Whittington Health NHS

Sickle Cell Disease (SCD) in childhood - Management

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Designation of Author:	Dr A Robins (Consultant Paediatrician) E Aimiuwu (Clinical Nurse Specialist)
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Introduction / Background

This document aims to present an overview of the problems encountered in Sickle Cell Disease (SCD) in children and their management. It is structured such that there are initial informative sections followed by appendices that are relevant to particular situations and can be downloaded, printed off and completed as necessary. They are written with the junior doctors and nurses in mind, but senior help should always be sought in the case of any ill child or for clarity. The problems described are descriptive and not exhaustive – ***children with SCD may suffer from any and all general paediatric conditions in addition to those related to SCD.***

Acknowledgement

Thanks to our colleagues in neighbouring hospitals who have offered their guidelines. In particular North Middlesex Hospital, St Mary's Hospital, Royal London and Central Middlesex paediatric sickle cell teams.

Content of guideline

List of abbreviations

Below is a list of abbreviations contained within the main document, in the order in which they appear:

SCD	Sickle cell disease
VOC	Vaso-occlusive crisis
TCD	Trans-cranial Doppler
HEADSS	*HEADSS* questionnaire for adolescents
CVA	Cerebro-vascular accident
TIA	Transient ischaemic attack
CNS x 2	Central nervous system Clinical nurse specialist
EC	Emergency card
ED	Emergency Department
AWR	Dr Andrew Robins
EA	Sister Edith Aimiuwu
ICP	Integrated care pathway
FBC	Full blood count
Hb	Haemoglobin
U+Es	Urea and electrolytes
LFT	Liver function tests
CRP	C-reactive protein
M,CS	Microscopy, culture and sensitivity
CSF	Cerebrospinal fluid
CXR	Chest x-ray
ECG	Electrcardiagram
DFO	Desferrioxamine
PCV	Packed cell volume
IV	Intravenous
Sa O_2	Oxygen saturation
HDU	High Dependency Unit
PICU	Paediatric Intensive Care Unit
CPAP	Continuous positive airway pressure
CATS	Children's Acute Transfer Service
HIV	Human immunodeficiency virus
ENT	Ear, nose and throat
OFC	Occipital head circumference
BP	Blood pressure
PRN	As required
ESR	Erythrocyte sedimentation rate
MRI	Magnetic resonance imaging
ABG	Arterial blood gases
BD	Twice daily
NBTS	National Blood Transfusion Service
HPLC	High pressure liquid chromatography
ABC	Airway, breathing, circulation
LDH	Lactate dehydrogenase
IgM	Immunoglobulin M.
CT	Computed tomography
GOSH	Great Ormond Street Hospital
KCH	Kings College Hospital
EEG	Electroencephalogram
PR	Per rectum
UTI	Urinary tract infection
NICE	National Institute of Clinical excellence
RCPCH	Royal College Paediatrics
MSU	Midstream urine
AVN	Avascular necrosis
BMI	Body mass index
Ca++	Calcium
Mg	Magnesium
ULN	Upper limit of normal
SH	Dr Sara Hamilton
>	Greater than
<	Less than

Clinical management

SECTION 1

PATIENT ATTENDANCES

A. The acute attendance with pain (Vaso-occlusive Crisis = VoC)

B. The outpatient attendances

- The new patient
- The six-monthly / annual review

A. The acute attendance with pain

Children with haemoglobinopathy will be identified by the National Bloodspot Screening Programme (*no longer referred to as "Guthrie Test")* and followed up appropriately. It will be unusual now to make a new diagnosis of major haemoglobinopathy such as SCD in anyone other than a child who was not part of the screening programme eg. born abroad or much older child. Haemoglobinopathy screening should be considered when the child's status is not known, when they present with features of SCD, prior to an operation or if the appearance of their blood count suggests a haemoglobinopathy. The hospital laboratory can provide same-day results if requested during working hours (Mon-Fri & Sat mornings). Families of newly identified patients should be screened with the assistance of the local haemoglobinopathy counselling service.

