Symptom Care

CONTENTS

NAUSEA AND VOMITING

Introduction

In general, children tolerate chemotherapy better than adult or adolescent patients. Even the most intense and emetogenic chemotherapy regimens can be given to children with the expectation that nausea and vomiting can be controlled. It is essential to be very vigilant during chemotherapy and for 24 - 48 hours following chemotherapy to ensure that children receive adequate *prophylactic* antiemetic therapy. The onset of nausea indicates impending breakthrough vomiting and requires re-evaluation of antiemetic therapy. Minimising a child's negative experience by controlling nausea and vomiting will decrease later anxiety and improve the overall compliance with therapy. The sensitivity to nausea and vomiting is variable in children being more likely in older preadolescent children than in younger children and infants. Other influences are the child's personality, anxiety, previous experiences, tiredness, parental anxiety.

Aetiology of nausea and vomiting

Vomiting is controlled centrally by the vomiting centre located in the medullary lateral reticular formation (brain stem). The vomiting centre receives afferent input from several sources:

1. the chemoreceptor trigger zone (CTZ - located in floor of the fourth ventricle)
2. vagal and sympathetic afferents from the viscera
3. midbrain receptors of raised intracranial pressure
4. the labyrinthine apparatus (inner ear)
5. higher cortical structures such as the limbic system.

Causes of nausea and vomiting

anxiety sensory stimuli	motion sickness	Drugs, uraemia hypercalaemia	Gastrointestinal tract stimulation
⇓	⇓	⇓	⇓
cerebral cortex	vestibular apparatus	Chemoreceptor trigger zone	Vagal and sympathetic afferents
⇓	⇓	⇓	⇓
		vomiting centre	

Anticipatory nausea and vomiting

This may occur under a number of circumstances:

- older children/adolescents receiving chemotherapy particularly if they have had bad experiences before. *It is important to prescribe the appropriate intensity of antiemesis with the first course of chemotherapy.* Additional factors include prior history of motion sickness, anxiety and female sex.
- children being treated as an outpatient especially where the treatment involves invasive procedures such as intrathecal (IT) therapy . Parents may report nausea at breakfast on the morning of an outpatient visit or vomiting at the door of the clinic. Ensuring that outpatient visits and invasive procedures are done with sensitivity, in a child-friendly environment and in a timely manner will decrease the child's anxiety and improve their compliance with therapy. Behaviour and distraction therapy may be helpful.

Other causes of nausea and vomiting

There are multiple mechanisms:

- Children with advanced disease with metastases especially during palliative care. Careful evaluation of vomiting and nausea is required when a child is receiving palliative care.
- Raised intracranial pressure - it is easy to be caught out with raised ICP particularly in children with VP shunts or tumours known to metastasise to the CNS
- Gastritis – Children with brain tumours who receive dexamethasone post-operatively
- Constipation
- Capsular stretching eg. liver tumour
- Narcotic analgesia (less common in children compared with adults)

Chemotherapy induced nausea and vomiting

Chemotherapy stimulates the vomiting centre either directly or most commonly via the chemoreceptor trigger zone (in itself the CTZ has no autonomous ability to induce vomiting). There are 2 possible mechanisms of CTZ stimulation:

1. Neuronal afferents activated by chemotherapeutic agents increase neural input to the CTZ – denervation of the vagus and sympathetic afferents prevents chemo- and radiation-induced vomiting in the animal model.
2. Release of serotonin from the enterochromaffin cells in the gut is triggered by chemotherapy. Circulating levels of serotonin increase following treatment with cisplatin. The circulating serotonin acts on serotonin receptors in the CTZ stimulating activity of the vomiting centre. In particular, there are high concentrations of 5-HT_3 receptors in the region of the CTZ. There are also other receptors in the CTZ (dopaminergic and cholinergic) which appear to mediate vomiting caused by some cytotoxics eg. nitrogen mustard. Interestingly, metoclopramide (Maxalon) inhibits 5-HT_3 receptors in the CTZ and perhaps works via this mechanism rather than dopamine receptor

inhibition.

Chemotherapy-induced nausea and vomiting may be:

- Acute – during first 24 hours after administration of chemotherapy
- Delayed – occurs 24 – 120 hours after receiving chemotherapy. Common with platinum agents, and also moderately emetogenic chemotherapy (see below). It was originally felt that ondansetron was not very useful for this but there is evidence to support ondansetron and dexamethasone in this setting.

