Crown to Cortex

Pharmacology

Cytotoxic Drugs

The Unhackables Medical

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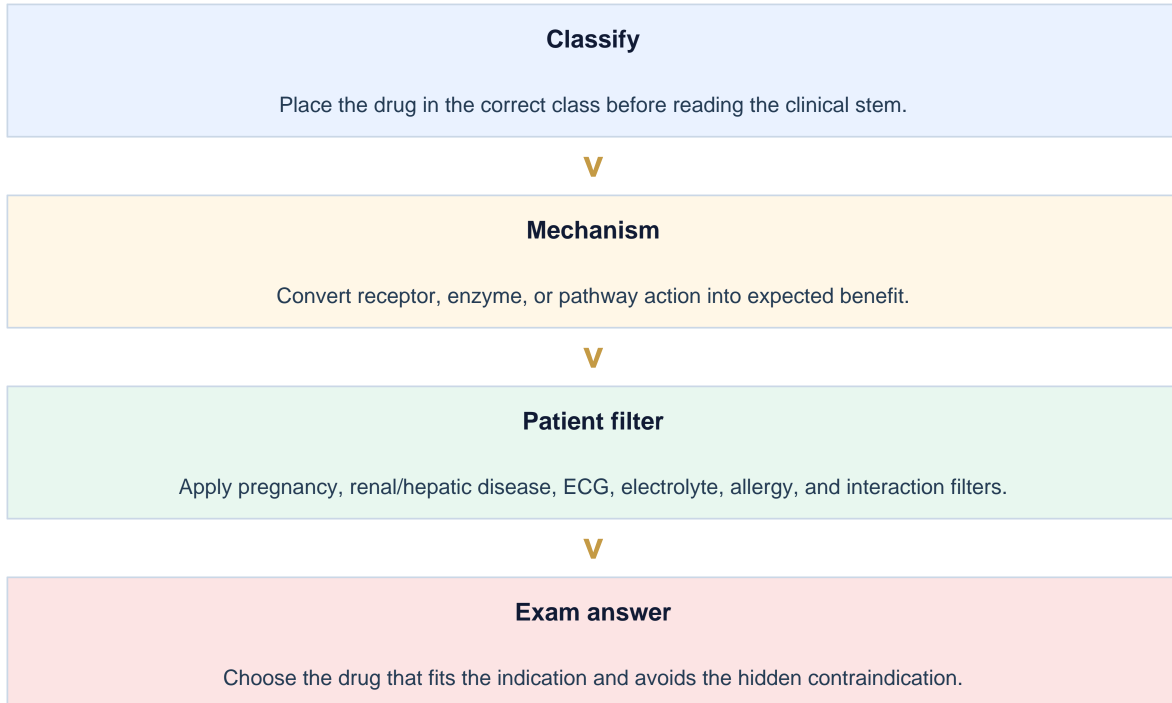
How to read this topic

Cytotoxic Drugs is a high-yield Pharmacology topic for NEET PG and INI-CET. The safest preparation approach is to organize it by mechanism, classification, prototype drugs, indications, adverse effects, contraindications, interactions, and emergency use. This PDF is designed as a compact final-revision note, not a textbook chapter.



Classification map

Class / axis	High-yield details
Alkylators	cyclophosphamide, ifosfamide, busulfan, nitrosoureas, platinum drugs
Antimetabolites	methotrexate, 5-FU, cytarabine, gemcitabine, 6-MP
Microtubule drugs	vinca alkaloids, taxanes
Topoisomerase inhibitors	etoposide, irinotecan, topotecan
Antitumor antibiotics	doxorubicin, bleomycin, actinomycin D

Prototype drug map

Prototype	What to remember
Cyclophosphamide	hemorrhagic cystitis prevented by mesna
Methotrexate	folate antagonist; leucovorin rescue
5-FU	thymidylate synthase inhibition; hand-foot syndrome
Vincristine	neurotoxicity, constipation
Doxorubicin	cardiomyopathy prevented partly by dexrazoxane
Bleomycin	pulmonary fibrosis

Mechanism to clinical use

1. Alkylators

Mechanism anchor: cyclophosphamide, ifosfamide, busulfan, nitrosoureas, platinum drugs. In NEET PG style questions, this becomes important when the stem asks for drug choice, mechanism of toxicity, resistance, organ-specific effect, or a contraindication. Always connect the class to the expected physiological change rather than memorizing the name alone.

