Management of hypocalcaemia in adult inpatients

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

This guideline covers the use of calcium supplementation products to manage hypocalcaemia in adults.

This guideline is for use by the following staff groups:

All qualified healthcare professionals involved in prescribing or administering calcium supplements for adult patients.

Lead Clinician(s)

Shane Kailla	Clinical Pharmacist
Approved by Medicines Safety Group on:	10th February 2020
This is the most current document and is to be used until a revised version is available:	10th February 2023

Key amendments to this guideline

Date	Amendment	By:
07/12/2011	Guideline approved by Medicines Safety Committee	
14/03/2012	Change to administration details of calcium chloride	Atif Ishaq
01/11/2013	Change of Lead Clinician no amendments made to the content of the guideline	Atif Ishaq
23/11/2015	Document extended for 12 months as per TMC paper approved on 22nd July 2015	TMC
Oct 16	Further extension as per TMC paper 22nd July 2015	TMC
Nov 17	Document extended with no changes	Keith Hinton
05/12/2017	Sentence added in at the request of the Coroner	
Sept 19	Changes made to formatting of document to improve clarity Treatment for severe hypocalcaemia has been adjusted to align with recommendations from the Society of Endocrinology and Medusa	Shane Kailla

Management of hypocalcaemia in adult inpatients

Introduction

This guideline is to be used by prescribers to aid them in prescribing calcium supplementation in adult inpatients to treat hypocalcaemia. Hypocalcaemia can potentially be a life-threatening biochemical abnormality. This guideline has been produced to ensure calcium supplements are prescribed using evidence-based practice and products are prescribed that have been approved in the Worcestershire NHS Joint Formulary, and stocked within the Worcestershire Acute NHS Hospitals Trust.

Aetiology

Hypocalcaemia is common in hospitalised patients and correlates with severity of illness, and found to be prevalent in up to 88% of intensive care unit patients.

Approximately 40% of plasma calcium is bound to albumin, but it is the unbound/ionised fraction of calcium that is important physiologically and the level for serum calcium is usually reported as both an unadjusted and adjusted (where adjustment is made for changes in albumin levels).

Severe hypocalcaemia, if untreated, can lead to serious neurological and cardiovascular complications. The main ECG change is prolongation of the QT interval. There is no increase in T wave duration but the ST segment is prolonged.

Causes

There can be a number of causes of hypocalcaemia, including:

These are the most common causes

- Hypoparathyroidism (often following surgery)
- Hypomagnesaemia
- Renal failure
- Vitamin D deficiency or malabsorption e.g. Coeliac disease
- Drug-induced e.g. bisphosphonates, phenytoin, furosemide, ketoconazole, aminoglycosides
- Hyperventilation
- Acute pancreatitis
- Acute rhabdomyolysis - usually in relation to crush injuries
- Malignancy - tumour lysis (following chemotherapy) or osteoblastic metastases (rare)
- Toxic shock syndrome
- Refeeding syndrome

Symptoms

Patients with mild hypocalcaemia may be asymptomatic, with symptoms presenting only in severe hypocalcaemia However, patients who have a rapid fall in serum calcium e.g. following a parathyroidectomy or thyroidectomy, often present with symptoms. Similarly, patients with severe hypocalcaemia but who are asymptomatic may have chronic hypocalcaemia.

- Neuromuscular excitability e.g. muscle twitching, spasms, tingling, and numbness
- Muscle cramps
- Paraesthesia (usually fingers, toes and around mouth)
- Tetany
- Carpopedal spasm (wrist flexion and fingers drawn together)
- Confusion / altered affect (irritability / anxiety / depression)

Signs

- Calcium levels (adjusted for serum albumin) below normal range
- Prolonged QT interval and ventricular fibrillation (VF) or heart block
- Laryngospasm
- Bronchospasm
- Seizures
- Chvostek's sign (tapping over facial nerve causes facial muscles to twitch) – *N.B. This sign may be observed in some normocalcaemic individuals and may be absent in chronic hypocalcaemia*
- Trousseau's sign (carpopedal spasm after inflating a blood pressure cuff on the upper arm)

Investigations

- Urea and Electrolytes (U&Es)
- Magnesium and bone profile (includes calcium and phosphate)
- Liver function tests (LFTs)
- FBC, ESR

Further Investigations

Mainly required for the diagnosis of hypoparathyroidism or osteomalacia

- PTH – Gold top bottle
- Vitamin D – Gold top bottle

Precautions & Interactions

Careful ECG monitoring is required, particularly in patients taking digoxin as they have increased cardiac sensitivity to fluctuations in serum calcium.