Emetogenicity of cytotoxic drugs

GROUP A: HIGH RISK OF VOMITING

90-100% risk of vomiting without antiemetic treatment:

- Cisplatin and carboplatin
- Cyclophosphamide (high dose - $\geq$ 1.5g/m^2)
- Actinomycin D
- Antracyclines (daunorubicin, doxorubicin)
- Dacarbazine [DTIC]

GROUP B: INTERMEDIATE RISK OF VOMITING

50% risk of vomiting without antiemetic treatment:

- Cyclophosphamide (<1.5g/m^2)
- Etoposide and tenoposide
- Cytarabine (doses <1g/m^2)
- High-dose methotrexate - > 0.5g/m^2

GROUP C: LOW RISK OF VOMITING

10% risk of vomiting without antiemetic treatment:

- Vincristine and vinblastine
- Bleomycin
- Methotrexate po/IT
- 6-Thioguanine and 6-Mercaptopurine
- L-asparaginase

Prevention and treatment of nausea and vomiting

Apply the algorithm below.

Serotonin antagonists (5HT$_3$ antagonists)- (if available)

- Serotonin antagonists work both centrally on the CTZ and peripherally on the vagus by blocking the 5HT$_3$ receptors.
- Minimal side effects – not associated with extrapyramidal reactions but

may cause transient headache, elevated liver function tests and constipation

- Efficacy is enhanced by dexamethasone
- Tolerance is induced if taken for a protracted period. Observe, "duration of treatment" guidelines below
- Ondansetron
    - dose 0.15 mg/kg/dose iv or po q6-8 hourly OR
    - 0.45mg/kg iv/po once daily but
    - maximum dose 8mg
    - first dose 30-60 min prior to chemotherapy
    - half life in children is shorter than in adult

Corticosteroids

- Mechanism of action is unknown but probably act by way of dopaminergic blockade
- Dexamethasone alone is only moderately effective but it potentiates the efficacy of other antiemetics – 5-HT_3 receptor antagonists and metoclopramide
- Dexamethasone iv/po dose q6-8 hrly to a maximum of 12 doses per course of chemotherapy:
    - < 3 yrs = 2mg
    - 3-5 yrs = 4mg
    - 5-10 yrs = 6 mg
    - >10 yrs = 8 mg
    - or 0.25 mg/kg/dose
- It is unlikely that short-term dosing with dexamethasone will significantly suppress the adrenal gland
- <u>Cautions</u>:

1. Dexamethasone has been shown to inhibit the efflux of chemotherapy into the brain in the animal model by "sealing" the blood-brain barrier. Therefore, avoid using dexamethasone as an antiemetic following chemotherapy in children with brain tumours
2. Often exacerbates acneform eruptions in adolescents – consider doxycycline as prophylaxis.
3. Steroids are potent inhibitors of wound healing – be cautious with their use in patients with wound breakdown
4. Dexamethasone obviously has anti-leukaemia and anti-lymphoma activity. Beware using it in a patient at particular risk of tumour lysis syndrome

Metoclopramide

Metoclopramide has both central and peripheral actions. It acts on

dopaminergic receptors in the CTZ and on peripheral vagal receptors to accelerate gastric emptying. In high dose appears to act on $5HT_3$ receptors in the CTZ

- Short half-life in children so needs to be given frequently
- There is a high risk of extrapyramidal reactions particularly oculogyric crises in children (much greater than seen in adults). Extrapyramidal reactions can be prevented by co-administration of diphenhydramine (Benadryl) and possibly scopolamine

Low dose metoclopramide**:** 0.12mg/kg/dose (max 10mg) iv/po 6 hourly

High dose metoclopramide: *Avoid use of "high dose"metoclopramide in children.*

1mg/kg iv over 60 minutes every 3 – 4 hours for a total of 5 doses PLUS

benztropine 50μg/kg (max dose 2mg)12 hourly IV given during and for 24 hours after metoclopramide therapy

Benzodiazepines

- These agents are not directly antiemetic and must always be used with other antiemetic agents
- Useful if there is an anticipatory component particularly in older children/adolescents
- Benzodiazepines are anxiolytic and induce antegrade amnesia
- Lorazepam 0.025 - 0.05mg/kg/dose q6 – 8 hrly (max dose 2 mg). Start off with a dose at the lower end of the scale to avoid hallucinations.
- May be given iv/po

