxial anesthesia remains the gold standard technique for cesarean delivery, offering the highest level of maternal and neonatal safety. Compared with general anesthesia, it minimizes the risk of airway complications, aspiration, and maternal cardiovascular instability, while allowing immediate skin-to-skin contact after birth. It is also associated with reduced postpartum hemorrhage and depression. To prevent spinal hypotension, continuous norepinephrine (NE) infusion at 4 μg/min combined with a crystalloid co-load of 10 mL/kg is currently recommended.

2. Rapid-Sequence Spinal Anesthesia (RSS)

Rapid-sequence spinal anesthesia is an emerging alternative to general anesthesia for Category 1 cesarean sections requiring urgent delivery. This technique utilizes a “no-touch” sterile approach to achieve intrathecal injection within 2–3 minutes. The recommended dose is hyperbaric bupivacaine 10–12 mg with or without fentanyl 10–20 μg. RSS allows rapid block onset and has been associated with higher neonatal Apgar scores and reduced airway-related risks compared with emergency general anesthesia. Successful implementation requires a well-trained and synchronized team, with readiness for immediate conversion to GA if necessary.

3. Dural Puncture Epidural (DPE)

Dural puncture epidural anesthesia combines the safety of an epidural with improved block quality. After locating the epidural space using a Tuohy needle, a 26–27G Whitacre spinal needle is advanced to create a small dural puncture, enhancing local anesthetic spread through minimal cerebrospinal fluid leakage. DPE produces faster onset and more uniform sensory blockade than conventional epidural anesthesia and causes less pruritus and hypotension than combined spinal-epidural (CSE) anesthesia. It is applicable for both labor analgesia and cesarean section.

4. Programmed Intermittent Epidural Bolus (PIEB)

PIEB is a modern automated epidural delivery system that administers local anesthetic boluses at fixed intervals, improving drug distribution within the epidural space. Typical settings include 5 mL every 30 minutes of 0.1% bupivacaine with fentanyl 2 μg/mL. This technique provides superior maternal comfort, decreases total anesthetic consumption, and minimizes motor block compared to continuous epidural infusion.

5. Continuous Spinal Anesthesia (CSA)

Continuous spinal anesthesia (CSA) involves inserting a fine 24G microcatheter into the subarachnoid space to allow incremental dosing of low-concentration local anesthetics. The initial dose typically consists of 0.5% hyperbaric bupivacaine 4–6 mg with fentanyl 10–15 μg, followed by 1–2 mg bupivacaine every 5–10 minutes or a continuous infusion of 0.1–0.2 mL/min, maintaining a total dose below 12 mg. CSA enables gradual onset and titration of block intensity, resulting in excellent hemodynamic stability. It is particularly useful in morbidly obese parturients, those with cardiovascular disease, or cases of failed epidural conversion. Potential risks include postdural puncture headache, infection, and catheter migration.

6. Ultrasound-Guided Neuraxial Anesthesia

Pre-procedural ultrasound guidance has become an invaluable adjunct for identifying spinal landmarks, especially in obese or anatomically challenging patients. Key sonographic patterns such as the “trident sign,” “camel hump,” and “bat sign” aid in determining the midline and depth of the epidural space. This technique significantly improves first-pass success rates and reduces procedural complications.

II. General Anesthesia (GA) for Cesarean Section

General anesthesia is reserved for cases with contraindications to neuraxial techniques or where rapid delivery is required. Optimal airway management combines the ramped position with head-elevated laryngoscopy (25°) to facilitate intubation. Videolaryngoscopy is recommended as the primary device, with laryngeal mask airway (LMA) as a rescue option.

Short-acting opioids such as remifentanil or alfentanil can be administered during induction to minimize intraoperative awareness without compromising neonatal Apgar scores.

For anesthetic maintenance, total intravenous anesthesia (TIVA) using propofol or remimazolam is preferred. Remimazolam provides improved hemodynamic stability and rapid recovery, though obstetric data remain limited.

III. Postoperative Analgesia

1. Multimodal Analgesia (PROSPECT 2023–2024)

Current PROSPECT guidelines recommend a multimodal regimen consisting of intrathecal morphine (50–100 μg) combined with paracetamol and NSAIDs. Fascial plane blocks such as transversus abdominis plane (TAP), quadratus lumborum (QLB), or erector spinae plane (ESPB) blocks are recommended as adjuncts, particularly when intrathecal morphine is contraindicated. These techniques significantly reduce 24-hour opioid consumption and improve patient satisfaction.

2. SOAP Consensus on Intrathecal Morphine Monitoring

According to the SOAP consensus, low-dose ITM (≤100 μg) requires standard postoperative monitoring, while high-risk patients—such as those with obstructive sleep apnea (OSA), BMI >40, or pulmonary disease—should receive continuous observation for at least 24 hours.

3. Enhanced Recovery After Cesarean (ERAC)

The ERAC protocol emphasizes early oral intake (within 6 hours), early ambulation, maintenance of normothermia, prophylactic antiemetic administration, and early Foley catheter removal (6–8 hours). An opioid-sparing multimodal regimen remains the cornerstone of rapid postoperative recovery.

