Perioperative Consultation : Arrhythmia

온 영 근
삼성서울병원 성균관의대

• **Purposes** of a cardiology consultation

: comprehensive evaluation of the patient's risk

(1) determine the stability of the patient's cardiovascular status

(2) and whether the patient is in optimal medical condition,

within the surgical illness.

Perioperative Consultation : Arrhythmia

- Significant cardiac arrhythmia
- Perioperative Atrial fibrillation
- Ventricular arrhythmia
- Perioperative anticoagulation
- Electromagnetic Interference (EMI) with Pacemakers and ICDs

• In acute surgical emergency, preoperative evaluation might have to be limited to simple and critical tests, such as a rapid assessment of cardiovascular vital signs, volume status, hematocrit, electrolytes, renal function, urine analysis, and ECG.

• Preoperative tests are recommended only if the information obtained will change the treatment.

• A more thorough evaluation can be conducted after surgery.

• In patients in whom coronary revascularization is not an option, it is often not necessary to perform a noninvasive stress test.

Active Cardiac Conditions for which the patient should undergo **evaluation and treatment** before Noncardiac Surgery (Class I, Level of Evidence: B)

Condition	Examples
Unstable coronary syndromes	Unstable or severe angina (CCS class III or IV) Recent MI
Decompensated HF (NYHA FC IV; worsening or new-onset HF)	
Significant arrhythmias	High-grade AV block Mobitz II AV block Third-degree AV heart block Symptomatic ventricular arrhythmias Supraventricular arrhythmias (including atrial fibrillation) with uncontrolled ventricular rate (HR >100 bpm at rest) Symptomatic bradycardia Newly recognized ventricular tachycardia
Severe valvular disease	Severe aortic stenosis (mean pressure gradient > 40 mm Hg, aortic valve area < 1.0 cm^2, or symptomatic) Symptomatic mitral stenosis (progressive dyspnea on exertion, exertional presyncope or HF)

Fleisher LA et al, JACC 2009;54:e13

- Cardiac arrhythmias and conduction disturbances are common in the perioperative period, particularly in the elderly.

- Both supraventricular and ventricular **arrhythmias** : independent risk factors for coronary events in the perioperative period.

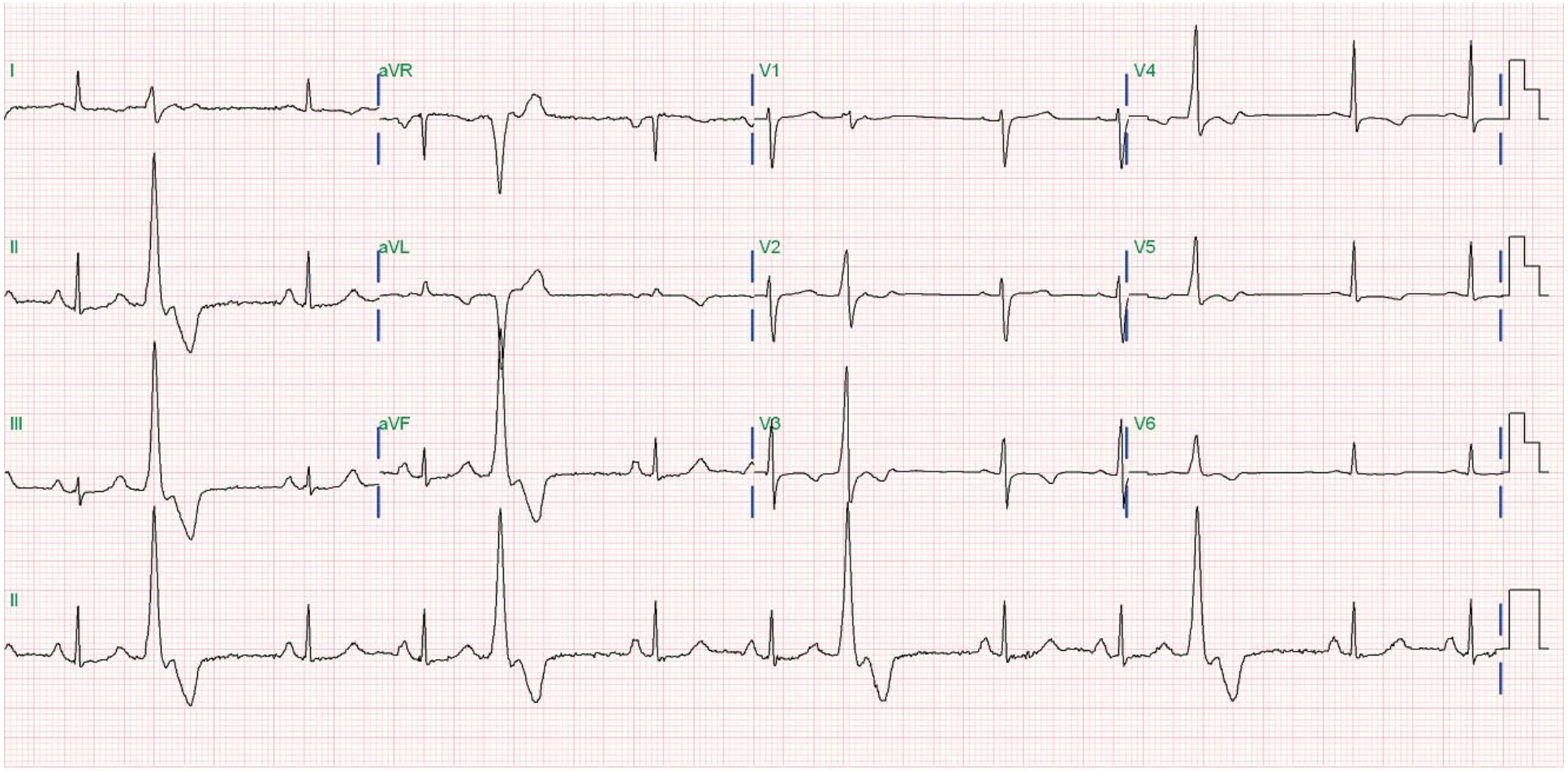
- The **perioperative cardiac arrhythmias** reflect the presence of underlying cardiopulmonary ds, ongoing myocardial ischemia or infarction, drug toxicity, or metabolic derangements.

  : search for **underlying problem**

- **AF** : most common type of sustained supraventricular tachycardia
  can produce ischemia by increasing myocardial oxygen demand in CAD
  AF with RVR in a patient with an accessory bypass tract may degenerate into VF.

- Sustained supraventricular arrhythmias may require electrical or pharmacological cardioversion.

- In atrial fibrillation or atrial flutter, a rate-control strategy can be accomplished with beta blockers, calcium channel blockers, or digoxin.


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Limb: 10 mm/mV
Chest: 5 mm/mV
Speed: 25 mm/sec
0.05-150 Hz

- **Asymptomatic ventricular arrhythmias** using continuous ECG monitoring, couplets and NSVT

  : **not** associated with an increase in cardiac complication.