Clinical conversion: ask whether the desired effect is immediate symptom relief, disease modification, prophylaxis, reversal of toxicity, or long-term prevention. The same class can be correct or wrong depending on timing, route, patient risk, and monitoring feasibility.

2. Antimetabolites

Mechanism anchor: methotrexate, 5-FU, cytarabine, gemcitabine, 6-MP. In NEET PG style questions, this becomes important when the stem asks for drug choice, mechanism of toxicity, resistance, organ-specific effect, or a contraindication. Always connect the class to the expected physiological change rather than memorizing the name alone.

Clinical conversion: ask whether the desired effect is immediate symptom relief, disease modification, prophylaxis, reversal of toxicity, or long-term prevention. The same class can be correct or wrong depending on timing, route, patient risk, and monitoring feasibility.

3. Microtubule drugs

Mechanism anchor: vinca alkaloids, taxanes. In NEET PG style questions, this becomes important when the stem asks for drug choice, mechanism of toxicity, resistance, organ-specific effect, or a contraindication. Always connect the class to the expected physiological change rather than memorizing the name alone.

Clinical conversion: ask whether the desired effect is immediate symptom relief, disease modification, prophylaxis, reversal of toxicity, or long-term prevention. The same class can be correct or wrong depending on timing, route, patient risk, and monitoring feasibility.

4. Topoisomerase inhibitors

Mechanism anchor: etoposide, irinotecan, topotecan. In NEET PG style questions, this becomes important when the stem asks for drug choice, mechanism of toxicity, resistance, organ-specific effect, or a contraindication. Always connect the class to the expected physiological change rather than memorizing the name alone.

Clinical conversion: ask whether the desired effect is immediate symptom relief, disease modification, prophylaxis, reversal of toxicity, or long-term prevention. The same class can be correct or wrong depending on timing, route, patient risk, and monitoring feasibility.

5. Antitumor antibiotics

Mechanism anchor: doxorubicin, bleomycin, actinomycin D. In NEET PG style questions, this becomes important when the stem asks for drug choice, mechanism of toxicity, resistance, organ-specific effect, or a contraindication. Always connect the class to the expected physiological change rather than memorizing the name alone.

Clinical conversion: ask whether the desired effect is immediate symptom relief, disease modification, prophylaxis, reversal of toxicity, or long-term prevention. The same class can be correct or wrong depending on timing, route, patient risk, and monitoring feasibility.

Drug signatures

Drug / class	Mechanism cue	Use cue	Toxicity cue
Cyclophosphamide	hemorrhagic cystitis prevented by mesna	Know preferred indication	Know signature adverse effect
Methotrexate	folate antagonist	Know preferred indication	Know signature adverse effect
5-FU	thymidylate synthase inhibition	Know preferred indication	Know signature adverse effect
Vincristine	neurotoxicity, constipation	Know preferred indication	Know signature adverse effect
Doxorubicin	cardiomyopathy prevented partly by dexrazoxane	Know preferred indication	Know signature adverse effect
Bleomycin	pulmonary fibrosis	Know preferred indication	Know signature adverse effect

Clinical edges

- Cell-cycle specificity: antimetabolites S phase; vinca/taxanes M phase; alkylators nonspecific
- Toxicity pattern: myelosuppression, mucositis, alopecia, infertility, secondary malignancy
- Extravasation: vesicant injury needs urgent local protocol
- Tumor lysis: hydration, allopurinol or rasburicase
- For Cytotoxic Drugs, start every clinical question by identifying the syndrome, patient risk factors, organ function, pregnancy status, and interacting drugs.
- Prototype drugs are more important than long drug lists; know one clean example for each mechanism.
- Adverse-effect signatures often identify the drug even when the stem hides the class name.
- When two drugs look similar, compare onset, route, elimination, monitoring, and toxicity.