Criteria for Admission

- Agonising pain (ie. unresponsive to analgesics at home/ requiring opiates)
- Increased pallor, breathlessness or exhaustion
- Marked pyrexia > 38.5 ^{o}C (especially when with signs of sepsis)
- Chest pain (especially when with signs of lung consolidation)
- Abdominal pain or distension (including diarrhoea or vomiting)
- Sequestration
- Severe thoracic / back pain
- Headache, drowsiness, CVA, TIA *or any abnormal CNS signs*
- Priapism (> 2 hours)

Admission procedure

- **The Paediatric SpR must be informed of all admissions including out of hours (bleep 3111)**

Emergency Cards

All children with haemoglobinopathy should have an **Emergency Card (EC)** that entitles the child and family direct access to the paediatric team, bypassing the Emergency Department (ED). Critically ill children ought to be seen in the ED resus area, the rest will be seen in the paediatric department (eg. Children's Ambulatory Unit (CAU) or Ifor ward or Outpatient clinic).

All attendances to the paediatric department are to be coded as **AWR** (Dr Andrew Robins) attendances. Please inform AWR and the Clinical Nurse Specialist (CNS) Mrs Edith

Aimiuwu (**EA**) of attendances and maintain a low threshold to seek information and advice from them. Day to day inpatient care is with the attending paediatric team, however EA and AWR will usually see all admitted patients to provide advice during their admission. Dr Sara Hamilton (**SH**) is the deputy lead paediatrician to AWR, whose advice can and should be sought in the absence of AWR.

Clinical Assessment – The Integrated Care Pathway (ICP)

A full history and examination must be carried out and documented on the Assessment Proforma **(Appendix 1)** which will assist the child's management and allow staff to follow an integrated care pathway for sickle cell disease.

Special attention should be paid to:

- The site and intensity of the pain **(Pain Assessment - Appendix 2)**
- Any analgesia already taken
- Any focus of infection (including the urinary tract)
- Pulse rate, cap refill and blood pressure
- Chest symptoms and signs, including respiratory rate
- Pulse oximetry (SaO_2) breathing room air
- Liver and spleen size (cm)
- Degree of pallor or jaundice

Blood tests may be ***avoided*** if ***all the following*** **criteria are fulfilled -**

- A simple painful (VOC) crisis
- Blood tests done in the hospital in the last 12 months
- Non febrile
- Not hypoxic (SaO_2 = clinic values)
- No signs of infection
- Looks well

However if the child *does not fulfil these criteria*, then perform the following tests:

- Full blood count (FBC) and reticulocytes (retics)
- Group and save and antibody screen
- Haemoglobin (Hb) electrophoresis (measures % HbS / F / A) ***only if***
  - recently transfused
  - if Hb F% levels not known
- Urea and electrolytes (U+Es)
- Creatinine
- Liver Function Test (LFTs)

- Bone profile
- C-reactive protein (CRP)

Microbiological screen (if symptoms or signs of infection)

- Urine dipstick and urine microscopy, culture and sensitivity (M,CS)
- Other cultures as indicated (see below)
- Save serum for viral and atypical pneumonia serology

Other tests are done as indicated, as follows:

Test	**Indication**
Culture: Blood, throat, urine, stool, CSF etc	As clinically indicated
CXR	Hypoxia, respiratory distress, chest pain, symptoms / signs of infection
Head Scan using CT or MRI	*See stroke and other CNS complications*
Arterial Blood Gases (ABG)	If deteriorating O_2 saturation in air
Mycoplasma and Chlamydia serology	Evidence of chest involvement
Abdominal ultrasound	Symptoms suggestive of cholecystitis or any other acute abdominal signs
Serology for Parvovirus B19 IgM	Fall in Hb with low retics
ECG	If possible arrhythmia or cardiac pain
Serum amylase	Abdominal symptoms / signs
Imaging of painful joints/limbs*	Discuss use of Ultrasound or MRI, *Plain X-rays are generally not helpful (see below)*
Screen stool for *Yersinia* Serum for *Yersinia* antibodies	Patients on Desferrioxamine (DFO) with diarrhoea / abdominal pain (STOP DFO)