If the patient has sepsis or renal failure, metabolic acidosis may accompany hypocalcaemia. Calcium must be replaced to achieve serum levels close to normal range before the acidosis can be corrected. Failure to do this may result in convulsions or cardiac arrest.

Monitor cannula sites for any signs of extravasation. Stop immediately if detected and contact a doctor.

Other side-effects to monitor for include vasodilation, hypotension, bradycardia, cardiac arrhythmias, syncope and cardiac arrest.

If parenteral calcium is used to treat hypocalcaemia when hyperphosphataemia is present (for example some acute cases of rhabdomyolysis), damaging precipitation of calcium-phosphate in soft tissues can result.

Calcium infusions should be given separately and not mixed with any other drugs.

If a patient is on parenteral nutrition, consult the PN pharmacist to correct hypocalcaemia and any other electrolyte imbalances.

Patients that are prescribed treatment for hypocalcaemia should have their calcium monitored daily and their treatment reviewed in relation to this.

Treatment

Follow the treatment table below. Generally treatment should be based on adjusted calcium levels however ionised calcium may be used in specific patient groups i.e. those with low albumin or based on calcium readings obtained from blood gas samples.

Note: If the patient is also hypomagnesaemic, it is necessary to correct this before correcting the hypocalcaemia (unless the patient presents with severe symptoms) – see WAHT-PHA-012 for guidance.

Classification	Adjusted Plasma Calcium Range (mmol/L)	Ionised Calcium Range (mmol/L)	Treatment	
Normal	2.20 – 2.60	1.18 – 1.28	***(Assess whether oral maintenance is indicated i.e. for bone protection/ osteoporosis prevention)*** ***Oral Maintenance:*** • Adcal D_3 – 1 tablet twice a day If chronic renal impairment or PTH deficiency : • Adcal (without the vitamin D) – 2 tablets once a day • Alfacalcidol 500 nanograms - 1 microgram daily	
Mild	2.00 – 2.19	1.08 – 1.17	***Mild & Asymptomatic*:** • Adcal D_3- 2 tablets twice a day If chronic renal impairment or PTH deficiency: • Adcal (without vitamin D) – 2 tablets twice a day • Alfacalcidol- 1 microgram twice a day	
Moderate	1.91 – 1.99	1.00 – 1.07	***Moderate & Asymptomatic*:** • Adcal (without vitamin D) – 2 tablets three times a day • Alfacalcidol – 1 microgram twice a day*	• *Also Seek endocrine advice* • **Colecalciferol has a slow onset and long duration of action and therefore may take some time before results are normal. Some patients may therefore need alfacalcidol which is rapid acting and more potent. Higher doses may be required in treatment resistant hypocalcaemia, consult pharmacy or endocrinologist.*
			Moderate & Symptomatic*:** • 10mL of 10% calcium *gluconate* (2.2 mmol) by slow IV injection ***over 5 minutes (can be given **peripherally into a large vein**) • Repeat as necessary or follow with infusion of calcium gluconate 10% infusion – 40mL (8.8 mmol) in 250mL sodium chloride 0.9% (or glucose 5%) over at least 4 hours**.	• Concurrently to this, commence oral therapy as for asymptomatic moderate hypocalcaemia and seek endocrine advice. • **Calcium gluconate may be given undiluted if the patient is fluid restricted. As it has a high osmolarity it may cause venous irritation and extravasation. Ideally give via central line. If giving peripherally into a large vein, monitor injection site closely for signs of extravasation. • If symptoms persist following treatment then follow management for severe hypocalcaemia.