- **Ventricular arrhythmia** (PVC, complex ventricular ectopy or NSVT) do not need therapy unless they result in hemodynamic compromise.

  not associated with an increased risk of nonfatal MI or cardiac death.

- Sustained or nonsustained ventricular tachycardia in perioperative period need an evaluation of ventricular function and screening **for CAD**.

- Sustained or symptomatic ventricular tachycardia should be suppressed preoperatively with intravenous lidocaine, procainamide, or amiodarone and a thorough search should be conducted.

- **Beta blocker therapy** can **reduce** perioperative ischemia, the risk of MI and cardiovascular death in high risk patients.

  The dose should be titrated to achieve adequate heart rate control and minimize the risks of hypotension and bradycardia.

  Routine high-dose beta blockers without dose titration is not recommended.

- Complete AV block need temporary pacing.

- LBBB or RBBB without history of advanced heart block or symptom rarely progress to complete AV block.

Postoperative arrhythmias in general surgery

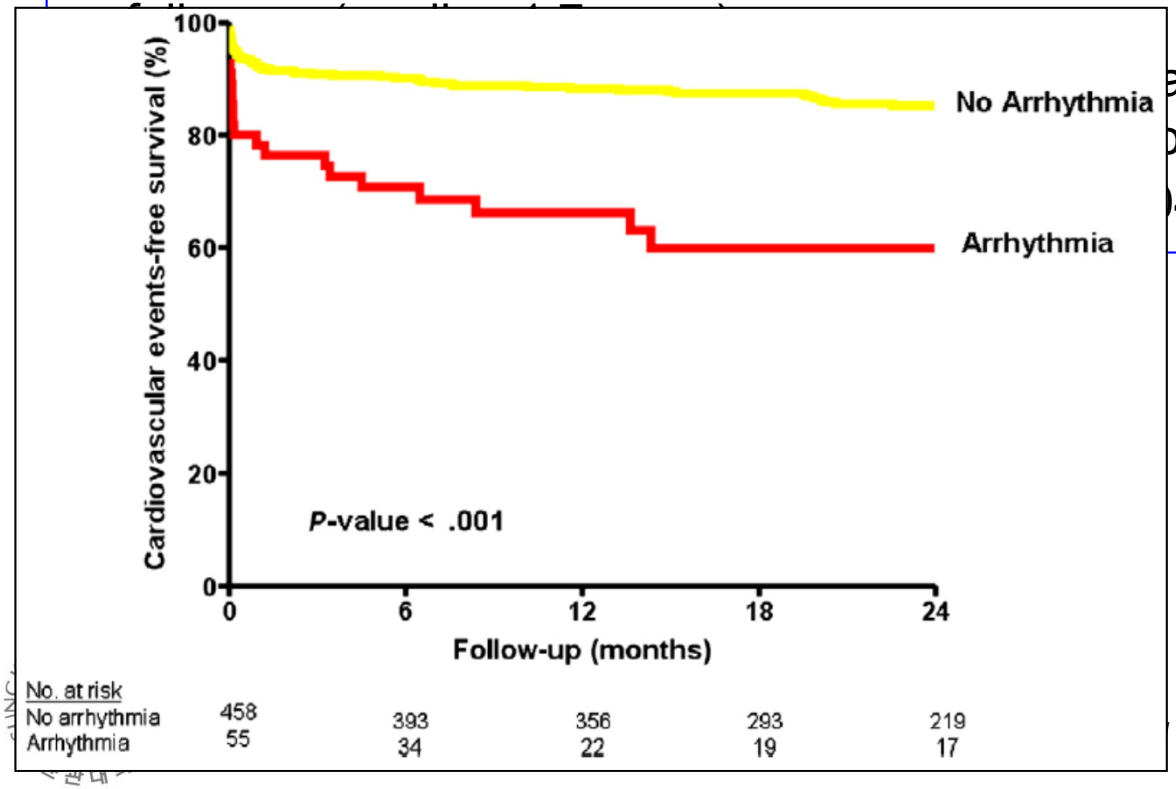
arrhythmias in prospective cohort

	Polanczyk[8]	Goldman[7]	Brathwaite[6]	Batra[4]	Valentine[13]	Bender[12]	Walsh[5]	
Total patients	4181	916	462	226	211	206	51	6253
Atrial fibrillation	171	17	31	20	21	9	7	276 (4.41%)
Atrial flutter	51	5	0	0	–	3	0	59 (0.94%)
Paroxysmal atrial tachycardia	14	4	0	1	–	0	0	19 (0.3%)
Multifocal atrial tachycardia	10	3	1	7	–	0	0	21 (0.4%)
Paroxysmal supraventricular tachycardia	156	6	15	0	–	16	4	197 (3%)
Ventricular ectopics	–	–	–	18	–	–	1	19 (0.3%)
Ventricular tachycardia	–	–	–	7	–	–	1	8 (0.13%)
Ventricular fibrillation	–	–	–	1	–	–	0	1 (0.02%)
Any dysrhythmia	317	35	47	29	21	28	13	490 (7.84%)

Walsh SR, et al. Ann R Coll Surg Engl 2007;89:91

Outcome of new-onset arrhythmias in vascular surgery

- Patients were continuously monitored with 12-lead ECG for 72 hours perioperatively starting 1 day before and continuing until 2 days after surgery.
- occurred in 55 (**11%**) of 513 patients
- atrial fibrillation(4%), ventricular tachycardia(7%),
- supraventricular tachycardia(1%), ventricular fibrillation(0.2%)
- Increased **age** and **reduced LVEF** : risk factors for arrhythmias



and stroke (CV events)
ong-term cardiovascular events
)4)

TA, et al. Am Heart J 2010;159:1108

- **Cardiac arrhythmias** are a frequent postoperative complication of both cardiac and noncardiac surgery.

  noncardiac surgery : up to 20%

- **AF** is the most common postoperative arrhythmia.

  8% of noncardiac surgeries

  12% of noncardiac thoracic surgical procedures (between 3~30%)

  16~46% after cardiac surgeries

  usually within the first 4 postoperative days

  at 6 weeks after surgery, nearly all patients are in sinus rhythm.