Antihistamines

- Antihistamines block labarynthine impulses to the CTZ
- Cyclizine:
    - Not a very powerful antiemetic
    - Causes drowsiness which some patients dislike
    - Do not use cyclizine in children < 1 years old as it may cause untoward reactions eg. uncontrollable hypertension
    - Cyclizine may be particularly useful in vomiting induced by raised intracranial pressure
- Dose: 0.5 – 1.0 mg/kg 8 hourly intravenously or oral

Phenothiazines

Levomepromazine (Nozinan^{TM}) is a potent antiemetic that also causes central depression so it is best reserved for:

- Patients receiving palliative care (Refer Palliative Care Guideline) or
- Patients with severe refractory vomiting eg. brain tumour patients receiving cisplatin and in whom dexamethasone is contraindicated.
- Side-effects are typical of the phenothiazines – psychotic reactions, extrapyramidal effects etc. Withdraw the infusion over at least 24 hours as withdrawal symptoms may occur.
- Dose:

  Oral: 250µg-1mg/kg/dose in 3-6 divided doses daily

  Subcut or IV for chemotherapy–induced vomiting: doses as low as 5mg/day have been effective in adults. Therefore, start at 100µg/kg/day and titrate against nausea/vomiting and degree of drowsiness.

  subcut or IV for palliative care: 500µg-3mg/kg/24hr continuous infusion. Compatible with morphine.

Prochlorperazine (Stemetil™)

Preparations:

Tablets 25mg or

Injection 25mg/ml

Suppositories 5mg, 25mg

0.1-0.2mg/kg/dose (IV) q6-8h

0.1-0.4mg/kg/dose (PR/po) q6-8h

Principles of Treating Chemotherapy-induced Nausea and Vomiting

- Prophylaxis - it is necessary to block the receptors mediating the emetic stimulus before the stimulus occurs and continue the blockade for as long as the stimulus is likely to continue
- Planned approach to prophylaxis based on:
  1. Emetogenicity of chemotherapy (see algorithm below) - for combination chemotherapy, always direct antiemetic therapy against the most emetogenic component
  2. Prior experience – if the patient required a more intensive antiemetic regimen with a prior course of chemotherapy, then start off with that combination with the next course of chemotherapy
- Scheduled doses of antiemetics must be given on time regardless of whether the patient is experiencing nausea/vomiting or not
- Do not count hyperhydration as chemotherapy – calculate duration of antiemetic therapy from the time that chemotherapy itself finishes
- “Follow-up” therapy should continue based on prior experience and chemotherapy received
- Antiemetics are usually given IV when patients are receiving chemotherapy

but are equally effective by mouth

- Take preference of older child/adolescent into account – they may prefer to be nauseated rather than experience sedation due to lorazepam or cyclizine
- **Avoid dexamethasone in patients with brain tumours receiving chemotherapy**

Algorithm for Chemotherapy-induced Nausea and Vomiting

NB: always check prior drug sheets for details of previous antiemetic treatment – prescribe treatment that has worked for that particular patient in the past.

This algorithm is for chemotherapy-naïve patients or those receiving a different combination of chemotherapy from that previously administered.

Intermediate/High risk of chemotherapy-induced vomiting

prescribe ondansetron 8 hourly iv/po

⇓

breakthrough vomiting or significant nausea

add dexamethasone 8 hourly iv/po

⇓

breakthrough vomiting or significant nausea

increase frequency of ondansetron and dexamethazone to 6hrly dosing

⇓

breakthrough vomiting or significant nausea

If anticipatory/anxiety component: *add* lorazepam if available. If this fails or not available, *add* cyclizine

If no anticipatory/anxiety component: *add* cyclizine. If this fails, *add* lorazepam

If no ondansetron use Metoclopramide

Low risk of chemotherapy-induced vomiting

Try nothing initially – explain to parent/child that it is very unlikely that nausea will be experienced

⇓

breakthrough vomiting or significant nausea

Treat as for intermediate risk chemotherapy (protocol B above)

Duration of antiemetic treatment

Treat for 24 hours after completing chemotherapy. Some patients will suffer delayed symptoms – prescribe “low dose” metoclopramide for a further 48 - 96 hours in this setting

ORAL HYGIENE AND MOUTH CARE PROTOCOL

Background

The oral cavity is a frequent site of complications:

- Chemotherapy may cause mucositis (see below)
- Gingivitis or gingivostomatitis may be due to bacterial (α-haemolytic Strep, anaerobes), viral (most commonly HSV) or fungal infection (most likely candida albicans)
- Focal mucosal ulceration (usually HSV)
- Dental abscesses
- Bleeding