Classification	Adjusted Plasma Calcium Range (mmol/L)	Ionised Calcium Range (mmol/L)	Treatment	
Severe (also follow if patient is symptomatic despite treatment with the above)	≤1.90	≤1.00	10–20 mL 10% calcium gluconate in 50–100 mL of 5% glucose slow IV over 10 minutes with ECG monitoring. This can be repeated until the patient is asymptomatic. (can be given **peripherally into a large vein**) This should be followed up with a calcium gluconate infusion as follows: Dilute 100 mL of 10% calcium gluconate (10 vials) in 1 L of sodium chloride 0.9% or 5% glucose and infuse at 50–100 mL/h. Titrate the rate of infusion to achieve normocalcaemia and continue until treatment of the underlying cause has taken effect.	• Concurrently to this, commence oral therapy as for asymptomatic moderate hypocalcaemia. • Seek endocrine advice. • NB: Large volume calcium infusions should not be used in patients with end stage renal failure or who are on dialysis. Seek advice from renal team. • **If the patient is fluid restricted then consider via Central Line ONLY:** 100mL of 10% calcium gluconate (22 mmol) diluted in 250mL of 5% dextrose or sodium chloride 0.9% over 4 hours. • Calcium chloride is considered to be the most irritant calcium salt. For this reason calcium gluconate should be the preferred calcium salt used in treatment. Nevertheless, calcium chloride 14.7% (1mmol/mL) may be given **undiluted through a central line only**. • NB: If using calcium chloride in place of calcium gluconate, 2.2 mL of 14.7% calcium chloride should be used as equivalent to 10 mL of 10% calcium gluconate.

Monitoring Tool

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
	WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
	Management of hypocalcaemia is as per guideline	By review of drug chart by ward based clinical pharmacist	Each time hypocalcaemia treatment is prescribed.	Ward based clinical pharmacists.	Deviations from guideline recommendations may be reported via DATIX.	Each time a reportable issue arises.
	Calcium monitoring is carried out daily for patients with hypocalcaemia.	By reviewing blood results of patients on ICE.	Each time a patient has a report of hypocalcaemia that requires treatment.	Ward based clinical pharmacists.	Deviations from guideline recommendations may be reported via DATIX.	Each time a reportable issue arises.

References

- Anaesthesia UK (2006). Electrolyte disturbances and ECG changes. www.anaesthesiauk.com
- Bushinsky, D. & Monk R (1998). *Calcium*. The Lancet, 352, pp306-311
- Cooper, M. & Gittoes, N. (2008). *Diagnosis and management of hypocalcaemia*. British Medical Journal, 336, pp1298- 1302
- Dickerson, R. (2006). *Hypocalcaemia during critical illness*. Hospital Pharmacy, 41 (10), pp 993–999
- Forsythe, RM. et al. (2008). *Parenteral calcium for intensive care unit patients*. Cochrane
- Martindale Pharma. *Summary of Product Characteristics – Calcium chloride injection 10 millimoles in 10ml*. Available at: www.emc.medicines.org.uk. [Accessed on 23/10/19]
- Wiffen, P. et al. (2017). *Oxford Handbook of Clinical Pharmacy*. 2nd edition. Oxford University Press: Oxford.
- UK Medicines Information (2017). *Q&A: How is acute hypocalcaemia treated in adults?* Available from: www.sps.nhs.uk [Accessed on 23/10/19]
- Injectable Medicines Guide (2016). *Calcium Chloride*. Available from: www.inguide.nhs.uk [Accessed on 23/10/19]
- Injectable Medicines Guide (2019). *Calcium Gluconate*. Available from: www.injguide.nhs.uk [Accessed on 26/10/19]
- Society for Endocrinology (2016). *Emergency Endocrine Guidance: Emergency Management of Acute Hypocalcaemia in Adult Patients*. Endocrine Connections. Vol. 8 (6). Available from: https://doi.org/10.1530/EC-16-0056 [Accessed 26/10/19]
- Society for Endocrinology (2019). *Emergency Endocrine Guidance: Emergency Management of Acute Hypocalcaemia in Adult Patients- Important Addendum*. Endocrine Connections. Available from: https://doi.org/10.1530/EC-16-0056a [Accessed 26/10/19]

CONTRIBUTION LIST

Key individuals involved in developing the document

Name	Designation

Mr Shane Kailla	Specialist Clinical Pharmacist
Mr Keith Hinton	Countywide Lead Pharmacist for Surgery & Critical Care