Recommendations for post-operative AF

AF : 30% after CABG, 40% after valve surgery,

50% after combined CABG/valve surgery

- Oral β-blockers are recommended to prevent post-operative AF for patients undergoing cardiac surgery in the absence of contraindications (Class I level A)
- If used, β-blockers (or other oral antiarrhythmic drugs for AF) are recommended to be continued until the day of Surgery (Class I level B)
- Ventricular rate control is recommended in patients with AF without hemodynamic instability (Class I level B)
- Restoration of sinus rhythm by DCC is recommended in patients who develop post-operative AF and are hemodynamically unstable (Class I level C)

ESC AF guideline Eur Heart J 2010

Recommendations for post-operative AF

- Anticoagulation medication for post-operative AF should be considered when the duration of AF is >48 h (Class IIa level A)
- If sinus rhythm is restored successfully, duration of anticoagulation should be for a minimum of 4 weeks but more prolonged in the presence of stroke risk factors (Class IIa level B)
- Pre-operative administration of amiodarone should be considered as prophylactic therapy for patients at high risk for post-operative AF (Class IIa level A)
- Antiarrhythmic medications should be considered for recurrent or refractory postoperative AF in an attempt to maintain sinus rhythm (Class IIa level B)

ESC AF guideline Eur Heart J 2010

Perioperative anticoagulation

- Temporary interruption of warfarin treatment before surgery (INR <1.5 or INR normalization)

- **Bridging anticoagulant therapy**

  may be indicated depending on the thromboembolic risk.

  : risk of clinically significant bleeding vs risk of stroke or thrombo-embolism

  : LMWH or unfractionated heparin during the temporary interruption

- **Warfarin** : half-life of 36~42 h, should be interrupted ~5 days

  INR 2~3 : four scheduled doses of warfarin should be withheld to allow the INR to fall spontaneously to 1.5 or less before surgery.

  INR >3 : warfarin should be withheld for a longer period

- The effect of warfarin can be reversed by parenteral vitamin K or fresh frozen plasma(FFP).

ESC AF guideline Eur Heart J 2010
Kearon C. NEJM 1997

ACCP risk stratification for perioperative thromboembolism

Risk category	Mechanical heart valve	Atrial fibrillation	Venous thromboembolism
High **(>10%/yr risk of ATE** or >10%/mo risk of VTE)	Any mechanical mitral valve Older aortic valve Recent (< 6 mo) stroke or TIA	$CHADS_2$ score of 5 or 6 Recent (< 3 mo) stroke or TIA Rheumatic valvular heart disease	Recent (< 3 mo) VTE Severe thrombophilia
Moderate (4~10%/yr risk of ATE or 4~10%/mo risk of VTE)	Bileaflet aortic valve and one of the following: AF, prior stroke/TIA, hypertension, diabetes, heart failure, age > 75 yr	$CHADS_2$ score of 3~4	VTE within past 3~12 mo Recurrent VTE Nonsevere thrombophilic conditions Active cancer
Low **(< 4%/yr risk of ATE** or < 2%/mo risk of VTE)	Bileaflet aortic valve without AF and no other risk factors for stroke	$CHADS_2$ score of 0~2 (and no prior stroke or TIA)	Single VTE within past 12 mo and no other risk factors

ACCP : American College of Chest Physicians

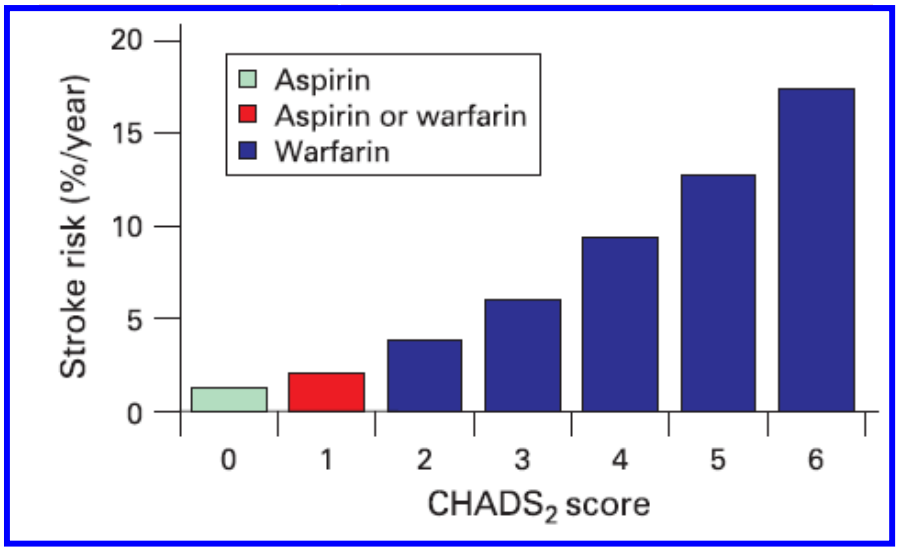
ACCP guideline *Chest 2008; 133(suppl):299S*

Annual stroke risk in patients with AF ($CHADS_2$ score)

$CHADS_2$ score

- congestive heart failure (1)
- hypertension (1)
- age ≥ 75 (1)
- diabetes (1)
- history of stroke or TIA (2)

$CHADS_2$ score	Adjusted stroke rate



Expected rate of stroke per 100 patient-years

Snow V, et al. Ann Intern Med 2003;139:1009

Bridging anticoagulant therapy

temporary use of intravenous unfractionated **heparin** (IV UFH)
or low-molecular-weight heparin (**LMWH**) prior to surgery

- **High risk** : bridging anticoagulation

  with therapeutic-dose subcutaneous LMWH or IV UFH

- **Moderate risk** : bridging anticoagulation

  with therapeutic-dose subcutaneous LMWH,

  therapeutic dose IV UFH,

  or low-dose subcutaneous LMWH

- **Low risk** : bridging anticoagulation

  with low dose subcutaneous LMWH

  or no bridging

ACCP guideline *Chest 2008; 133(suppl):299S*

Practical approach to Bridge Therapy

Before surgery

- Discontinue warfarin 5 days before surgery (hold four doses) if the preoperative INR is 2~3, and 6 days before surgery (hold five doses) if the INR is 3~4.5.
- Age is associated with a slower rate of decrease in the INR.
- For bridge therapy, start LMWH (enoxaparin 1 mg/kg sc every 12 hours) beginning 36 hours after the last dose of warfarin.
- Give the last dose of LMWH approximately 24 hours prior to surgery.

After surgery

- For minor surgery, reinitiate LMWH at full dose approximately 24 hours after surgery.
- For major surgery and for patients at high risk of bleeding, consider using prophylactic doses on the first two postoperative days.
- Restart warfarin at preoperative dose 1 day after surgery.
- Discontinue LMWH when the INR is between 2 and 3 for 2 consecutive days.

Jaffer AJ. Cleveland Clin J Med 2009

Procedures that can be performed without discontinuing warfarin

Ophthalmic	Dental	Dermatologic	Gastrointestinal
Cataract surgery Trabeculectomy	Restorations Uncomplicated extractions Endodontics Prosthetics Periodontal therapy Dental hygiene	Mohs' surgery Simple excisions	Diagnostic esophagogastroduodenoscopy Colonoscopy without biopsy Diagnostic endoscopic retrograde cholangiopancreatography Biliary stent without sphincterotomy Endoscopic ultrasonography without biopsy Push enteroscopy

Jaffer AJ. Cleveland Clin J Med 2009

Antithrombotic strategies following PCI (coronary artery stenting) in patients with AF

Major bleeding with triple therapy : 2.6~4.6% at 30 days, 7.4~10.3% at 12 months.