X-rays of bones and joints** show little or no change in the first week of an acute illness and rarely differentiate between ***infarction and infection. Ultrasound should be considered for suspected osteomyelitis, MRI also has a role. X-rays can be useful in confirming avascular necrosis as a cause of joint / referred pain (common head of humerus or femur). ***Good, senior liaison with radiology is essential to get most timely and relevant imaging.***

Clinical Management

1. General Principles

- The aim of treatment is to break the vicious 'sickling' cycle

->hypoxia & acidosis -> more sickling -> all of which are exacerbated by dehydration

- This is best achieved by:
    a. Hydration
    b. Oxygenation
    c. Prompt and adequate analgesia (pain relief)
    d. Early and prompt treatment of infection
    e. Identification and treatment of any complications

a. Hydration

- Dehydration occurs readily in children with sickle cell disease due to impairment of renal concentration power. Poor intake and excess losses (eg. diarrhoea and vomiting) are of particular concern
- All children should be assessed for any degree of dehydration by the history; duration of the illness; by clinical examination; and weight loss (if known). Hb and Packed Cell Volume (PCV) may be elevated as compared with the child's steady state values
- A strict input / output fluid chart should be started on every child, with at least daily weights
- Hyper-hydration, with 1.5 litres / m^2 / day should be commenced on admission, and must be reviewed on a daily basis (see *EXTRA* pages at back of cBNF or http://bnf.org/bnf/search.htm?n=5&q=surface+area). Alternatively an equivalent calculation can be made using:

Body weight (kg)	Fluids (ml / kg / day)
First 10 kg	150
11- 20 kg	75
Subsequent kilograms over 20	30

- **The oral route should be used whenever possible**
- Children with severe pain, abdominal symptoms and who are not settling should receive intravenous (IV) re-hydration
- IV hydration should be stopped once the patient is stable and pain is controlled
- Although adequate hydration is important in the management of painful VOC, care should be taken to **avoid fluid overload** with IV fluids
- Use fluids recommended in paediatric IV therapy guidelines, usually: 5% Dextrose + 0.9% saline (review needed for added potassium)
- Blood U+Es and creatinine should be regularly monitored

  Note that a slightly raised urea is significant, as these children normally have a low blood urea

b. Oxygenation

Supplemental Oxygen (O_2) may be given by high-flow face mask if the patient has a SaO_2< 94% in air **or** <4% from baseline SaO_2 recorded at last outpatient review or if there is any indication of a chest infection or chest crisis.

O_2 therapy is of doubtful use if the patient has only limb pain.

The patient's oxygen saturation (SaO_2) should be monitored by pulse oximetry **with regular readings on room air** (minimum 4 hourly).

- Consider giving O_2 to anyone with trunk (ie. chest or abdominal) pain, as may reduce risk of chest crisis
- Consider checking arterial gases if SaO_2 on air is <90%
- Monitor SaO_2 while patient is on supplementary O_2, aiming to keep SaO_2> 95%

c. Prompt and adequate analgesia *(Pain Prescribing Guideline Appendix 3)*

Record the duration and site of the pain, ask patient to score pain and record which analgesics, at what doses, have already been administered on the front of the assessment sheet. Promptly arrange for delivery of more analgesia, at the beginning of the assessment.

d. Early and prompt treatment of infection (ie. when to be using antibiotics)

- Infection is a common precipitating factor of painful VOC as well as other types of sickle crises. Children with SCD have functional hyposplenism (irrespective of spleen

size) and thus have increased susceptibility to infection, especially to encapsulated organisms such as *Pneumococcus, Meningococcus, Haemophilus, and Salmonella* – all of which can cause life-threatening sepsis.

- Patients who are admitted with uncomplicated painful VOC without specific evidence of infection should continue Penicillin V prophylaxis. They require clinical review and if they show signs of sepsis should have blood cultures taken, Penicillin V stopped and systemic antibiotics commenced.
- The first line parenteral antibiotic is Ceftriaxone, which provides cover for Pneumococcus, Meningococcus, Haemophilus and Salmonella. If they require oral antibiotics, then the first line is Co-Amoxyclav.
- If there are chest signs, or an abnormal CXR, add azithromycin (If IV needed - use IV clarithromycin)
- If the patient is unwell or fails to improve, discuss with the attending paediatric team, AWR and clinical microbiology and haematology teams regarding change in antibiotics.
- Siblings of children with Salmonella infections should be discussed with microbiologists.

e.Thromboprophylaxis (VTE prophylaxis)

- Venous Thrombo Embolism (VTE) prophlylaxis is recommended in all children who are pubertal or over 11 years of age.