Rationale for mouthcare

Good mouth care is important because:

1. Infection in the oral cavity is a potential source of Gram +ve and anaerobic bacteraemia
2. Overgrowth by candida may allow the yeast to become invasive (candidaemia) which has extremely serious consequences
3. Infection in the mouth (in addition to chemotherapy-induced mucositis) produces pain, reduces oral intake and has implications for adequate nutrition

Aims of mouthcare

The aim of good mouth care is to maintain:

- the oral mucosa in a clean, moist condition
- free of infection
- teeth hygiene
- good control of pain caused by mucositis

Education of parent and child

The role of the nurse is pivotal in achieving these aims:

- implementing the guidelines
- hands-on help with mouth care if mucositis severe or patient uncooperative
- initial (*and continuing*) education of child and parents

Mucositis

This occurs following the administration of some types or combinations of chemotherapy due to interruption in the replication of mucosal epithelial cells leading to “rawing” of the oral surface.

The incidence and severity of oral mucositis is related to:

- prior oral hygiene and presence of pre-existing dental disease
- type of chemotherapy particularly:
  - anthracyclines
- dose of chemotherapy – mucositis is much more likely high-dose chemotherapy
- combination of mucositis-inducing chemotherapy eg. doxorubicin + cyclophosphamide
- schedule of chemotherapy – more likely to occur when chemotherapy “spaced out” eg. given weekly rather than a number of days in a row

Typically occurs when the patient becomes neutropenic ie. 7 – 10 days after start of chemotherapy block.

Basic Oral Hygiene

All newly diagnosed patients require a complete dental evaluation but defer any dental therapy until the neutrophil count is > 1.0 x 10^9/l unless it is very urgent.

Good basic oral hygiene is an important aspect that should not be overlooked even when the child is not eating much eg. vomiting/nauseated, drowsy.

Teeth should be cleaned twice daily (after meals, if eating) with a small-headed, soft toothbrush and mild fluoride toothpaste.

Rinse mouth with tap water following brushing and eating/drinking

The majority of children will only require basic oral hygiene.

Treatment of Established Mucositis

In addition to the preventative measures described above, the following should be considered:

<u>nutrition</u> – mucositis is not a contraindication for nasogastric feeds so preferentially use this route.

<u>pain control</u> - consider

- paracetamol and/or morphine
- lignocaine viscous 2% as mouthwash

Treatment of Established Thrush

Mycostatin – 5 mls swish and swallow twice daily

and/or oral fluconazole (if available) 3 mg/kg once a day

(maximum prophylactic dose 150mg daily).

Oral Assessment Guide (OAG)

CATEGORY	Method of Observation	Rating .1.	Rating .2.	Rating .3.
VOICE	Converse with patient. Listen to crying	Normal	Deeper or raspy	Difficulty talking, crying, or painful
Ability to Swallow	Ask patient to swallow	Normal swallow	Some pain on swallowing	Unable to swallow
LIPS	Observe and feel tissue	Smooth, pink and moist	Dry or cracked	Ulcerated or bleeding
SALIVA	Insert depressor into mouth, touching centre of tongue and the floor of the mouth	Watery	Thick or ropy. Excess salivation due to teething	Absent
TONGUE	Observe appearance of tissue	Pink, moist and papillae present	Coated or loss of papillae with a shiny appearance with or without redness. Fungal infection	Blistered or cracked
Mucous Membrane	Observe appearance of tissue	Pink and moist	Reddened or coated without ulceration. Fungal infection	Ulceration with or without bleeding
GINGIVA	Gently press tissue	Pink and firm	Oedematous with or without redness, smooth. Oedema due to teething	Spontaneous bleeding or bleeding with pressure
Teeth (If no teeth, score 1)	Visual. Observe appearance of teeth	Clean and no debris	Plaque or debris in localised areas (between teeth)	Plaque or debris generalised along gum line

(Adapted from Eilers et al, 1988)

The scores of the eight categories are summed.

A normal mouth will receive a score of 8.

The highest possible score is 24.

An OAG score of **>10** indicates a need for specific management of signs and symptoms.

BASIC MOUTHCARES

Clean teeth with small headed soft toothbrush and fluoride toothpaste twice daily (BD)

Rinse mouth with water following brushing and everytime following eating and drinking.