Circulated to the following individuals for comments

Name	Designation
Dr Ramalingam Bhaskar	Consultant Endocrinologist
Dr Andy Burtenshaw	Consultant Anaesthetist
Dr Ian Gee	Consultant Gastroenterologist
Mr Chris Ayshford	Consultant Surgeon (ENT)

Circulated to the following CD's/Heads of dept for comments from their directorates / departments

Name	Directorate / Department
Mr Paul Rajjayabun	DMD Surgery
Dr Jasper Trevelyan	DMD Specialist Medicine

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and included as an appendix to key document when submitted to the appropriate committee for consideration and approval.

Please complete assessment form on next page;

NHS Worcestershire Acute Hospitals NHS Trust

Herefordshire & Worcestershire STP - Equality Impact Assessment (EIA) Form
Please read EIA guidelines when completing this form

Section 1 - Name of Organisation (please tick)

Herefordshire & Worcestershire STP		Herefordshire Council		Herefordshire CCG	
Worcestershire Acute Hospitals NHS Trust		Worcestershire County Council		Worcestershire CCGs	
Worcestershire Health and Care NHS Trust		Wye Valley NHS Trust		Other (please state)	

Name of Lead for Activity	

Details of individuals completing this assessment	**Name**	**Job title**	**e-mail contact**
Date assessment completed			

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	**Title:**			
What is the aim, purpose and/or intended outcomes of this Activity?				
Who will be affected by the development & implementation of this activity?	❑ ❑ ❑ ❑	Service User Patient Carers Visitors	❑ ❑ ❑ ❑	Staff Communities Other _____
Is this:	❑ Review of an existing activity ❑ New activity ❑ Planning to withdraw or reduce a service, activity or presence?			
What information and evidence have you reviewed to help inform this assessment? (Please name sources, eg demographic information for patients / services / staff groups affected, complaints etc.				
Summary of engagement or				

consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	
Summary of relevant findings	

Section 3

Please consider the potential impact of this activity (during development & implementation) on each of the equality groups outlined below. **Please tick one or more impact box below for each Equality Group and explain your rationale**. Please note it is possible for the potential impact to be both positive and negative within the same equality group and this should be recorded. Remember to consider the impact on e.g. staff, public, patients, carers etc. in these equality groups.

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Age				
Disability				
Gender Reassignment				
Marriage & Civil Partnerships				
Pregnancy & Maternity				
Race including Traveling Communities				
Religion & Belief				
Sex				
Sexual Orientation				
Other Vulnerable and Disadvantaged Groups (e.g. carers; care leavers; homeless; Social/Economic deprivation, travelling communities etc.)				
Health Inequalities (any preventable, unfair & unjust differences in health status between groups, populations or individuals that arise from the unequal distribution of social, environmental & economic conditions within societies)				

Section 4

What actions will you take to mitigate any potential	Risk identified	Actions required to	Who will lead on	Timeframe

negative impacts?		**reduce / eliminate negative impact**	**the action?**	
		.		
How will you monitor these actions?				
When will you review this EIA? (e.g in a service redesign, this EIA should be revisited regularly throughout the design & implementation)				

Section 5 - Please read and agree to the following Equality Statement

1. Equality Statement

1.1. All public bodies have a statutory duty under the Equality Act 2010 to set out arrangements to assess and consult on how their policies and functions impact on the 9 protected characteristics: Age; Disability; Gender Reassignment; Marriage & Civil Partnership; Pregnancy & Maternity; Race; Religion & Belief; Sex; Sexual Orientation

1.2. Our Organisations will challenge discrimination, promote equality, respect human rights, and aims to design and implement services, policies and measures that meet the diverse needs of our service, and population, ensuring that none are placed at a disadvantage over others.

1.3. All staff are expected to deliver services and provide services and care in a manner which respects the individuality of service users, patients, carer's etc, and as such treat them and members of the workforce respectfully, paying due regard to the 9 protected characteristics.

Signature of person completing EIA	
Date signed	
Comments:	
Signature of person the Leader Person for this activity	
Date signed	
Comments:	

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval