NEET SS ANESTHESIA

Updated Notes 2026

ONCO ANAESTHESIA

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MODALITIES FOR ANTICANCER TREATMENT AND PERIOPERATIVE IMPLICATIONS

Chemotherapy 00:00:40

Overview :

Chemotherapy affects the following systems :

- Central nervous system.
- Cardiovascular system.
- Pulmonary system.
- Renal.
- Hepatic.
- Immunological system.
- Haematopoeitic system.

CNS toxicity :

- most common adverse effect (Limiting factor).
- Cumulative dose/dose intensity dependent.

Risk factors :

- DM.
- Advanced age.
- Hereditary neuropathies.
- Previous treatment with neurotoxic agent.

Symptoms :

1. Peripheral neuropathy : Chemotherapy induced peripheral neuropathy (CIPN).
   - Pins and needle sensation.
   - Ants crawling like sensation.
2. Central (Autonomic) neuropathy :
   - Reduced autonomic reflexes.
   - Large fluctuations in hemodynamics during post-operative period.

Symptoms usually start during treatment and stabilise after that.
Implicated agents : Vince alkaloids, platins, paclitaxel and dorcetaxil.

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Central neurotoxicity :

- Encephalopathy.
- Acute cerebellar syndrome.
- Posterior reversible encephalopathy syndrome.
- Aseptic meningitis.
- Cognitive deficits.
- Hemiparesis.
- Progressive dementia.

Peripheral neuropathy :

- Pre-dominantely affects sensory neurons.
  - Pins and needle sensation.
  - Ants crawling like sensation.
- Autonomic dysregulation.
- Regional anaesthesia not contraindicated but pre-existing neurological abnormality should be documented.

Cardiovascular system :

- Cardiotoxicity → mechanism is not understood.
- most accepted : Chemotherapy → Damage myocytes → Limited repair.

Plethora of symptoms :

- LV dysfunction.
- Arrhythymias.
- Heart failure (HF).
- myocardial ischemia.

Drugs implicated (CATAPAA) :

- Cytotoxic antibiotics.
- Arsenic Trioxide.
- Taxanes.
- Anthracyclines.
- Platinum compounds.
- Alkylating agents.
- Antimetabolites.

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Drug class	Effect on CVS
Cytotoxic antibiotics (Pneumonic : C8M) Bleomycin/mitomycin	Cardiomyopathy
Arsenic trioxide	QT prolongation
Taxanes (Docetaxel, Paclitaxel)	Ventricular arrhythmias Bradycardia AV Blocks
Antimetabolites : Gemcitabine, Capecitabine, 5- Fluorouracil, Tioguanine, Fluoropyrimidines	Myocardial Ischemia Heart failure Atrial Fibrillation
Platinum Compounds : Carboplatin, Cisplatin, Oxaliplatin	Heart failure Atrial fibrillation (12-32% Cisplatin) Torsades de pointes (Cisplatin causes hypomagnesimia)
Anthracyclines : major group Irreversible cardiotoxicity, with incidence of 9-18%	ECG changes (Early signs) Nonspecific ST and T wave changes Decreased QRS voltage Prolongation of QT interval Supraventricular arrhythmias (Atrial Fib : 2-10%) Transient LV dysfunction Late → Decline in LVEF : Dilated cardiomyopathy
Alkylating agents : Cyclophosphamide, Ifosfamide, Melphalan, Treosulphan, Mitomycin C, Busulfan	Myocardial Ischemia Heart failure Atrial Fibrillation

Respiratory system :

Many CT agents :

- Bleomycin (m/c known, used for testicular tumours).
- Alkylating agents.
- Antimetabolites.
- Mitomycin C.
- Gemcitabine.
- Paclitaxel/Docetaxel.

Bleomycin induced pulmonary toxicity :

- m/c known pulmonary toxicity.
- Interstitial pulmonary fibrosis (ITP).
- If given concentration >400 IU/m^2.
- Incidence : 5-16%.
- Life threatening.
- Lung injury within 6m.
- Lung injury progress to chronic pulmonary toxicity → ILD.
- Fractional inspired O2 concentration (FiO2) kept to maintain SPO2 at 88-92%.
- Symptoms :
  - Dry cough.
  - Rhales on auscultation.
- Later stages → ILD (Restrictive lung disease).