2. Transferring patient for High Dependency Unit (HDU) or Paediatric Intensive Care Unit (PICU) care

It is vital to discuss any patient likely to require HDU admission as early as possible with the attending paediatric medical and nursing team and duty haematologist (and if available, EA and AWR). Indications for HDU transfer might include:

- Suspected or impending Acute Sickle Chest Crisis
- Need for Continuous Positive Airway Pressure (CPAP) ventilatory support
- Exchange Transfusion
- Any other severely unwell child with complications of SCD

The Children's Acute Transport Service (CATS - a mobile PICU) should be informed of unstable HDU patients and any patients needing PICU. Indications for PICU transfer might include:

- Actual or impending respiratory failure (unable to maintain oxygen saturation with CPAP)

- Invasive monitoring needed
- Unable to maintain an adequate haemoglobin (>4g/dl) – Hyperhaemolysis (see page 45)
- Hypotension requiring inotropic support
- Severe sepsis
- Renal failure likely to require dialysis / haemofiltration
- Any other indication for PICU transfer

Whittington Hospital Case Notes

The notes should always be sought urgently for any attendance and are usually easily obtained, even out of hours. The case notes of children with sickle cell disease are labeled with a red dot, to signify they are filed separately and kept in clinic 4D in the haemoglobinopathy cupboard. Patients on regular transfusion may have their notes in Roses Day Care Unit. Children seen recently in clinic may have their notes stored in a Labelled bin in the Hot Office, awaiting completion of their Outpatient Letter. Movement of all notes should be tracked on Medway.

Discharge from ED / CAU / Roses Day Care Unit / Ifor Ward

If there are no other indications for admission, following discussion with the paediatric SpR or the CNS, the child can be discharged from ED, CAU or from Ifor Ward with:

- A supply of oral analgesia
- Instructions to drink 1.5L / m^2 / day

The child should have a follow-up appointment booked already. If there are particular concerns then this may be brought forward. If there was no appointment at all, then one needs to be made and AWR and EA informed.

- Ensure a supply of Folic acid and Prophylactic Penicillin V
- Specific course of antibiotics if there is evidence of infection

Social support / assessment

If needs are identified (met or unmet) then liaise with EA and AWR and when necessary, children and families social work team based at the Whittington Hospital. Discuss in Ifor Ward MDT on Tuesday afternoons. There is a weekly Sickle Cell MDT (adults and children) held every Monday at 1.30pm on Mercers Seminar Room

Tukiso Manonga (**TM**) is a Sickle cell counsellor are based in the community at the Hornsey Street Health Centre, N7 for Camden and Islington families and for Haringey, Enfield and Barnet families, counsellors are based at the George Marsh Centre, St Anne's Hospital, Tottenham, N15.

B. The outpatient attendances

The paediatric sickle clinic is held weekly on Monday mornings by AWR & SH, Dr Bernard Davis (**BD**) and EA the Clinical Nurse Specialist. In addition, TM and Ella Beeson (**EB**) paediatric clinical psychologist & Deborah Wellington (**DW**) consultant child psychotherapist are usually available.

The aims of the clinic are to:

- Monitor the medical, educational and psychosocial progress and development of the children with SCD and to make timely interventions
- Establish baseline observations for comparison in acute illness
- Educate parents and children in the management of sickle-related problems
- Provide genetic counselling

Appointment frequency

Well children with SCD are seen 3-6 monthly until 2 years of age and 6 monthly until their 5th birthday and annually thereafter, unless there are medical, educational or psychosocial concerns in which case they should be seen more frequently.

