cycloPHOSphamide (IV) Methotrexate and 5-Fluorouracil (CMF) 21 Day Therapy

INDICATIONS FOR USE:

INDICATION	ICD10	Regimen Code	HSE approved reimbursement status*
Adjuvant treatment for breast carcinoma in patients who are considered unsuitable for anthracycline therapy	C50	00381a	N/A
Metastatic breast carcinoma	C50	00381b	N/A

*This applies to post 2012 indications only

TREATMENT:

The starting dose of the drugs detailed below may be adjusted downward by the prescribing clinician, using their independent medical judgement, to consider each patients individual clinical circumstances.

cycloPHOSphamide, methotrexate and 5-Fluorouracil are administered on day 1 of a 21-day cycle.

Adjuvant treatment: Treatment is administered for 8 cycles.

Metastatic: Treatment is administered until disease progression or unacceptable toxicity develops.

Facilities to treat anaphylaxis MUST be present when systemic anti-cancer therapy (SACT) is administered.

Admin. Order	Day	Drug	Dose	Route	Diluent & Rate	Cycle
1	1	5-fluorouracil[a]	600mg/m^2	IV bolus	n/a	Every 21 days
2	1	Methotrexate	40mg/m^2	IV bolus	n/a	Every 21 days
3	1	cycloPHOSphamide [b]	600mg/m^2	IV	250mL 0.9% NaCl over 30 minutes	Every 21 days
[a]See dose modifications section for patients with identified partial dihydropyrimidine dehydrogenase (DPD) deficiency						
[b]cycloPHOSphamide may also be administered as an IV bolus over 5-10 minutes						

ELIGIBILITY:

- Indications as above
- ECOG status 0-2
- Adequate haematological, renal and liver status

EXCLUSIONS:

- Hypersensitivity to cycloPHOSphamide, methotrexate, 5-Fluorouracil or any of the excipients.
- Known complete dihydropyrimidine dehydrogenase (DPD) deficiency

- Pregnancy
- Lactation

PRESCRIPTIVE AUTHORITY:

The treatment plan must be initiated by a Consultant Medical Oncologist

TESTS:

Baseline tests:

- FBC, renal and liver profile
- DPD testing prior to first treatment with 5-Fluorouracil using phenotype and/or genotype testing unless patient has been previously tested

In patients with moderate or severe renal impairment, blood uracil levels used for dihydropyrimidine dehydrogenase (DPD) phenotyping should be interpreted with caution, as impaired kidney function can lead to increased uracil blood levels. Consequently, there is an increased risk for incorrect diagnosis of DPD deficiency, which may result in under dosing of 5-Fluorouracil or other fluoropyrimidines, leading to reduced treatment efficacy. Genotype testing for DPD deficiency should be considered for patients with renal impairment.

Regular tests:

- FBC, renal and liver profile prior to each cycle

Disease monitoring:

- Disease monitoring should be in line with the patient's treatment plan and any other test/s as directed by the supervising Consultant.

DOSE MODIFICATIONS:

- Consider a reduced starting dose in patients with identified partial DPD deficiency
  - Initial dose reduction may impact the efficacy of treatment
  - In the absence of serious toxicity, subsequent doses may be increased with careful monitoring
- Any dose modification should be discussed with a Consultant

Haematological:

Table 1: Dose modification of CMF in haematological toxicity

ANC ($x10^9$/L)		Platelets ($x10^9$/L)	Recommended Dose
>1.5	or	>90	100%
1-1.49	or	70-89	75%
<1	or	<70	delay

Renal and Hepatic Impairment:

Table 2: Dose modifications in renal and hepatic impairment

Drug	Renal Impairment		Hepatic Impairment			
cycloPHOSsphamide	**CrCl (mL/min)**	**Dose**	**Severe impairment: Clinical Decision**			
	>20	100%				
	10-20	75%				
	<10	50%				
Methotrexate	**CrCl (mL/min)**	**Dose**	**Bilirubin (micromol/L)**		**AST**	**Dose**
	≥50	100%	<50	and	<180	100%
	20-50	50%	51-85	or	≥180	75%
	<20	Not recommended. If unavoidable, consider haemodialysis	>85	Contraindicated		
5-Fluorouracil	Consider dose reduction in severe renal impairment only.		**Bilirubin (micromol/L)**		**AST**	**Dose**
			<85	Or	<180	100%
			>85	or	>180	Contraindicated
			Clinical decision. Moderate hepatic impairment; reduce initial dose by 1/3. Severe hepatic impairment, reduce initial dose by 1/2. Increase dose if no toxicity.			