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Drug class	Pulmonary toxicity
Alkyating agents (Especially mitomycin C)	• ARDS • Bronchospasm • Intersitial pneumonitis • Diffuse Alveolar haemorrhage (DAH)
Antimetabolites	• Interstitial pneumonitis • DAH • Capillary leak syndrome • Pleural effusion
Platinum compounds (Carboplatin, Cisplatin & Oxaliplatin)	Interstitial pneumonitis
Gemcitabine	• DAH • Interstitial pneumonitis • Capillary leak syndrome • Non cardiogenic PE • Pleural effusion
Taxanes (Pacilataxel, Docetaxel)	• Interstitial pneumonitis • Capillary leak syndrome • Pulmonary toxicity occurs in days to weeks

CT induced pulmonary toxicity :

- Course of pulmonary toxicity → weeks to months.
- Symptoms
  - Cough, dyspnoea, low grade fever.
  - Bibasal crackles.
- Investigations
  - CXR : U/L or B/L reticular markings.
  - ↓ DLCO.
  - Spirometry : ↓ TLC and FVC.

Renal system :

- CT agents are renally excreted.
  - Alkylating agents, antimetabolites, platins.
- Chemotherapy induced acute kidney injury (AKI).
  - AKI : Presents as proximal tubular injury.
  - Proteinuria.
  - Phosphate wasting.
  - Fanconi syndrome : Hypophosphataemia, hypokalemia, glycosuria, proteinuria (HHGP).
  - Magnesium wasting.

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Cisplatin induced renal toxicity :

- Cisplatin : Notorious due to AKI.
- In HIPEC surgeries : U/O monitored carefully.
  - ↓GFR and deranged RFT.
  - ↓ Sr magnesium (Due to ↑ magnesium wasting)/potassium/calcium.
- Dose related toxicity.
- Reversible.
- Watch for signs and symptoms of hypomagnesemia.

CT induced renal toxicity :

- Ifosfamide (Alkylating agent) :
  - Proximal tubular injury.
  - Fanconi syndrome.
  - Nephrogenic diabetes insipidus .
- methotrexate : Intratubular precipitation of oxalate crystals.
- mitomycin C : microangiopathic hemolytic anaemia and renal failure.

Hepatic system :

- CT agents are metabolised in liver.
- Risk : ↑ pre-existing liver dysfunction.
- Clinically :
  - Usually, asymptomatic.
  - Only increase in liver enzymes.
  - Inflammatory hepatitis.
  - Cholestasis.
  - Steatosis.
  - End stage liver disease.

Drug class	Pulmonary toxicity
Alkylating agents/platinum compounds	• Hepatic Sinusoidal injury • Sinusoidal obstruction syndrome • Centrilobular hepatocyte necrosis
Antimetabolites	Steatosis : Increased risk of intraoperative blood loss and postoperative complications
Topoisomerase (Irinotecan, topotecan)	• Increase in enzymes (Transaminases) • Steatosis • Critical Hepatocellular injury
Vinca alkaloids (Vincristine)	Transient increase in transaminases

Grading of severity : WHO/ National cancer institute grading of severity for CT induced liver toxicity.

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Haematological system :

- Alkylating agents.
- Anthracyclines.
- Antimetabolites.
- Arsenic trioxide.
- Cytotoxic antibodies.
- Platinum compounds.
- Vinca alkaloids.

Clinical features :

- Bone marrow suppression.
- Increased risk of thrombosis.

Immune response and CT :

- Affects innate & acquired immune system.
- Innate immunity : myelosuppression → CT induced neutropenia (CIN).
  - Febrile (>38.5°C in 2 occasions) neutropenia on two occasions.
- Seen in 50% of solid tumours.
  - In haematological malignancies seen in 80% of cases.

Pancytopenia :

- ↓ Erythrocytes, leukocytes, & platelets.
- Perioperative period → Haemorrhage → ↓ O2 carrying capacity → Complicated by pre-existing anaemia.
- WBC (ANC) : Infection rates ↑ if ANC <500.
- BM recovery : Take upto 6 weeks.

Adaptive immune system (Immunosuppression) :

- Lymphopenia.
- Depends on the CT agent used, and malignancy type.
- Alkylating agents/Protein Kinase Inhibitors : Impaired function of peripheral "T" cells.
- Platinum compounds : Enhance "T" cell activation by dendritic cells.

CT and thrombosis :

- Seen in cancer and neo-adjuvant CT (NACT).
- Both conditions
  - ↑ Inflammatory response (↓ Antithrombin, protein C).
  - ↑ Procoagulant response (↑ TF expression).
  - ↑ Antifibrinolytic response.
  - ↑ Pro-aggregative response.