Prophylaxis against pneumococcal and other infections

There is very good evidence that penicillin prophylaxis protects against encapsulated bacterial septicaemia / meningitis ***provided it is taken regularly***. It is essential that all children with sickle cell disease take penicillin twice daily continuously (or clarithromycin, if penicillin allergic), starting by the age of 3 months. Stress to the parents the importance of giving it continuously and keep this under review.

Children should be vaccinated as per the UK vaccination schedule, which will specifically protect them for several severe types of encapsulated bacterial infections (eg. Meningococcal C, Haemophilus influnuezae type B (HiB) and the Pneumococcal Conjugate Vaccine (PCV) are all part of the routine immunisation schedule for all infants). Pneumovax is given to children with sickle cell disease over the age of two years and five yearly thereafter, for life.

The New Patient Appointment

Affected infants are usually referred following detection by the neonatal blood spot screening program. Some other, older children may be referred because they have moved into our catchment area, have immigrated to the UK, or been referred by colleagues at other centres.

Full history, including:

- Birth history -including mum's antenatal / booking serology
- Immunisation history - ask to see and take copies of any documentation
- Feeding and diet
- Developmental history including schooling and school attendances (be aware that subtle problems in development may be due to silent stroke)
- Medical history – include number, frequency and types of crises, previous HDU / PICU admissions
- Transfusion history
- Medication
- Allergies
- Family history - include names and DOB of siblings and haemoglobinopathy status, as well as family's previous experience of SCD
- Family Social History – include education, jobs, housing and country of origin

Examination, full and thorough, including:

- Baby check (if relevant)
- SaO_2
- Height and weight and head circumference (OFC) in infants and plot them
- Mid-parental height estimation
- Tanner / pubertal staging (as appropriate)
-

Blood tests (delayed in babies until >6 months old):

- FBC, retics and film
- G6PD assay
- Haemoglobinopathy screen. This should be repeated at 1 year of age
- U+Es, LFTs
- Group and Save and ***full red cell phenotype***

- Hepatitis B Ag and Ab
- Consider HCV and HIV Ab especially in those whose family have recently arrived in UK

Discuss:

- Diagnosis and its implications
- Acute complications in infancy including dactylitis, acute splenic sequestration
- Other complications as relevant
- Emergency Card and explain how to use it

***Provide / Organise / Prescribe*:**

- Instructions on how to examine for an enlarged spleen / liver
- Penicillin V and Folic acid
- Vaccinations
- Haemoglobinopathy card
- Emergency Card
- Contact details for the hospital, including EA and AWR's secretary
- Genetic counselling: plans for future children can be discussed
- Trans-Cranial Dopplers (TCDs)
- Splenectomy / hyposplenism card
- Referral to any other specialist as required
- GP information flyer ***(Appendix 5)***
- Follow-up appointment

The Follow-up / Annual Review Appointment

Not all of the following need to be done on each attendance. Always check that the child has had everything done on the new-patient list; due to the nature of a new-patient attendance it is not always possible to have achieved everything at that first appointment. Fill in Annual Review Sheet ***(Appendix 15)*** where appropriate.

History to include:

- Immunisation
- Diet
- Developmental progress (be aware that subtle problems in development may be due to silent stroke)
- School attendance and achievement; ask to read reports
- Medical history – include number, frequency and types of crises

- Snoring / sleep apnoea, consider ENT referral
- Other problems including enuresis
- Medication – including doses of analgesia used at home
- Allergies
- Family history - note any changes eg. siblings etc.
- Family social history – include jobs, housing
- HEADSS questionnaire in adolescents

Examination, full and thorough, including:

- Height and weight (OFC in <2yr olds) and plot them
- Document spleen and liver size and presence of pallor and jaundice
- Cardio-respiratory SaO_2, BP
- Pubertal staging (as appropriate, when >10yr old)

Blood tests*: 1 - 2 yearly*

- FBC, retics and film (inc. Hb A:S ratio only if recently transfused)
- Haemoglobinopathy screen. This should be repeated after 1 year of age
- U+Es, Creatinine, LFTs
- Group and Save
- HBV, HCV, HIV antigen / antibody if previously transfused
- Hep B antibodies if vaccinated