SUPPORTIVE CARE:

EMETOGENIC POTENTIAL:

5-Fluorouracil: Low (**Refer to local policy).**

Methotrexate: Low (**Refer to local policy).**

CycloPHOSphamide: Moderate (**Refer to local policy).**

PREMEDICATIONS:

Not usually required

OTHER SUPPORTIVE CARE:

Patients should have an increased fluid intake of 2-3 litres on day 1 and day 8 to prevent haemorrhagic cystitis associated with cycloPHOSphamide.

ADVERSE EFFECTS / REGIMEN SPECIFIC COMPLICATIONS

The adverse effects listed are not exhaustive. Please refer to the relevant Summary of Product Characteristics for full details.

- **Neutropenia**: Fever or other evidence of infection must be assessed promptly and treated appropriately.
- **Pleural effusion or ascites**: Methotrexate should be used with caution in patients with pleural effusion or ascites, as methotrexate may accumulate in third space fluid compartments.
- **DPD deficiency:** DPD is an enzyme encoded by the DPYD gene which is responsible for the breakdown of fluoropyrimidines. Patients with DPD deficiency are therefore at increased risk of fluoropyrimidine-related toxicity, including for example stomatitis, diarrhoea, mucosal inflammation, neutropenia and neurotoxicity. Treatment with 5-Fluorouracil, capecitabine or tegafur-containing medicinal products is contraindicated in patients with known complete DPD deficiency. Consider a reduced starting dose in patients with identified partial DPD deficiency. Initial dose reduction may impact the efficacy of treatment. In the absence of serious toxicity, subsequent doses may be increased with careful monitoring. Therapeutic drug monitoring (TDM) of 5-Fluorouracil may improve clinical outcomes in patients receiving continuous 5-Fluorouracil infusions.
- **Hand-foot syndrome (HFS),** also known as palmar-plantar erythrodysaesthesia (PPE) has been reported as an unusual complication of high dose bolus or protracted continuous therapy for 5-Fluorouracil.
- **Myocardial ischaemia and angina**: Cardiotoxicity is a serious complication during treatment with 5-Fluorouracil. Patients, especially those with a prior history of cardiac disease or other risk factors, treated with 5-Fluorouracil, should be carefully monitored during therapy.

DRUG INTERACTIONS:

- CYP3A inhibitors decrease the conversion of cycloPHOSphamide to both its active and inactive metabolites. Patients should also be counselled with regard to consumption of grapefruit juice.
- CYP3A inducers may also increase the conversion of cycloPHOSphamide to both its active and inactive metabolites.
- NSAIDs may decrease the clearance of methotrexate by decreasing its renal perfusion and tubular secretion thus increasing its toxicity.
- Sulphonamides and penicillins may displace bound methotrexate from plasma protein increasing serum methotrexate levels and its toxicity.
- Concomitant administration of drugs that cause folate deficiency may lead to increased methotrexate toxicity.
- Ciprofloxacin may inhibit renal tubular transport of methotrexate, increasing serum methotrexate levels and its toxicity.
- Probenecid may inhibit renal excretion of methotrexate, increasing serum methotrexate levels and its toxicity.
- 5-Fluorouracil significantly reduces the metabolism of warfarin. INR and signs of bleeding should be monitored regularly and dose of warfarin adjusted as required.
- 5-Fluorouracil is contraindicated in combination with brivudin, sorivudin and analogues as these are potent inhibitors of the 5-Fluorouracil-metabolising enzyme DPD.

- Caution should be taken when using 5-Fluorouracil in conjunction with medications which may affect DPD activity.
- Concurrent administration of 5-Fluorouracil and phenytoin may result in increased serum levels of phenytoin.
- Current drug interaction databases should be consulted for more information.

REFERENCES:

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Version	Date	Amendment	Approved By
1	01/12/2016		Prof Maccon Keane
2	26/11/2018	Updated to new NCCP template. Standardised administration of cycloPHOSphamide and dosing in renal and hepatic impairment	Prof Maccon Keane
3	27/12/2019	Updated exclusions, dose recommendation for hepatic impairment and drug interactions.	Prof Maccon Keane
4	25/08/2020	Reviewed. Updated exclusion criteria, baseline testing, dose modifications and adverse	Prof Maccon Keane

		events with respect to DPD deficiency as per DHPC from HPRA June 2020 Updated Adverse events regarding palmar-plantar erythrodysaesthesia	
5	03/11/2021	Amended renal impairment table. Updated emetogenic potential.	Prof Maccon Keane
5a	01/12/2021	Removed duplicated adverse event.	NCCP
5b	23/11/2023	Formatting changes and grammaticalcorrections.	NCCP
5c	03/03/2025	Additional wording added to baseline testing section.	NCCP

Comments and feedback welcome at oncologydrugs@cancercontrol.ie.