- Increased risk of thrombosis that persists upto 6 months.
- Extended thromoprophylaxis for 4 weeks after surgery is required.
- There is increased perioperative risk of thrombosis.
- Patients can be on anticoagulants.
- Timing of neuraxial block : ASRA guidelines.

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Immunotherapy 00:34:13

Overview :

- Cancer immunotherapies :
  - Manipulate host's immune system.
  - Reactivate the antitumor immune response.
- Different immunotherapies :
  - Interferon.
  - Immune checkpoint inhibitors (ICIs).
  - Chimeric antigen receptor T cells.

Toxicity of immunotherapy :

Immunotherapy (Toxicity) :

- Endocrine.
- Cardiac.
- Pulmonary.
- Hepatic.
- Miscellaneous S/E : Fever, fatigue, nausea, diarrhoea, thrombocytopenia and leukopenia.

Immune checkpoint inhibitors (ICIs) :

Endocrinopathies :

- Hypophysitis (Inflamed pituitary gland).
- Hypothyroidism/hyperthyroidism.
- Adrenal insufficiency.
- Hypongonadism.
- Diabetes insipidus.
- Insulin dependent diabetes mellitus (IDDM).

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Cardiac toxicity of immunotherapy :

- Cardiac toxicity (Overall < 1%).
- Myocarditis most common (1.14%).
  - ↑ Ipilimumab + Nivolumab (0.27%).
  - Nivolumab alone : 0.06%.
  - Median onset time : 17 days.
- Grade : 1 (Asymptomatic).
- Grade 2 : Mild.
- Grade 3 : Completely symptomatic.

Symptoms and signs :

- Fatigue.
- Dyspnoea.
- Chest pain.

Management :

- Investigations : Raised BNP, troponin, ECG abnormalities.
- Treatment :
  - High dose glucocorticoids.
  - Alternatively immunosuppressants.

Other effects :

- Cardiac fibrosis.
- Pericarditis.
- Arrhythymias.
- Heart failure.
- Cardiomyopathy.

Pulmonary toxicity of immunotherapy :

- Pneumonitis (most common) :
  - PD-1 inhibitors : Incidence is 3-7%.
  - PDL1 : Incidence is 1.3%.
  - Life threatening.
- Symptoms of pneumonitis : Non specific symptoms.
  - Cough.
  - Chest pain.
  - Wheezing.
  - SOB.
  - Respiratory failure/hypoxemia.
- CT : Ground glass opacities with peripheral consolidations.

Gastrointestinal toxicity of immunotherapy :

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- Most common S/E.
  - Diarrhoea.
  - Gastritis.
  - Enterocolitis (most common).
- Incidence is 20-30%.

Hepatitis (5-10%) :

- Anti PD 1, hepatitis (5%).
- Ipilimumab + Nivolumab : 30%.
- Screening for immune hepatitis to be done before starting of therapy.
- Grade 2 hepatitis : AST/ALT > 5x.

Monoclonal antibodies

00:41:22

Drugs :

Drug class (monoclonal antibodies)	Indication
Transtuzumab (Her2/neu inhibitor)	Breast cancer
Bevacizumab (VEGF- inhibitor)	Colorectal cancer (High chance for thrombosis)
Imatinib	GIST
Panitumumab	Colorectal cancer
Sorafenib (multikinase inhibitors)	Renal cell carcinoma
Sunitinib	Renal cell carcinoma

- Sorefenib and Sunitinib induced hypertension are usually not controlled with conventional antihypertensives.

Systemic effects of monoclonal antibodies :

Drug class	Toxicity
Sorafenib	Rash, diarrhoea, hand and foot syndrome
Sunitinib	Fatigue, nausea, diarrhoea, hypertension, myelosuppression, Hand and foot syndrome
Transtuzumab	Cardiac dysfunction, decrease in LVEF
Bevacizumab	Hypertension, proteinuria, bleeding, poor wound healing, visceral perforation
Imatinib	Fluid retention

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Drug class	Hepatic system effects
HER – 2 inhibitors : Transtuzumab, Lapatinib	• Elevated LFTs • Sinusoidal obstruction syndrome, hepatitis
Small molecule TKIs & VEGF inhibitors : • Imatinib • Vemurafenib • Erlotinib • Geftinib • Crizotinib • Sorafenib	• Elevated LFT's • Hepatitis • Cholestatic Hepatitis • Granulomatous Hepatitis • Hepatocellular liver injury • Acute liver failure
Check –point inhibitors • Nivolumab • Pembrolizumab • Atezolizumab • Darvalumab	• Elevated LFTS • Hepatitis • Cholestatic Liver injury • Hepatocellular Liver injury