Adverse effects and contraindication logic

Cyclophosphamide

Expected exam cue: hemorrhagic cystitis prevented by mesna. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

Methotrexate

Expected exam cue: folate antagonist; leucovorin rescue. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

5-FU

Expected exam cue: thymidylate synthase inhibition; hand-foot syndrome. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

Vincristine

Expected exam cue: neurotoxicity, constipation. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

Doxorubicin

Expected exam cue: cardiomyopathy prevented partly by dexrazoxane. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

Bleomycin

Expected exam cue: pulmonary fibrosis. When this drug or class appears in a clinical vignette, actively look for allergy, pregnancy risk, renal or hepatic impairment, ECG abnormality, electrolyte disturbance, bleeding risk, respiratory disease, CNS depression, or interacting medicines.

How to eliminate options: reject drugs that worsen the dominant clinical danger in the stem, even if their mechanism seems suitable. This is especially important in pharmacology questions where the wrong option is often a contraindicated first-line drug.

Exam traps

- Do not choose a drug only because it belongs to the right class; contraindications can reverse the answer.
- Do not ignore renal or hepatic impairment in dosing questions.
- Drug interactions are commonly tested through enzyme induction, enzyme inhibition, additive toxicity, or pharmacodynamic opposition.
- Emergency therapy depends on speed and route, not only mechanism.
- In Cytotoxic Drugs, do not memorize a class without its route, onset, elimination, and monitoring.
- Toxicity questions often hide the drug name and reveal the answer through one adverse-effect signature.
- Contraindications are tested more often than rare mechanisms.
- A drug can be first-line in one patient and dangerous in another.

Last-day revision grid

Question	Answer to recall quickly
Best prototype?	Cyclophosphamide, Methotrexate, 5-FU, Vincristine
Most tested danger?	toxicity, contraindication, interaction, and monitoring
Emergency angle?	route, onset, antidote, supportive care
Do-not-miss filter?	pregnancy, renal/hepatic failure, ECG/electrolytes, bleeding or respiratory risk

High-yield definitions

Term	Definition / exam meaning
Alkylators	cyclophosphamide, ifosfamide, busulfan, nitrosoureas, platinum drugs
Antimetabolites	methotrexate, 5-FU, cytarabine, gemcitabine, 6-MP
Microtubule drugs	vinca alkaloids, taxanes
Topoisomerase inhibitors	etoposide, irinotecan, topotecan
Antitumor antibiotics	doxorubicin, bleomycin, actinomycin D
Cyclophosphamide	hemorrhagic cystitis prevented by mesna
Methotrexate	folate antagonist; leucovorin rescue
5-FU	thymidylate synthase inhibition; hand-foot syndrome
Vincristine	neurotoxicity, constipation
Doxorubicin	cardiomyopathy prevented partly by dexrazoxane
Bleomycin	pulmonary fibrosis

How this helps in Cytotoxic Drugs: this page is meant to convert memorized pharmacology into option elimination. Read the left column first, then force yourself to say the mechanism, clinical use, toxicity, and reason another option is wrong.

Drug-by-drug comparison

Comparison	How to separate them in an exam stem	Most useful discriminator
Cyclophosphamide vs Methotrexate	Cyclophosphamide is recalled by: hemorrhagic cystitis prevented by mesna. Methotrexate is recalled by: folate antagonist; leucovorin rescue.	Indication, toxicity pattern, route/onset, or contraindication hidden in the stem.
5-FU vs Vincristine	5-FU is recalled by: thymidylate synthase inhibition; hand-foot syndrome. Vincristine is recalled by: neurotoxicity, constipation.	Indication, toxicity pattern, route/onset, or contraindication hidden in the stem.
Doxorubicin vs Bleomycin	Doxorubicin is recalled by: cardiomyopathy prevented partly by dexrazoxane. Bleomycin is recalled by: pulmonary fibrosis.	Indication, toxicity pattern, route/onset, or contraindication hidden in the stem.