Memo.

Updates on anesthetic management for robotic surgery

Jun-Young Park
University of Ulsan, Republic of Korea

Learning Objective

1. Robotic surgery continues to expand across specialties, demanding tailored anesthetic strategies.
2. Steep Trendelenburg position and pneumoperitoneum cause major physiologic changes and complications.
3. Understanding these effects and anticipating limited access and prolonged operation are key to patient safety.

Background

Robotic surgery has rapidly evolved over the past two decades and is now widely adopted across various surgical specialties, including general, urology, gynecology, thoracic, and transoral, surgery. With its three-dimensional visualization, tremor filtration, and seven degrees of freedom, robotic systems allow for highly precise dissection and enhanced surgeon ergonomics compared with conventional laparoscopic or open techniques.

Reported advantages associated with patients include reduced blood loss, lower transfusion rates, decreased wound complications, faster recovery, and improved functional outcomes such as urinary continence and sexual function, particularly observed in prostate cancer surgery. Conversion rates to open surgery are also markedly reduced compared with laparoscopy in this context.

However, these benefits are not universal across all surgical types, and the technique remains limited by high equipment costs, longer operation times, and uncertain oncologic superiority in certain cancers.

From the anesthesiologist's standpoint, robotic surgery introduces unique challenges arising from limited patient access, steep Trendelenburg or reverse Trendelenburg position, CO2 pneumoperitoneum, and the extended duration of procedures. Understanding these physiologic perturbations and implementing proactive management strategies are critical to ensuring patient safety.

Physiologic Considerations

A typical robotic pelvic surgery requires a steep Trendelenburg position (30–45°) combined with CO_2 pneumoperitoneum, leading to significant alterations in cardiovascular, respiratory, neurologic, and renal physiology. Venous return, central venous pressure, and mean arterial blood pressure increase, while cardiac output may fluctuate depending on preload and afterload conditions. Elevated intra-abdominal pressure (IAP) and hypercapnia increase systemic vascular resistance and pulmonary artery pressure, thereby imposing a strain on the heart, particularly in elderly or cardiac-compromised patients. Especially, the increased heart rate often persists into the postoperative period; therefore, special caution is required in patients with underlying cardiac disease.

On the respiratory side, cephalad displacement of the diaphragm and abdominal organs reduces functional residual capacity, lung compliance, and tidal volume while increasing airway pressure and dead space. These changes predispose patients to ventilation–perfusion mismatch, hypercarbia, and atelectasis. Consequently, postoperative pulmonary complications (PPCs) such as desaturation, pneumonia, or prolonged oxygen requirement occur in up to one-third of cases.

Cerebral physiology is also affected. Pneumoperitoneum and Trendelenburg position increase intracranial reducing cerebral perfusion pressure and venous outflow. Intracranial pressure and optical nerve sheath diameter (ONSD) can be elevated during robotic procedures, though these changes are generally reversible. Preventive strategies—such as limiting intra-abdominal pressure, avoiding excessive hypercapnia, and shortening operative duration—are essential to minimize neurologic risk.

Intraocular pressure (IOP) also increases during robotic surgery, and in patients with preexisting glaucoma, this elevation may, in rare cases, lead to vision loss.

Renal perfusion and splanchnic blood flow decrease as intra-abdominal pressure rises, contributing to transient oliguria or acute kidney injury (AKI). Careful fluid titration, maintaining low IAP (<12 mmHg), and early release of pneumoperitoneum can reduce this risk.

Anesthetic Management Strategies

Patient access becomes extremely limited once the robot is docked, particularly during airway procedures such as transoral robotic surgery. In situations requiring CPR or airway intervention, undocking of the robot can be necessary; therefore, close teamwork and preoperative simulation training with the surgical team are essential.

Optimal anesthetic care during robotic surgery requires balancing hemodynamic stability, respiratory mechanics, and surgical field quality.

Lung-protective strategies with tidal volumes of 6–8 mL/kg, moderate PEEP (4–7 cmH_2O), and recruitment maneuvers help maintain oxygenation and minimize PPCs. Pressure-controlled ventilation or I:E ratios of 1:1 or 2:1 can lower peak inspiratory pressure.

Deep neuromuscular block (PTC 1–2) improves surgical workspace at lower IAP, reduces postoperative shoulder pain and intraocular pressure and facilitates smooth emergence. Emerging evidence also supports the use of **modified Z-Trendelenburg positioning** to reduce intraocular pressures without compromising surgical exposure.

In robotic-assisted prostatectomy and gynecologic surgery, careful fluid management, along with avoidance of prolonged pneumoperitoneum and excessive intra-abdominal pressure, is crucial to prevent postoperative AKI.

Secure airway fixation, protective eye taping, adequate padding of dependent limbs, and frequent verification of endotracheal tube position are mandatory due to restricted intraoperative access.