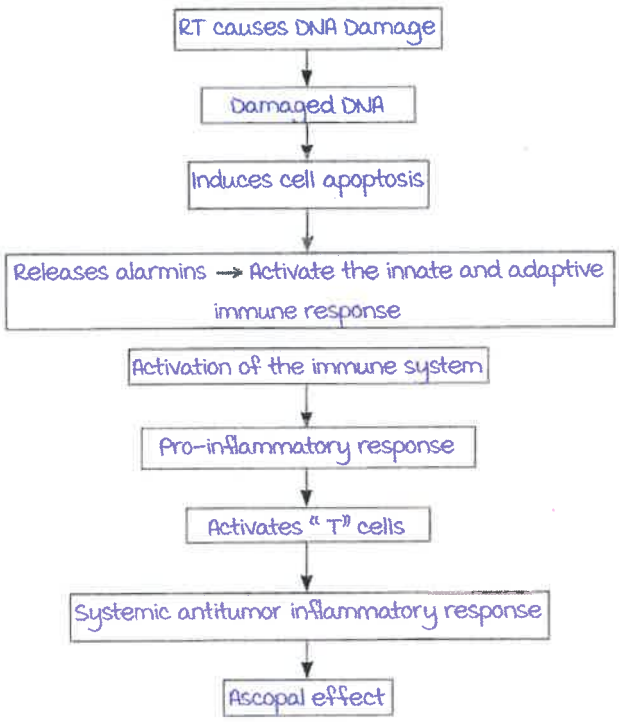
Radiotherapy 00:46:08

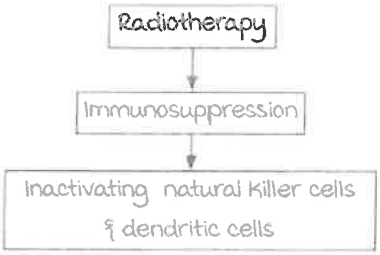
Overview :

Affects the following systems :

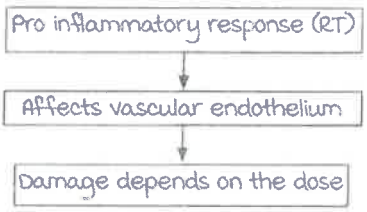
1. Immune system.
2. Cardiovascular.
3. Pulmonary.
4. Head and neck.
5. Skin.
6. Mucosa.

Effect of RT on immune system :





RT induced vascular thrombosis :



- Mild dose (5-10 Gy per fraction) → Damage is mild.
- Doses > 10 Gy → more damage → ↑ Vascular permeability.
- Can lead to thrombosis.

Cardiac toxicity of RT :

- Thoracic RT (Hodgkin's lymphoma, CA breast).
- Cardiac toxicity : Endothelial damage + Oxidative stress + Inflammation + DNA damage.

Effects :

Can damage any cardiac component : Pericardium/myocardium/heart valves/ conduction system/coronary arteries.

- Pericardium :
  a. Exudative pericarditis.
     - Develops early.
     - Can cause hemodynamic instability.
     - Self limiting.
  b. Pericardial effusion.
- Conduction abnormalities :
  - Early complication.
  - Self limiting within 12 months.
  - AV block/ QTc prolongation.
  - Supraventricular arrhythmia /VT.
- Late complication : CAD.
- Restrictive cardiomyopathy due to fibrosis.

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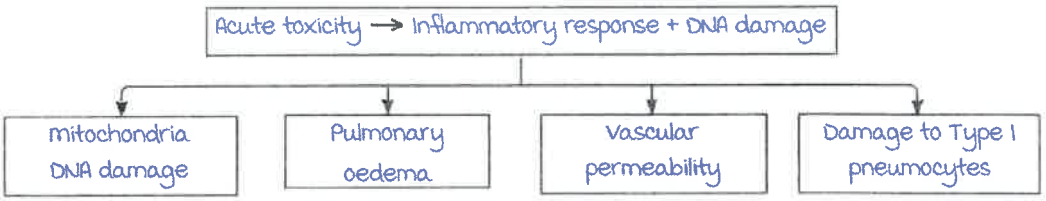
Pulmonary toxicity of RT :

- Lung injury is in three phases.
  a. Acute.
  b. Subacute.
  c. Late.
- Acute → Hours/ days.