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Toxicity signatures

Drug / class	Toxicity pattern to actively search for	Immediate exam response
Cyclophosphamide	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: hemorrhagic cystitis prevented by mesna	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
Methotrexate	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: folate antagonist; leucovorin rescue	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
5-FU	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: thymidylate synthase inhibition; hand-foot syndrome	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
Vincristine	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: neurotoxicity, constipation	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
Doxorubicin	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: cardiomyopathy prevented partly by dexrazoxane	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
Bleomycin	Link the prototype clue to organ toxicity, laboratory change, ECG change, bleeding, CNS depression, allergy, or pregnancy risk. Cue: pulmonary fibrosis	Stop/avoid the drug if the stem contains the danger sign; choose antidote or safer alternative when asked.
Cytotoxic Drugs	Any severe allergy, organ failure, pregnancy risk, or dangerous interaction can override first-line status.	Do not pick a drug only because it is famous.

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Contraindication filters

Clinical filter	What it changes	Exam habit
Pregnancy/lactation	Avoid teratogenic, fetal-toxic, or neonatal-toxic drugs; prefer established safer options.	Always scan age/sex/history lines.
Renal impairment	Accumulation increases toxicity for renally cleared drugs; dose interval may need extension.	Look for creatinine, oliguria, CKD, elderly patient.
Hepatic disease	Reduced metabolism, low albumin, and bleeding risk can change drug choice.	Check jaundice, cirrhosis, INR, albumin.
ECG/electrolytes	QT prolongation, heart block, hypokalemia, and hyperkalemia decide many answers.	Never ignore ECG and potassium.
Respiratory disease	Bronchospasm or respiratory depression risk can make a familiar drug unsafe.	Asthma/COPD/sleep apnea are not decorative details.
Bleeding risk	Antiplatelets, anticoagulants, thrombolytics, NSAIDs, and marrow-toxic drugs need caution.	Check ulcer, surgery, stroke, platelets, INR.
Cyclophosphamide	hemorrhagic cystitis prevented by mesna	Ask: where is this drug dangerous?
Methotrexate	folate antagonist; leucovorin rescue	Ask: where is this drug dangerous?
5-FU	thymidylate synthase inhibition; hand-foot syndrome	Ask: where is this drug dangerous?

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Drug interaction map

Interaction type	Mechanism	Common exam expression
CYP induction	Increases metabolism of substrate drugs and can cause treatment failure.	Rifampicin/carbamazepine/phenytoin reducing OCP, warfarin, antiretroviral, or steroid effect.
CYP inhibition	Raises substrate levels and toxicity.	Macrolide/azole/ritonavir/cimetidine/grapefruit toxicity stem.
Additive toxicity	Two drugs injure the same organ or pathway.	QT plus QT, bleeding plus bleeding, nephrotoxic plus nephrotoxic, CNS depressant plus CNS depressant.
Pharmacodynamic opposition	One drug blocks the desired effect of another.	NSAID reducing antihypertensive effect; beta blocker opposing beta agonist.
Cyclophosphamide	hemorrhagic cystitis prevented by mesna	Check whether the vignette adds another drug that amplifies toxicity or reduces benefit.
Methotrexate	folate antagonist; leucovorin rescue	Check whether the vignette adds another drug that amplifies toxicity or reduces benefit.
5-FU	thymidylate synthase inhibition; hand-foot syndrome	Check whether the vignette adds another drug that amplifies toxicity or reduces benefit.
Vincristine	neurotoxicity, constipation	Check whether the vignette adds another drug that amplifies toxicity or reduces benefit.