Future Directions

As robotic platforms continue to expand into **thoracic, cardiac, and transoral** procedures, anesthetic management must continue to evolve. The use of **low-pressure pneumoperitoneum**, and **modified Z-Trendelenburg positioning** may further enhance safety. Furthermore, robotic surgery is increasingly being applied to **vulnerable patient populations**, including **elderly, obese, and pediatric patients**, where physiologic tolerance and recovery differ significantly from healthy adults. Personalized anesthesia protocols and multidisciplinary coordination are therefore essential.

Conclusion

Robotic surgery represents an inevitable shift in modern surgical practice, offering remarkable precision yet posing new physiologic and anesthetic challenges. By understanding the physiologic effects of positioning, pneumoperitoneum, and prolonged operative duration, anesthesiologists can anticipate complications and tailor perioperative management accordingly.

The integration of evidence-based ventilation, hemodynamic, and neuroprotective strategies will be pivotal in optimizing outcomes as robotic surgery continues to expand its clinical frontiers.

Memo.

Updates on anesthetic management for VATS

Wonjung Hwang
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Learning Objective

1. Review updated OLV and lung separation strategies
2. Understand ERAS-based recovery and pain control
3. Explore emerging trends (RATS, NIVATS, oncoanesthesia)

Video-assisted thoracic surgery (VATS)는 폐절제 및 종격동 수술에서 표준적 접근으로 자리 잡았다. 최소침습 수술임에도 불구하고 일측폐 환기 중 발생하는 생리적 변화와 호흡기계 합병증의 위험은 여전히 주요한 마취과적 과제이다. 이에 따라 최근의 마취 전략은 lung-protective ventilation, multimodal analgesia, 그리고 enhanced recovery after surgery (ERAS) 개념을 통합한 회복 중심 관리로 발전하고 있다.

폐분리와 환기전략은 수술 중 안정성을 결정하는 핵심 요소이다. 성인에서는 double-lumen tube (DLT) 또는 bronchial blocker (BB)를 사용하며, fiberoptic bronchoscopy로 정확한 위치 확인이 필요하다. 환기 전략은 low tidal volume (4–6 mL/kg predicted body weight)과 적절한 PEEP (5–8 cmH_2O) 유지가 기본이며, 재팽창 시 과도한 FiO_2는 피해야 한다. 소아에서는 Arndt, Fogarty, EZ-blocker 등의 사용이 일반적이고, 신생아나 영아에서는 extraluminal bronchial blocker 또는 mainstem intubation이 적용될 수 있다. 이 경우 airway resistance증가와 hypercapnia의 위험이 높으므로, 세심한 모니터링이 필요하다.

ERAS/ESTS 2024 가이드라인은 2019년판의 원칙을 확장하여 opioid-sparing multimodal analgesia의 표준화와 team-based perioperative pathway의 중요성을 보다 명확히 강조하였다. PROSPECT 2022 가이드라인에서는 VATS 환자에서 thoracic epidural analgesia의 통상적 사용은 권장되지 않으며, paravertebral block 또는 erector spinae plane block을 일차 선택으로 권고하였다. 또한, serratus anterior plane block 과 intercostal nerve block 이 주요 차단술의 시행이 어렵거나 금기일 때 유용한 대안으로 제시되었다. Multimodal analgesia 는 acetaminophen과 NSAID 병용 요법을 기본으로 하며, 그 외 lidocaine, ketamine, dexamethasone 등을 보조적으로 병합할 수 있다. Opioid-free/sparing anesthesia는 opioid 관련 부작용을 줄일 수 있으나, 현재까지는 임상적 유용성에 대한 근거가 제한적이므로 고위험군 환자에 선택적으로 적용하는 것이 바람직하다.

최근에는 robotic-assisted VATS (RATS), non-intubated VATS (NIVATS), 그리고 oncoanesthesia가 새로운 주제로 부상하고 있다. RATS에서는 CO_2 insufflation에 따른 hypercapnia 및 정맥환류 감소로 인한 혈역학적 변화 관리가 중요하며, 로봇 도킹 이후 접근이 제한되므로 수술 전 기도 확인 및 라인 확보가 필수적이다. NIVATS는 기관 삽관 없이 자발호흡으로 시행되는 수술로, 회복이 빠르고 opioid 사용을 줄일 수 있으나, hypoventilation 및 전신마취로의 전환 위험이 있으므로 숙련된 팀에서 선택적으로 시행되어야 한다. 한편, oncoanesthesia는 마취가 종양면역 등 예후에 미치는 영향을 연구하는 분야로, 현재까지의 임상 근거는 제한적이다. 다만, 최근 연구들은 하나의 마취제/마취방법의 선택보다 전반적인 생리적 안정 유지가 장기 예후에 더 더 큰 영향을 미친다고 제시하고 있다.

결론적으로, 현재의 VATS 마취는 lung-protective ventilation, opioid-sparing analgesia, 그리고 ERAS 기반 회복 전략을 통합하는 방향으로 발전하고 있으며, RATS, NIVATS, oncoanesthesia 등 새로운 패러다임이 확산되고 있다.

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