SUPPRESSION OF MENSTRUATION

Overview

Adolescents with cancer who experience menses are potentially at risk of menorrhagia, infection and pain during menstruation. This is often more of a theoretical than practical concern, and some units offer no specific prophylactic intervention

Prevention of Menorrhagia

Treatment likely to cause platelets to fall <$50x10^9$/l – give norethisterone 5mg twice daily. Should breakthrough bleeding occur, increase dose to 10mg twice daily but resume initial dosing once spotting ceases.

Treatment of Menorrhagia

In the unlikely event that heavy menstrual bleeding occurs despite prophylactic measures, the following may be given:

- Platelets
- Tranexamic acid, either orally or IV
- High-dose medroxyprogesterone (discuss with NZ centre)

COPULATION PROTOCOL

Adolescents should be advised to avoid sexual intercourse unless:

- Platelets >$50x10^9$/l, and
- Neutrophils >$1x10^9$/l, and
- Reliable contraception is used – under no circumstances should patients assume that they are either temporarily or permanently infertile.

CONSTIPATION

Causes in child cancer patients

Constipation is most likely to occur during treatment with:

- weak or strong opioid drugs or
- vincristine (particularly when it is administered weekly)

Other factors such as inactivity, poor nutrition, poor fluid intake, hypercalcaemia and hypokalaemia may also be implicated.

Treatment

Laxatives should always be prescribed prophylactically for children on opioids and those receiving weekly vincristine

Initially prophylaxis or treatment for constipation can start with lactulose; stool softeners, oral stimulants and paraffin can then be added. If these do not work rectal preparations can be tried.

Lactulose

(Mild, osmotic – acts in about 48 hours)

⇓

and/or

Stimulant laxatives **-Senna** -(act in about 12 hours)

$^{+}/_{-}$

Stool softener -**Docusate sodium** -acts in 1 - 2 days)

⇓

Paraffin

⇓

rectal preparations (**phosphate enema; microlax enema -** acts in 15 - 30 mins

Doses of laxatives:

Lactulose: 0.5ml/kg/dose 12 – 24 hourly.

This is a starting point and often is exceeded.

Docusate sodium (Coloxyl™):

- oral total daily dose is 5mg/kg
- Rectal total daily dose is <3 years 2.5 mls and >3 years 5 mls.
- Use 1 - 3 times daily. Use in bigger doses initially, then reduce.

Paraffin: 1ml/kg daily orally (max 45mls)

Senna: 7.5mg tablets. Dose is once daily.

- 6 mo – 2 yr ½ - 1 tab
- 3 – 10 1 – 2 tabs
- > 10 2 – 4 tabs

PAIN MANAGEMENT AND PRINCIPLES OF PALLIATIVE CARE

Refer Palliative Care Guideline

HYPERTENSION

Introduction

Hypertension is a common sign in paediatric oncology patients. It is most often transient and as a result of:

- the cancer itself – particularly Wilms tumour and neuroblastoma
- the treatment – in particular protracted steroid therapy

Borderline hypertension can be managed in a "wait and watch" fashion whereas marked hypertension may need to be managed urgently in view of the risk of hypertensive encephalopathy.

Causes of hypertension

It is unusual for a paediatric oncology patient to have hypertension unrelated to their illness (although this should not be automatically discounted!). Hypertension is most often as a result of:

- Wilms tumour compressing the normal kidney and inducing reno-vascular hypertension
- Neuroblastoma – it is still often thought that hypertension is as a result of the catecholamine excess state. This is not the case. Hypertensive crises may be induced by massive release of catecholamines eg. during surgery/biopsy of a neuroblastoma. However, chronic hypertension is almost always observed only with large abdominal neuroblastoma compressing the kidney. In other words, the aetiology of chronic hypertension is the same as that for Wilms tumour.
- Therapy-induced – steroid, tumour lysis syndrome

Is the patient hypertensive?

Do not guess! Use table 2 (below) and judge a patient hypertensive if systolic and/or diastolic pressure > 95th%tile for age, sex and height.

BP consistently above the assigned level should be treated.

Hypertensive Crisis

This scenario may obviously be encountered if the BP is particularly high but can also be seen, rather surprisingly, when the BP appears only moderately elevated *and*:

- patient suffering from tumour lysis syndrome. Under these circumstances, the aetiology is usually fluid overload due to continuing hyperhydration in the face of worsening renal function. Treat with frusemide but watch the serum Ca^{++} carefully as this may plummet (Ca^{++} reserves already depleted by raised serum PO_4).

Under these circumstances, there is metabolic/immune mayhem that presumably lowers the threshold for symptoms of encephalopathy. Patients may rapidly develop the posterior leucoencephalopathy syndrome.

Posterior leucoencephalopathy syndrome

The features of this syndrome may develop as part of a hypertensive crisis and are characterised by sudden onset of:

Seizures

Reduced level of consciousness

Cortical blindness

Symptoms and signs often reverse as rapidly as they appear.

Treatment of hypertension

See Table 1 for drug doses. Choice of therapy depends on the severity of the hypertension and its underlying cause (and drug availability)

Important: Many children with severe hypertension at presentation have ECF depletion, the administration of diuretics at that point is contraindicated because severe hypotension may ensue. Unless saline overload is obvious, as confirmed by cardiopulmonary congestion, it is probably safer to reserve diuretics until the hypertensive state is stabilised.

A: Moderate to Severe Hypertension

Children with moderate to severe hypertension can be managed effectively by the stepwise introduction of:

- Slow-release nifedipine; if BP not controlled add
- Oral labetolol; if BP not controlled add
- Oral frusemide

Diuretics should **not** be administered indiscriminately when the blood pressure

is increased in view of the risk of producing uncontrollable reductions in blood pressure and it is preferable to gain control of the blood pressure with other drugs first. A diuretic may however, be necessary if there is evidence of fluid overload (as in the case of steroid therapy), or to offset the salt and water retention that occurs with the use of peripheral vasodilators. Additional agents eg. captopril may be added if the BP is poorly controlled (see table below for doses of drugs).

B: Hypertensive Crisis/Acute Hypertensive Encephalopathy

Discuss with the NZ centre. Emergency management is indicated when the level of BP is a threat to life or to the function of vital organs. Drugs with a rapid action are necessary but require careful administration to prevent sudden hypotension and resulting failure of autoregulation mechanisms. Drugs that can be infused to finely control BP during the critical early phase of management are preferred. Labetalol and sodium nitroprusside are both effective. Labetalol may be more appropriate for initial use because its method of administration is simpler (Na^+ nitroprusside will need to be administered in ICU). It is preferable to avoid simultaneous administration of oral hypotensive agents or diuretics in the initial management of hypertensive crisis; these are best reserved until the blood pressure is safely controlled.

Throughout the management severe hypertension, the BP must be monitored frequently and the defined limits of BP values that justify change in treatment must be clear. The object is to reduce the BP sufficiently to avoid hypertensive complications yet maintain it at a level that permits autoregulatory mechanisms to function and that ensures an adequate blood supply to the brain and other viscera:

- BP should be decreased in the first 6 hours by not more than one-third of the total reduction planned
- by a further one third over the next 12-36 hours
- and the final third over the next two days

An IV line must be available throughout so that saline or plasma can be administered if the BP drops unexpectedly. A central line is also valuable to monitor the CVP for detection of volume overload or depletion.

In the event of a convulsion, diazepam and a loading dose of phenytoin should be administered intravenously in addition to steps being taken to reduce blood pressure by IV Labetalol

Table 1: Drug Doses

Drug	Route	Normal Starting Dose	Normal Dose Range	Divided doses /day
Atenolol	oral	1mg/kg/dose	1-8mg/kg/day	1 - 2
Captopril	oral	0.5mg/kg/dose	1.5 – 3 mg/kg/day	3
Frusemide	Oral Iv	0.5mg/kg/dose 0.5mg/kg/dose	1-4mg/kg/day 0.5-4mg/kg/d	1 - 6 2 - 6
Hydralazine	iv/im stat then as an infusion oral	0.1mg/kg/dose stat (max 10mg) 0.2mg/kg/dose	Infusion of 10-50 μgrams/kg/hour 1-8mg/kg/day	as an infusion 3 - 4
Hydrochlorothiazide	Oral	0.5 mg/kg/dose	1-4mg/kg/day	2
Labetalol	Iv Oral	1mg/kg/hr 0.5mg/kg/dose	1-3mg/kg./hr 3mg/kg/day	Infusion only 2 – 4
Minoxidil	Oral	0.05 - 0.1 mg/kg/dose	Up to 1mg/kg/day	2
Nifedepine	Oral (capsules) slow release tablets	0.25mg/kg/dose 0.5mg/kg/dose	1-3mg/kg/day 1-3mg /kg/day	4 – 6 2 (used in older children)

Phenoxy Benzamine	Oral Iv	0.2mg/kg/dose 0.5mg/kg over 1hr (stat dose)	1-4mg/kg/day 1-2mg/kg/day	2 2-4
Phentolamine	Iv	100 μ/kg stat bolus dose	5 –50 μ/kg/minute titrated to response	Infusion only
Propranolol	Oral	1mg/kg/dose	1-10mg/kg/day	2 – 4
Sodium nitroprusside	Iv	0.5μg/kg/min	0.5-8.0 μg/kg/min	Infusion only
Spironolactone	Oral	0.5mg/kg/dose	1-3mg/kg/day	2

Table 2 Normal Blood Pressure

TABLE 2a BLOOD PRESSURE LEVELS FOR THE 90TH AND 95TH PERCENTILES OF BLOOD PRESSURE FOR **BOYS** AGED 1 TO 17 YEARS BY PERCENTILES OF HEIGHT

Age, Y	Blood Pressure Percentile *	Systolic Blood Pressure by Percentile of Height Mm Hg+							Diastolic Blood Pressure by Percentile of Height, mm Hg+						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	90th	94	95	97	98	100	102	102	50	51	52	53	54	54	55
	95th	98	99	101	102	104	106	106	55	55	56	57	58	59	59
2	90th	98	99	100	102	104	105	106	55	55	56	57	58	59	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
3	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	111	112	113	63	63	64	65	66	67	67
4	90th	102	103	105	107	109	110	111	62	62	63	64	65	66	66
	95th	106	107	109	111	113	114	115	66	67	67	68	69	70	71
5	90th	104	105	106	108	110	112	112	65	65	66	67	68	69	69
	95th	108	109	110	112	114	115	116	69	70	70	71	72	73	74
6	90th	105	106	108	110	111	113	114	67	68	69	70	70	71	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
7	90th	106	107	109	111	113	114	115	69	70	71	72	72	73	74
	95th	110	111	113	115	116	118	119	74	74	75	76	77	78	78
8	90th	107	108	110	112	114	115	116	71	71	72	73	74	75	75

	95th	111	112	114	116	118	119	120	75	76	76	77	78	79	80

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		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
9	90th	109	110	112	113	115	117	117	72	73	73	74	75	76	77
	95th	113	114	116	117	119	121	121	76	77	78	79	80	80	81
10	90th	110	112	113	115	117	118	119	73	74	74	75	76	77	78
	95th	114	115	117	119	121	122	123	77	78	79	80	80	81	82
11	90th	112	113	115	117	119	120	121	74	74	75	76	77	78	78
	95th	116	117	119	121	123	124	125	78	79	79	80	81	82	83
12	90th	115	116	117	119	121	123	123	75	75	76	77	78	78	79
	95th	119	120	121	123	125	126	127	79	79	80	81	82	83	83
13	90th	117	118	120	122	124	125	126	75	76	76	77	78	79	80
	95th	121	122	124	126	128	129	130	79	80	81	82	83	83	84
14	90th	120	121	123	125	126	128	128	76	76	77	78	79	80	80
	95th	124	125	127	128	130	132	132	80	81	81	82	83	84	85
15	90th	123	124	125	127	129	131	131	77	77	78	79	80	81	81
	95th	127	128	129	131	133	134	135	81	82	83	83	84	85	86
16	90th	125	126	128	130	132	133	134	79	79	80	81	82	82	83
	95th	129	130	132	134	136	137	138	83	83	84	85	86	87	87
17	90th	128	129	131	133	134	136	136	81	81	82	83	84	85	85
	95th	132	133	135	136	138	140	140	85	85	86	87	88	89	89

TABLE 2b BLOOD PRESSURE LEVELS FOR THE 90TH AND 95TH PERCENTILES OF BLOOD PRESSURE FOR **GIRLS** AGED 1 TO 17 YEARS BY PERCENTILES OF HEIGHT

AGE Y	Blood Pressure Percentile *	Systolic Blood Pressure by Percentile of Height Mm Hg+							Diastolic Blood Pressure by Percentile of Height, mm Hg+						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	90th	97	98	99	100	102	103	104	53	53	53	54	55	56	56
	95th	101	101	103	104	105	107	107	57	57	57	58	59	60	60
2	90th	99	99	100	102	103	104	105	57	57	58	58	59	60	61
	95th	102	103	104	105	107	108	109	61	61	62	62	63	64	65
3	90th	100	100	102	103	104	105	106	61	61	61	62	63	63	64
	95th	104	104	105	107	108	109	110	65	65	65	66	67	67	68
4	90th	101	102	103	104	106	107	108	63	63	64	65	65	66	67
	95th	105	106	107	108	109	111	111	67	67	68	69	69	70	71
5	90th	103	103	104	106	107	108	109	65	66	66	67	68	68	69
	95th	107	107	108	110	111	112	113	69	70	70	71	72	72	73
6	90th	104	105	106	107	109	110	111	67	67	68	69	69	70	71
	95th	108	109	110	111	112	114	114	71	71	72	73	73	74	75
7	90th	106	107	108	109	110	112	112	69	69	69	70	71	72	72
	95th	110	110	112	113	114	115	116	73	73	73	74	75	76	76
8	90th	108	109	110	111	112	113	114	70	70	71	71	72	73	74
	95th	112	112	113	115	116	117	118	74	74	75	75	76	77	78

TABLE 2b BLOOD PRESSURE LEVELS FOR THE 90TH AND 95TH PERCENTILES OF BLOOD PRESSURE FOR **GIRLS** AGED 1 TO 17 YEARS BY PERCENTILES OF HEIGHT

Age in years	Blood pressure percentile	Systolic Blood Pressure by Percentile of Height (Mm Hg)							Diastolic Blood Pressure by Percentile of Height, (mm Hg)						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
9	90th	110	110	112	113	114	115	116	71	72	72	73	74	74	75
	95th	114	114	115	117	118	119	120	75	76	76	77	78	78	79
10	90th	112	112	114	115	116	117	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
11	90th	114	114	116	117	118	119	120	74	74	75	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	79	79	80	81	81
12	90th	116	116	118	119	120	121	122	75	75	76	76	77	78	78
	95th	120	120	121	123	124	125	126	79	79	80	80	81	82	82
13	90th	118	118	119	121	122	123	124	76	76	77	78	78	79	80
	95th	121	122	123	125	126	127	128	80	80	81	82	82	83	84
14	90th	119	120	121	122	124	125	126	77	77	78	79	79	80	81
	95th	123	124	125	126	128	129	130	81	81	82	83	83	84	85
15	90th	121	121	122	124	125	126	127	78	78	79	79	80	81	82
	95th	124	125	126	128	129	130	131	82	82	83	83	84	85	86
16	90th	122	122	123	125	126	127	128	79	79	79	80	81	82	82
	95th	125	126	127	128	130	131	132	83	83	83	84	85	86	86
17	90th	122	123	124	125	126	128	128	79	79	79	80	81	82	82
	95th	126	126	127	129	130	131	132	83	83	83	84	85	86	86

ANOREXIA AND NUTRITIONAL SUPPORT

Introduction

Once significant weight loss occurs in children with cancer, the prognosis is poorer and survival shorter. In children, treatment causes greater problems with appetite than does the underlying malignancy. The reasons for weight loss include:

- cancer cachexia - inevitable with terminal cancer.
- chemotherapy-induced nausea and vomiting. Taste perception is frequently altered - distaste for bitter foods, more appreciation for salty or sweet-tasting foods.
- psychological factors - such as anticipatory vomiting in older children.
- brain tumour patients present a particular challenge - the combination of raised intracranial pressure, the tumour itself, neurosurgery, steroid-induced gastritis and chemo- and radiotherapy (if given) present a huge challenge.
- Children with cancer have an abnormal metabolism characterised by nitrogen depletion (reduced skeletal muscle), impaired glucose tolerance, tendency to lactic acidosis and gluconeogenesis, and hyperlipidaemia with reduced lipid stores.

Assessment of nutritional status

Weight and BMI are the most common parameters but are a crude measure of the nutritional wellbeing of a patient. Other measures such as skin-fold thickness and mid-arm circumference may be more informative.

SEDATION PROTOCOL FOR CHILDREN- CONSULT ANAESTHETIST

Important

1. Never sedate a patient with an anterior mediastinal mass
2. Doctors administering sedation should be skilled in resuscitation
3. One doctor/nurse to do the procedure, another nurse to monitor the child's vital signs
4. Children receiving intravenous sedation should be monitored with pulse oximetry

Types of sedation

Give 30 minutes before procedure

Awake sedation

Oral midazolam: 0.5mg/kg (max 15mg)

Sleep sedation (low stimulus procedure)

Oral midazolam: 0.5mg/kg (max 15mg) and oral chloral hydrate 50mg/kg

Sleep sedation (painful procedure)

Oral midazolam: 0.5mg/kg (max 15mg) and oral ketamine 5mg/kg

NB: 2 nurses present during this form of sedation