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Monitoring and dose adjustment

Monitoring target	Why it matters	What to remember
Clinical endpoint	Symptom relief or prevention outcome confirms benefit.	Pain, BP, seizure control, infection response, glucose, dyspnea, psychosis, bleeding.
Laboratory endpoint	Detects efficacy and silent toxicity.	Renal function, liver enzymes, CBC, electrolytes, coagulation, glucose, drug levels.
ECG	Many drugs alter conduction, QT, or rhythm.	QT prolongation, AV block, QRS widening, torsades risk.
Therapeutic drug monitoring	Needed when therapeutic window is narrow.	Lithium, digoxin, phenytoin, valproate, aminoglycosides, vancomycin, tacrolimus.
Cyclophosphamide	Monitoring depends on the toxicity implied by its mechanism and elimination.	hemorrhagic cystitis prevented by mesna
Methotrexate	Monitoring depends on the toxicity implied by its mechanism and elimination.	folate antagonist; leucovorin rescue
5-FU	Monitoring depends on the toxicity implied by its mechanism and elimination.	thymidylate synthase inhibition; hand-foot syndrome

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Emergency decision table

Emergency scenario	First pharmacology decision	Common mistake
Shock/anaphylaxis/severe acute state	Choose route and onset before elegance of mechanism.	Choosing an oral chronic drug for an emergency.
Poisoning/toxicity	Stabilize airway, breathing, circulation, then antidote if indicated.	Giving antidote while ignoring supportive care.
Severe infection or organ-threatening disease	Start rational empirical therapy promptly, then narrow when data arrives.	Waiting for perfect information in an unstable patient.
Withdrawal or rebound	Recognize dependence physiology and taper/replace appropriately.	Abruptly stopping clonidine, beta blockers, steroids, opioids, alcohol, or benzodiazepines.
Cytotoxic Drugs: Cyclophosphamide	hemorrhagic cystitis prevented by mesna	Wrong route, delayed onset, or ignored contraindication.
Cytotoxic Drugs: Methotrexate	folate antagonist; leucovorin rescue	Wrong route, delayed onset, or ignored contraindication.
Cytotoxic Drugs: 5-FU	thymidylate synthase inhibition; hand-foot syndrome	Wrong route, delayed onset, or ignored contraindication.
Cytotoxic Drugs: Vincristine	neurotoxicity, constipation	Wrong route, delayed onset, or ignored contraindication.

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INI-CET stem decoding

Stem clue	What it is trying to test	Answer strategy
Age, pregnancy, renal/liver disease	Safety filter rather than diagnosis.	Eliminate unsafe drugs first.
New symptom after drug start	Adverse-effect signature.	Name the drug from toxicity.
Drug added recently	Interaction question.	Check CYP, QT, bleeding, CNS depression, nephrotoxicity.
Emergency wording	Route/onset question.	Prefer fast, titratable, evidence-based acute therapy.
Chronic prevention wording	Outcome benefit question.	Prefer disease-modifying therapy over only symptomatic relief.
Alkylators	cyclophosphamide, ifosfamide, busulfan, nitrosoureas, platinum drugs	Place this under Cytotoxic Drugs, then compare with nearby alternatives.
Antimetabolites	methotrexate, 5-FU, cytarabine, gemcitabine, 6-MP	Place this under Cytotoxic Drugs, then compare with nearby alternatives.
Microtubule drugs	vinca alkaloids, taxanes	Place this under Cytotoxic Drugs, then compare with nearby alternatives.
Topoisomerase inhibitors	etoposide, irinotecan, topotecan	Place this under Cytotoxic Drugs, then compare with nearby alternatives.

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Rapid pathway

Read the stem

Disease, severity, age, pregnancy, organ function, emergency status.

Name the class

Mechanism and prototype before option elimination.

Apply exclusions

Contraindications, interactions, and toxicity signatures.

Pick final answer

Most specific safe drug for that exact stem.