Provide / Organise / Prescribe / Check:

- Penicillin V and Folic acid
- Vaccinations
- Reinforce advice on healthy diet and lifestyle choices
- Travel advice as appropriate
- Ensure parents / patient aware of complications (esp. boys and priapism)
    - Discuss ***disease modifying therapy*** such as:
      - Hydroxyurea (Appendix 4)
      - Transfusion
      - Bone Marrow Transplant (BMT) **(Appendix 16)**
- Annual TCD from age 2 -16 years
- Transition plans to be introduced in those >15 years old
- Involve Clinical Psychologist *when there are concerns about developmental or cognitive abilities and or if there are particular difficulties in coping with illness*
- Follow-up appointment to be booked

SECTION 2

Management of specific issues in SCD

A. Pain
B. Limb / Bone Pain
C. Abdominal Crisis and Girdle Syndrome
D. Acute Chest Syndrome
E. Acute Severe Anaemia
F. Neurological Manifestations
G. Sequestration Syndromes
H. Priapism
I. Renal Problems
J. Biliary Tract
K. Avascular Necrosis and Orthopaedic Problems
L. Growth, Puberty and Fertility
M. Eye Problems
N. Transition to Adult Services

See 'Contacts' section (pages 69 – 71) for specialist advice for specific issues

A. Pain

Pain experienced by patients with SCD can be quite unpredictable and highly variable. Whilst pain is not directly life threatening, the application of inappropriate treatment can lead to unnecessary suffering and serious complications.
Treat common complications effectively as some of them can be life threatening. All children admitted must have analgesia prescribed at **regular** individuals. As required ('PRN') is not recommended.

Exclude and treat any complications such as:

- Sepsis (eg. osteomyelitis, septic arthritis)
- Acute chest syndrome
- Acute sequestration (splenic, pulmonary, hepatic)
- Acute abdomen (eg. cholecystitis)
- Vascular-stroke priapism, girdle syndrome
- Aplastic crisis (fall in Hb. no retics)
- Avascular necrosis (hips and shoulders)

(**See separate pages of guidelines for management)**

Ask about

- Site, severity and duration of pain (can involve any bone, but usually long bones, spine and sometimes abdomen)
- If pain is typical of *their* sickle cell disease pain
- Dactylitis or hand-foot syndrome (occurs in infants)
- Obtain treatment history -
  - Medication taken in the past 24hours
  - Previous hospital admission and medication as patients / family often know what medication and dosage have been effective in the past

Rapid assessment of acute pain episodes

- Severe pain should be considered a medical emergency requiring prompt assessment, and aggressive management
- Assess patients pain intensity using the hospital pain assessment tool ***(Appendix 2)***

- The patient is the best guide on the level of pain experienced. In the case of very young patients, the parent's assessment should be accepted
- Use pain prescribing guideline ***(Appendix 3)***
- **Pain management is equally effective given orally or intranasally, as it is intravenously.** Although intravenous analgesia is rapid and avoids absorption problems, repeated venous cannulation over months / years leads to loss of peripheral venous access which is a serious complication
- The goal of therapy should be adequate analgesia as determined by the patient, family and staff
- Monitor closely for complications of both sickle cell disease and analgesia treatment (respiratory rate, sedation score, drop in SaO_2 etc.)
- Analgesia should be given within 15 minutes of arrival at hospital (effective analgesia should be achieved within 30 - 60 minutes of first assessment)
- Pharmacological intervention **see *prescribing guideline* (Appendix 3)**
- Non-pharmacological intervention:
  - Reassurance - give the patient the assurance that their pain will be relieved as soon as possible
  - Heat pads / warmth
  - Establishing a position of maximum comfort
  - Massage
  - Distraction technique (eg. television, games consoles, storytelling, music, books may help most children)

B. Limb / Joint Pain

- This is usually due to VOC crisis but the possibility of osteomyelitis or septic arthritis needs to be considered as this can be difficult to differentiate. If in doubt, discuss with senior colleagues
- All patients should receive general pain management **(Appendix 2 & 3)**
- Never attempt to aspirate joint without prior discussion with duty consultants
- If febrile, start IV antibiotics (Ceftriaxone) after cultures taken, if temperature fails to respond to antibiotics after 48-72hrs repeat blood cultures, ESR, CRP, and consider ultrasound scan or MRI (the X-ray changes of osteomyelitis may take10-14 days to become apparent and are thus usually of little value)

C. Abdominal Crisis and Girdle Syndrome

There are a variety of clinical conditions that can result in abdominal pain.