Haemorrhagic risk	Clinical setting	Stent implanted	Anticoagulation regimen
Low or intermediate (HAS-BLED score 0~2)	Elective	Bare-metal	**1 month**: triple therapy of VKA (INR 2~2.5) + aspirin ≤ 100 mg/day + clopidogrel 75 mg/day **Lifelong**: VKA (INR 2~3) alone
	Elective	Drug-eluting	**3 (-olimus group) to 6 (paclitaxel) months**: triple therapy of VKA (INR 2~2.5) + aspirin ≤100 mg/day + clopidogrel 75 mg/day Up to **12th month**: combination of VKA (INR 2~2.5) + clopidogrel 75 mg/day (or aspirin 100 mg/day) **Lifelong**: VKA (INR 2~3) alone
	ACS	Bare-metal/ drug-eluting	**6 months**: triple therapy of VKA (INR 2~2.5) + aspirin ≤100 mg/day + clopidogrel 75 mg/day Up to **12th month**: combination of VKA (INR 2~2.5) + clopidogrel 75 mg/day (or aspirin 100 mg/day) **Lifelong**: VKA (INR 2~3) alone
High (HAS-BLED score ≥3)	Elective	Bare-metal	**2~4 weeks**: triple therapy of VKA (INR 2~2.5) + aspirin ≤100 mg/day + clopidogrel 75 mg/day **Lifelong**: VKA (INR 2~3) alone
	ACS	Bare-metal	**4 weeks**: triple therapy of VKA (INR 2~2.5) + aspirin ≤100 mg/day + clopidogrel 75 mg/day Up to **12th month**: combination of VKA (INR 2~2.5) + clopidogrel 75 mg/day (or aspirin 100 mg/day) **Lifelong**: VKA (INR 2~3) alone

ESC AF guideline 2010. Eur H J 2010

심방세동 환자의 출혈 위험도 평가

뇌출혈 위험인자

- 65세이상 고령 (1점)
- 뇌졸중 (1점)
- 고혈압 (1점)
- 간기능 이상 (1점)
- 신장기능 이상 (1점)
- 출혈 (1점)
- 심한 INR 변화 (1점)

HAS-BLED bleeding risk score

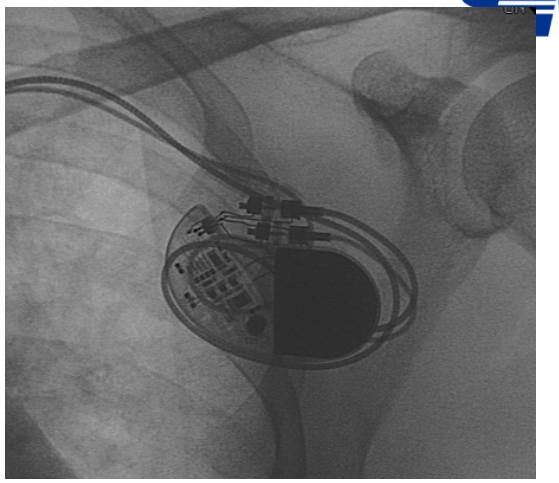
Letter	Clinical characteristic[a]	Points awarded
H	Hypertension	1
A	Abnormal renal and liver function (1 point each)	1 or 2
S	Stroke	1
B	Bleeding	1
L	Labile INRs	1
E	Elderly (e.g. age >65 years)	1
D	Drugs or alcohol (1 point each)	1 or 2

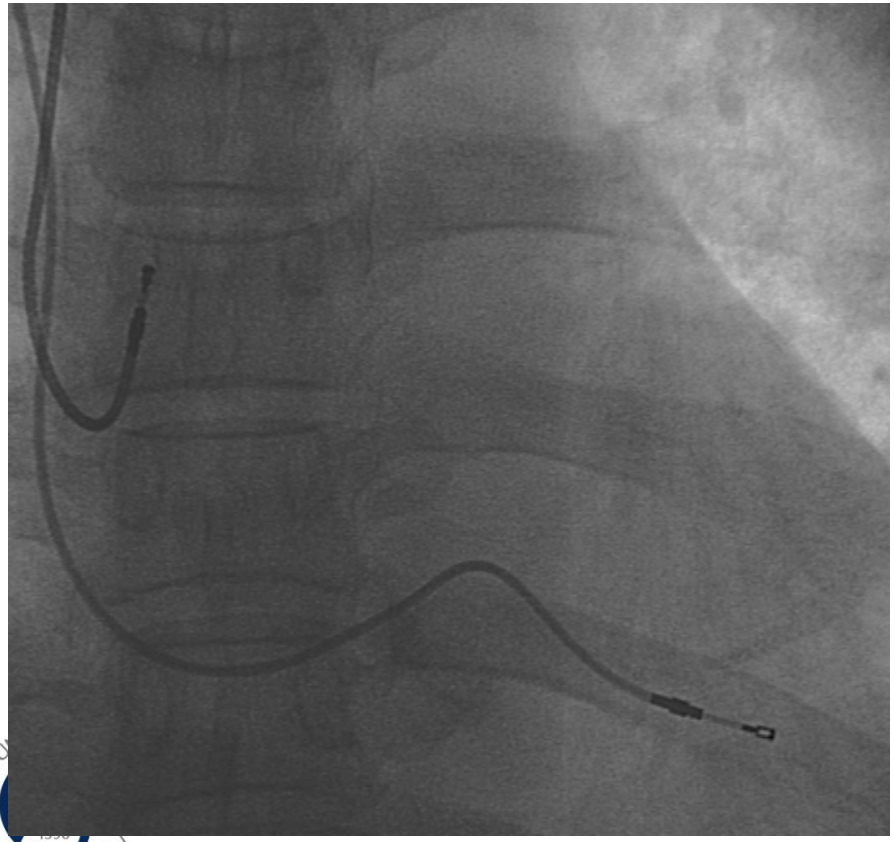
'Abnormal kidney function' : the presence of chronic dialysis or renal transplantation or serum creatinine ≥ 200 mmol/L.
'Abnormal liver function' : chronic hepatic disease (e.g. cirrhosis) or biochemical evidence of significant hepatic derangement (e.g. bilirubin >2 x upper limit of normal, in association with aspartate aminotransferase/alanine aminotransferase/alkaline phosphatase >3 x upper limit normal.

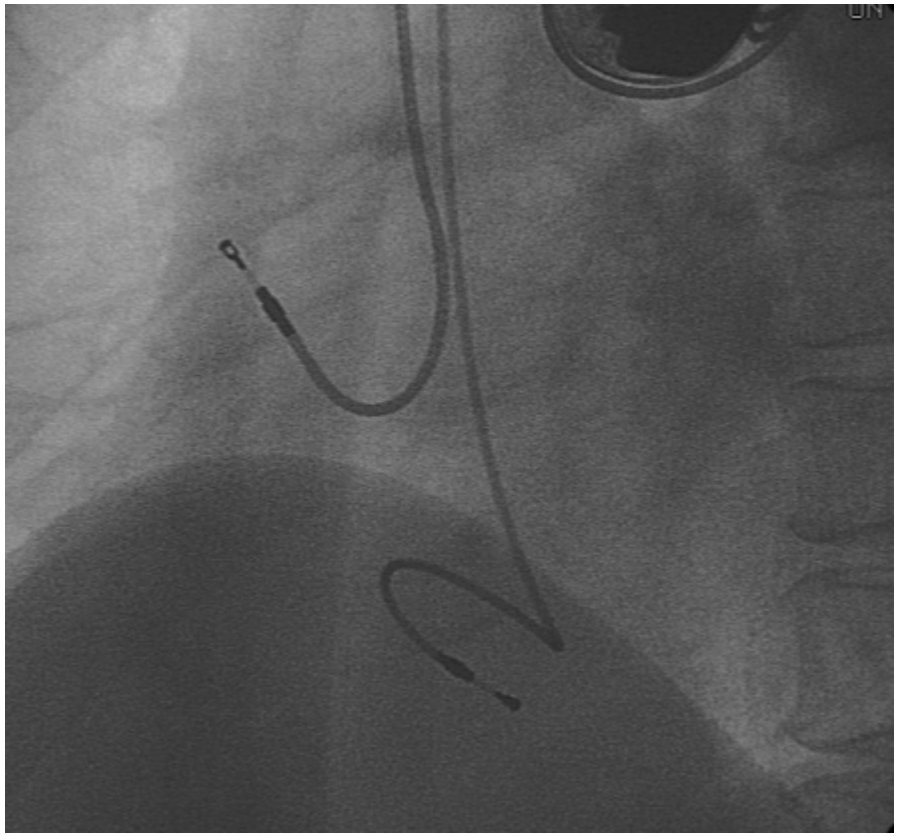
뇌출혈의 빈도는 과거에 비해 최근 많이 감소하여 0.1~ 0.6% 로 보고 되고 있다.

ESC AF guideline 2010. Eur H J 2010

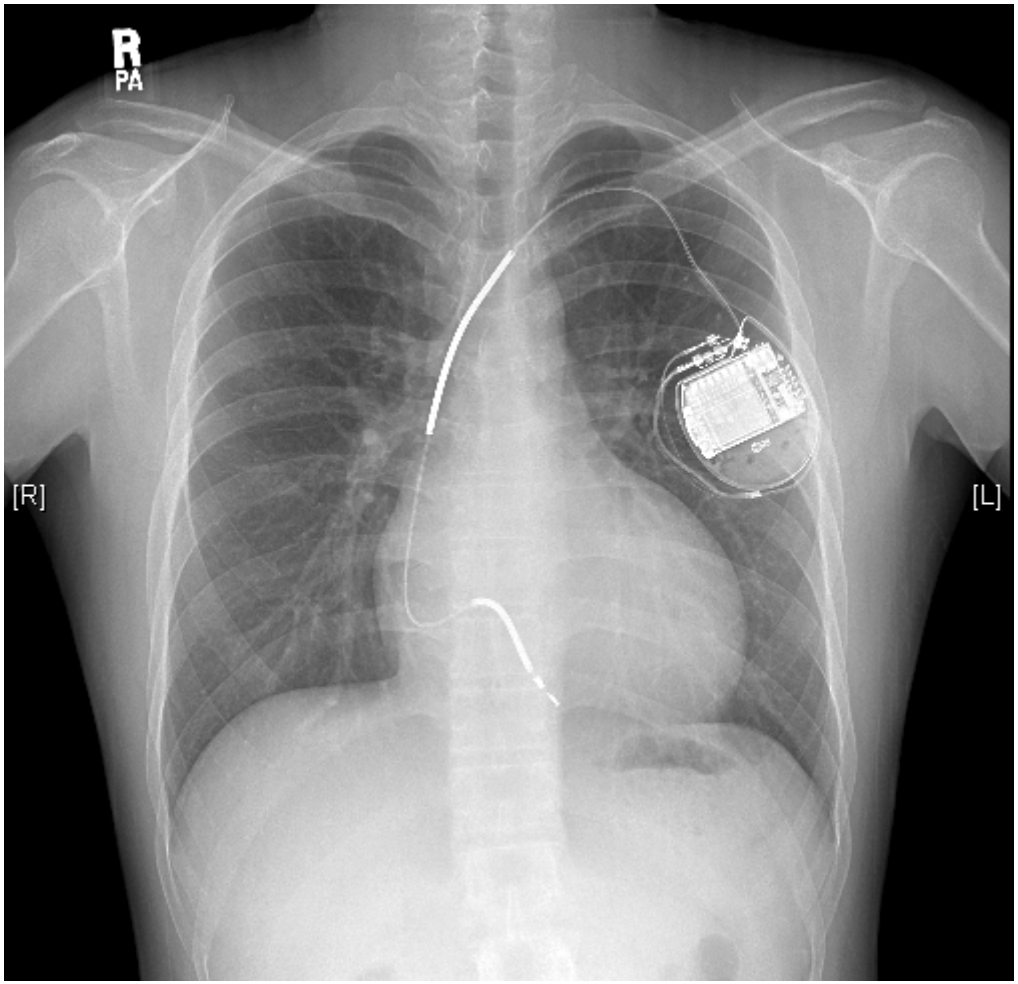
Permanent Pacemaker implantation

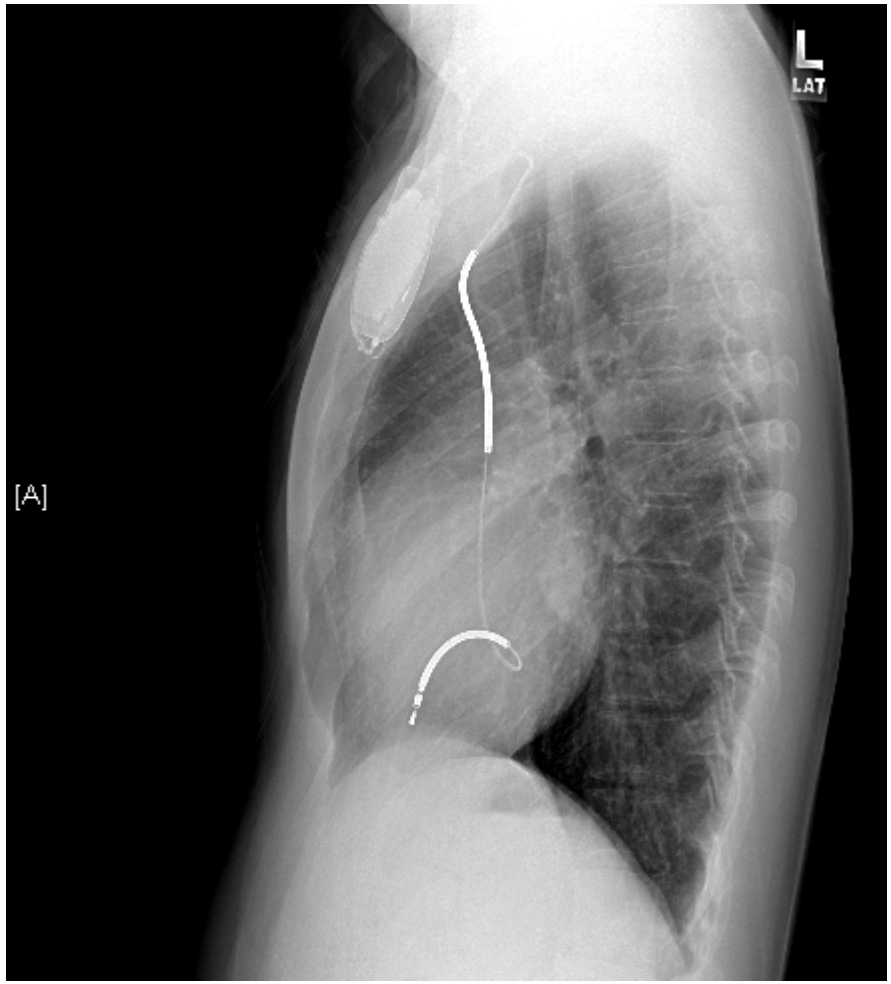




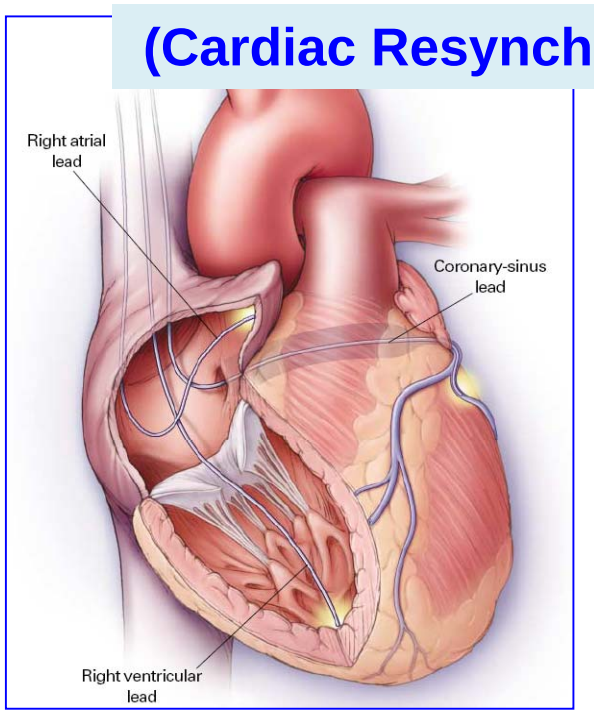


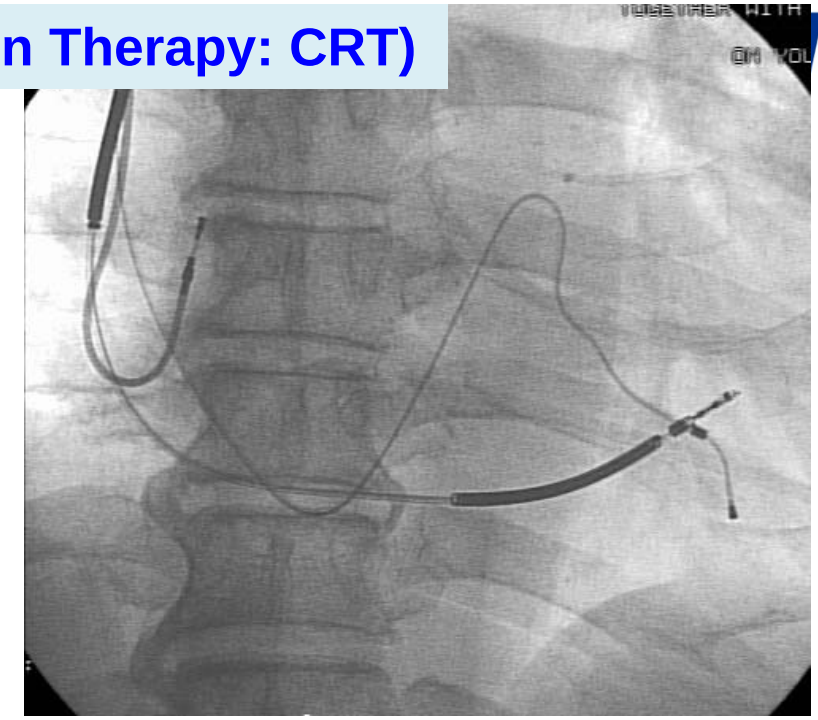
Implantable cardioverter defibrillator(ICD)

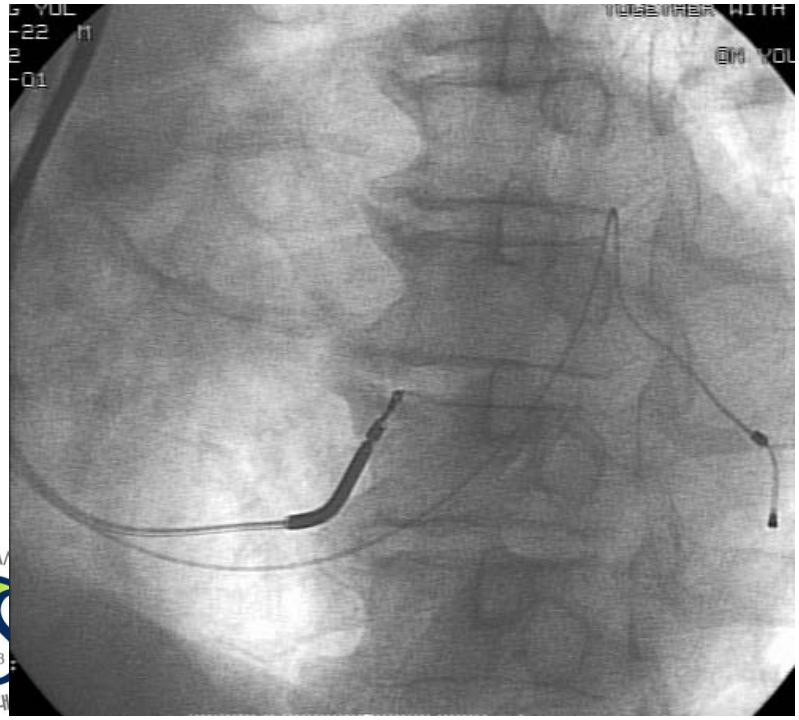


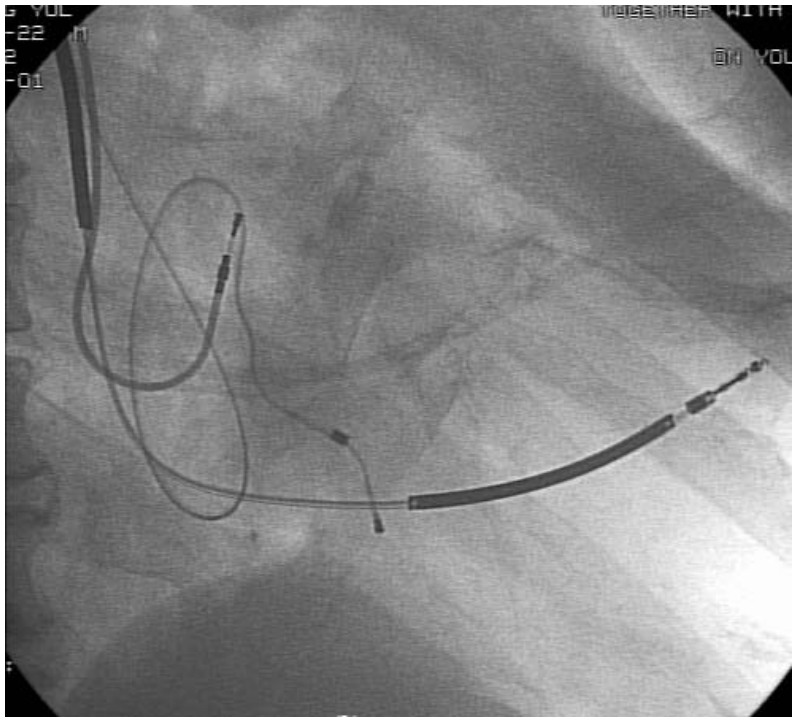


(Cardiac Resynchronization Therapy: CRT)

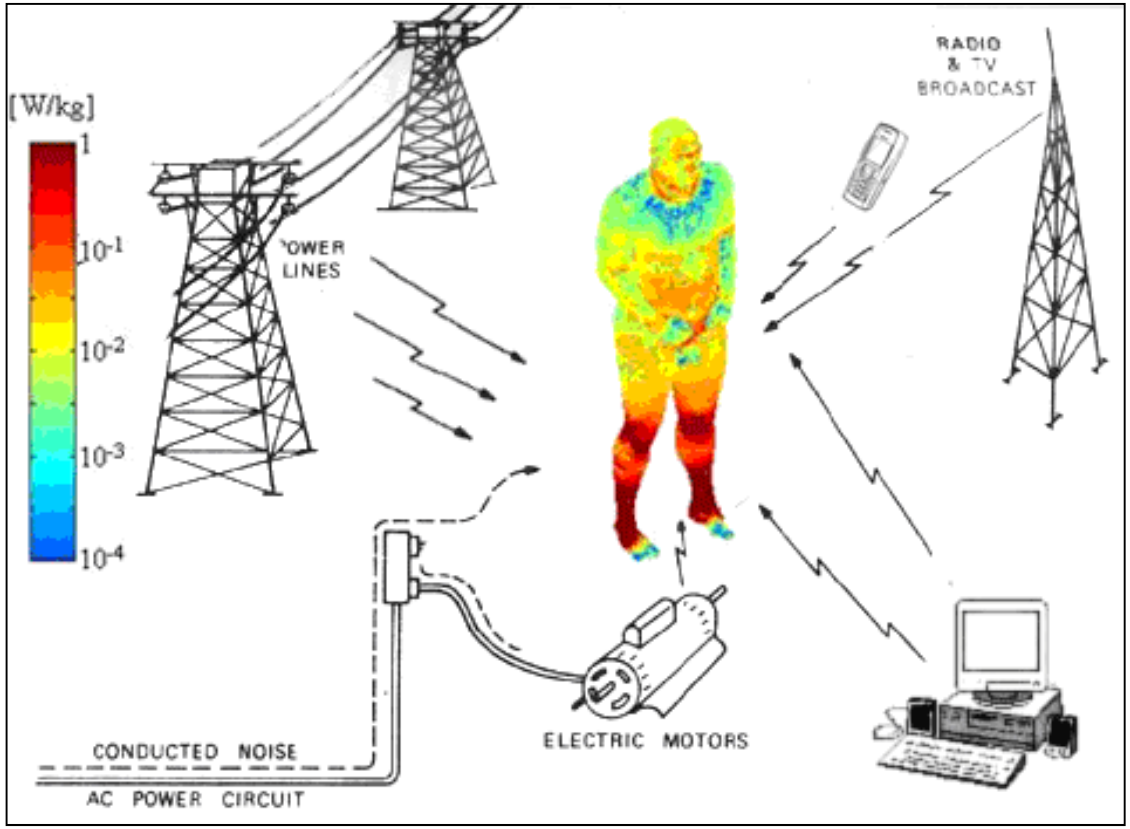






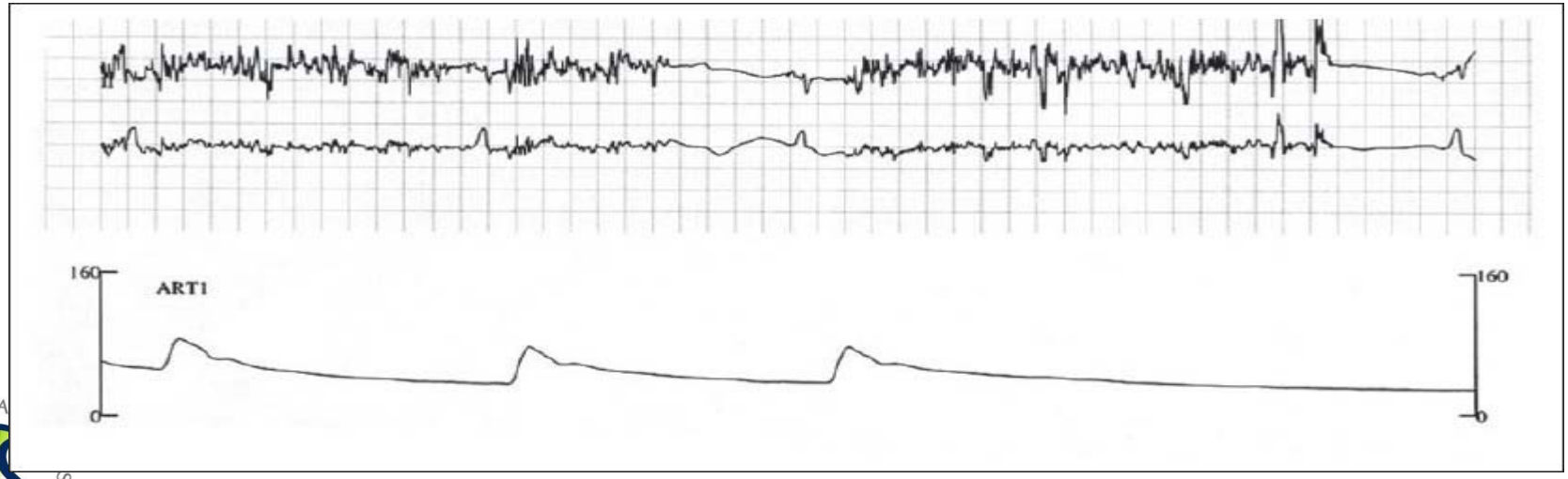


Electromagnetic Interference (EMI) with Pacemakers and ICDs



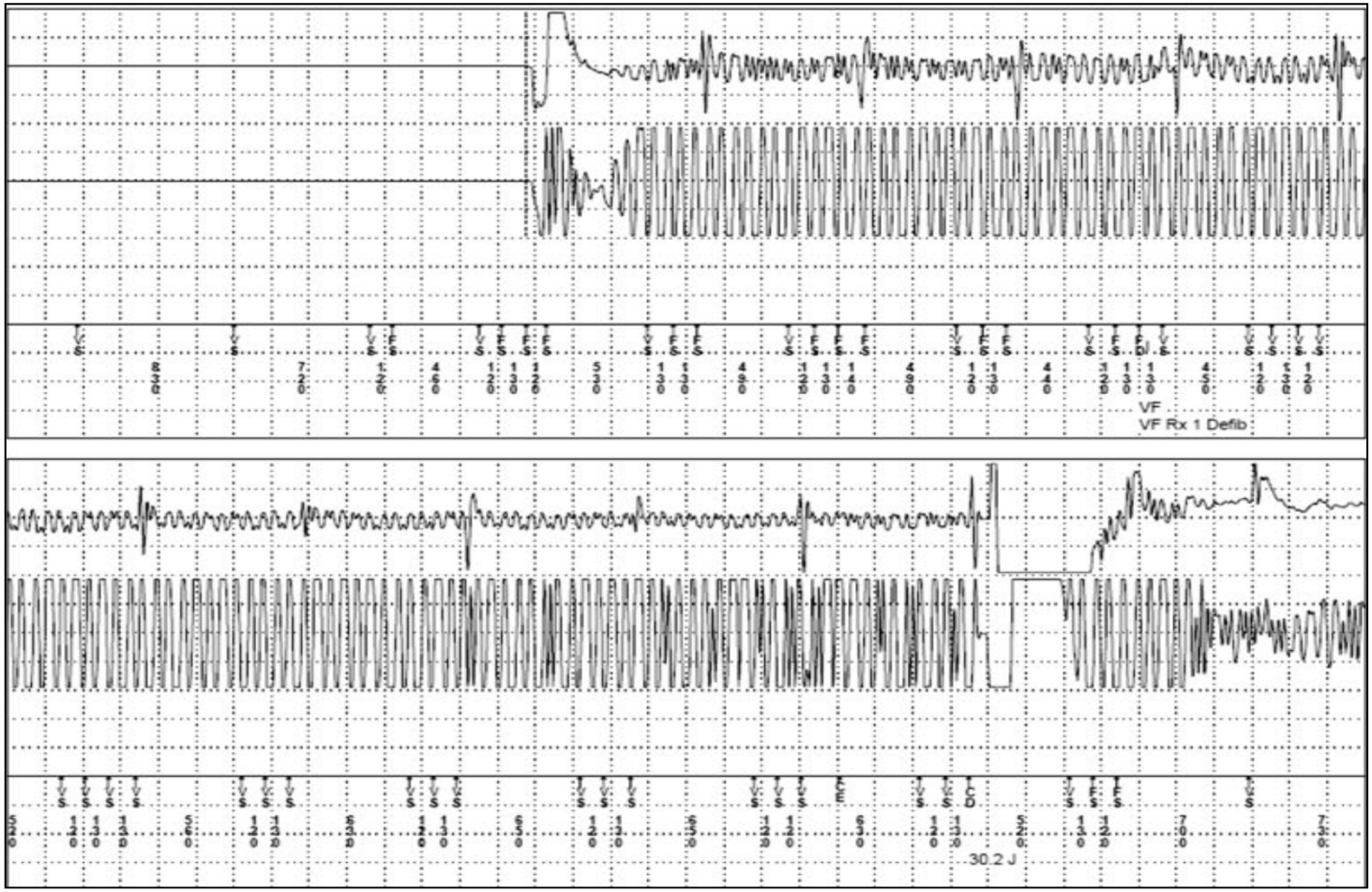
Normal paced rhythm with good perfusion prior to the application of electrocautery

Bradycardia evolving to asystole as a result of EMI during **electrocauterization**



Abdelmalak B. J Anaesth Clin Pharm 2011:27;527

Inappropriate ICD shock resulting from the ICD sensing current from an unexpected external source



Intraoperative Electromagnetic Interference (EMI) with Pacemakers and ICDs

- Potential for adverse interactions between electrical/magnetic activity and pacemaker or ICD function during operative period.

  : **Electrocautery** (unipolar current path between the cautery device and the plate attached to the patient's skin(thigh)

- EMI from monopolar electrosurgery : most common problem
- Bipolar electrosurgery does **not** cause EMI unless it is applied directly to a CIED(cardiovascular implantable electronic devices)

Electromagnetic Interference (EMI)

- Electromagnetic interference can cause a variety of responses.

  resetting to a backup, reset, or noise-reversion pacing mode (DDD reset to VVI pacing at a fixed rate)

  oversensing and inhibition of pacemaker output

  increasing pacing rate d/t activation of the rate responsive sensor

  ICDs and pacemakers with antitachycardia function may be inhibited

  ICD firing d/t activation by electrical noise

  myocardial injury at the lead tip that may cause failure to sense or capture.

Crossley GH, et al. Heart Rhythm 2011;8:1114

Clinical impact of EMI

will be influenced by a number of factors.

- whether the patient is pacemaker dependent,
- whether the pacemaker has unipolar or bipolar leads,
- whether the electrocautery is bipolar or unipolar,
- the relative distance from and orientation of the electrocautery to the pacemaker and pacemaker lead.

Perioperative Management of Patients With Devices

- When the patient is not pacer dependent and/or the cautery is remote and will be administered in brief bursts, and the operative team can monitor the ECG and pulse oximeter, it may be unnecessary to interrogate the pacer.

- If a patient is pacemaker dependent, the device should be reprogrammed to an asynchronous mode during surgery (VOO or DOO), or a magnet should be placed over the device during surgery.

- ICD should have their tachyarrhythmia treatment algorithms programmed off before surgery.

- During the period of device inactivated, the patient should be monitored continuously for a life-threatening arrhythmia.

Take Home Messages

Perioperative Consultation : Arrhythmia

- Significant cardiac arrhythmia
- Perioperative Atrial fibrillation
- Ventricular arrhythmia
- Perioperative anticoagulation
- Electromagnetic Interference (EMI) with Pacemakers and ICDs