Acute → Chronic (2-6m post RT) → Pneumonitis.

Risk factors :

- Mean lung dose.
- Proportion of lung dose > 20 Gy.
- Underlying comorbidities.

Findings :

- CT scan : Asymptomatic ↑ density of tissues.
- Clinically : Suggestive of sterile pneumonitis.
  - Low grade fever.
  - Dyspnoea.
  - Non-productive cough.

Management :

- Severe symptoms are to be managed with steroids.
- Sx is done in subacute phase .
  - Not at ↑ risk of PPCs.

Late pulmonary toxicity :

- Occurs 9-12 months.
- Irreversible re-modeling of lung parenchyma.
- Increased stiffness.
- Fibrosis and thickening.

RT of Head & Neck :

Most important concern as it anticipated difficult airway.

Effects :

- Acute phase :
  - Mucositis/fistulae.
  - Osteonecrosis.
  - Lack of dentition.
- Later :
  - Fibrosis of neck → ↓ Neck extension.
  - Floor of mouth/facial muscles.
  - TMJ fibrosis → Trismus.
- Glottic/ epiglottic edema.
- Swollen oral mucosa.
- Glossomegaly.

} Difficult BMV

} Limited MO

} Difficult laryngoscopy and intubation

- Fibrosis & oedema → Suprahyoid region → Limited neck mobility.
- Mobility of larynx compromised externally.
- Oral mucositis : Bleeds on DL scopy.
- RT administered to neck → Thyroid abnormalities.
  - Hypothyroidism should be ruled out pre-operatively.

External beam radiation therapy (EBRT) :

- Given preoperatively in carcinoma rectum/cervix.
- Peri-operative concerns :
  - Tissues adherent/ tissue fibrosis/obstructed lymphatics.
  - ↑Blood loss.
  - ↑Surgical duration.
  - ↑Surgical stress.

Anaesthetic implications 00:56:32

Considerations :

Organ system	Preoperative considerations	Intraoperative considerations
Cardiac	• 12 lead ECG • QT interval • 2D ECHO • Lab tests : – Plasma troponin – NT-pro BNP	• Invasive monitoring as per patient's status • 5 lead ECG is to be taken • Stress dose glucocorticoids as needed • Avoid QT prolonging drugs (Ketamine, Etomidate, Isoflurane, sevoflurane, desflurane, succinylcholine, 5HT3 antagonists, Antidepressants, β-blockers, antifungals) LA (Toxic dose) • Avoid hypothermia • Fluid management

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Organ system	Preoperative considerations	Intraoperative Considerations
Pulmonary	• Room air SpO_a • CXR • BHT • PFT • DLCO • CT scan	• Prehabilitation • Lung protective ventilation : VT of 6ml/Kg, airway pressures< 30cmH2O) • Stress dose glucocorticoids as needed • Patients treated with Bleomycin : FiO2 to maintain SpO2 88-92% • Analgesia • Avoid fluid overload
Hepatic	• Lab test • Hepatic transaminases • INR	• Avoid hepatotoxic drugs
Renal	• Labs – Urea/Cr • GFR	• Fluid management • Electrolyte correction (Mg^{2+}, K^+, $Ca2+$) • Avoid nephrotoxic drugs
Endocrinopathy (Immunotherapy)	• TSH , Free T4 • HbAIC, ACTH, cortisol, electrolytes • Cardiac troponins at 6 weeks after treatment	• Stress dose steroids • Balanced fluid management • Electrolyte monitoring • Interaction with antidepressants & antiemetics
Central and peripheral neuropathy	• Detailed assessment and documentation of any baseline neurological deficit	• Autonomic neuropathy : Abnormal hemodynamic response to laryngoscopy & intubation, surgical stress and blood loss • Aspiration prophylaxis and RSI
Haematopoetic System	• Rule out Pancytopenia	• Increased risk of postoperative infections with low TLC / ANC count • Proceed surgery if thrombocytopenia is : – Gen surgery : > 50,000 – Closed cavity Sx : > 1,00,000 – RA > 75000-80,000
Head and neck RT	• Assessment and Counselling for DA	• Difficult airway management • Consider VI scope/Awake FOB

Time to surgery after these therapies :

- Time to surgery (TTS) after neoadjuvant therapy.
- Weeks : Cytotoxic effects to recover.
  - Optimally 4-6 weeks.
- This window allows for prehabilitation.