Constipation is a very common cause of abdominal pain in these patients, especially if codeine or other opiates have been used as analgesia.

Abdominal crisis, characterised by abdominal distension, generalised abdominal tenderness but no rebound tenderness and diminished bowel sounds. The abdomen is not rigid and moves on respiration. Vomiting and diarrhoea are usually not prominent features.

Girdle (or mesenteric) syndrome is characterised by an established ileus, with vomiting, a silent distended abdomen and distended bowel loops and fluid levels on abdominal x-ray.

Bilateral basal lung consolidation may herald the onset of an **Acute Chest Syndrome.**Consider other possible **surgical pathology** such as acute appendicitis, cholecystitis, acute pancreatitis, biliary colic, peptic ulcer etc.

Investigations

- Chest x-ray (this may be repeated)
- Oxygen saturation
- Abdominal imaging, ultrasound and / or plain abdominal film
- FBC, U+Es, creatinine, LFTs, bone profile
- Serum amylase to exclude pancreatitis

Management

In addition to analgesia and fluids, as outlined under general principles of management, if there is vomiting, abdominal distension or absent bowel sounds, keep nil by mouth and consider naso-gastric suction.

- Cross-match blood for a top-up or exchange if transfusion likely
- **Girdle syndrome is an indication for exchange transfusion**
- Monitor abdominal girth (at umbilicus) initially 1 hourly, then 4 hourly.
- Measure liver size and examine chest. Monitor SaO_2 in air.
- Measure arterial blood gases if SaO_2<90% in air, as per chest syndrome
- **Initiate incentive spirometry *(Appendix 9)***
- Antibiotics if child is pyrexial, give Ceftriaxone or treat as per cholangitis

D. Acute Chest Syndrome (ACS)

ACS is probably multi-factorial in origin with infection, thrombosis of pulmonary arterioles and fat embolism all resulting in potentially similar clinical patterns.

Frequent clinical review, regular observations, demonstrating SaO_2 <94% in air and chest x-ray findings are all important in the recognition of this life threatening complication.

Children with SCD frequently develop simple pneumonia. Generally, these children usually have unilateral chest signs, are only mildly unwell, have normal SaO_2 and have no chest pain.

Any child with SCD in hospital has the potential to develop a chest crisis, no matter what they presented with

Care should be taken with opiate administration in any type of crisis, as over sedation may result in hypoventilation, atelectasis and worsening hypoxia precipitating a chest crisis.

Acute neurological symptoms should not be overlooked as they may herald a stroke that is a common sequele of an acute chest syndrome.

Symptoms and Signs

- Unwell, often quiet
- Pain (often pleuritic) in chest wall, upper abdomen and / or thoracic spine
- Respiratory distress, hypoxia, cough
- High fever, tachycardia
- Signs of lung consolidation, usually bilateral, generally starting at the bases, but may be unilateral and impossible to distinguish from infection
- Drop in Hb (>10g/L)
- **Physical signs often precede x-ray changes**

Investigations

- FBC and retics
- Hb HPLC (HbS/F, or HbS/F/A if recently transfused)
- Biochemistry (U+Es, Creatinine, LFTs, CRP)
- Blood cultures and other infection screen, as clinically indicated
- Atypical pneumonia serology
- Cross match packed red cells 60ml/kg immediately
- Arterial blood gases (ABG) if SaO_2< 90% in air
- Chest x-ray

Management

- ***Transfer all patients to HDU***
- Urgent review by paediatric SpR / attending consultant paediatrician, liaison with haematology and discussion with CATS service
- Oxygenation - options include face mask oxygen or may need CPAP
- Analgesia *taking care not to over sedate with opiates*
- Intravenous fluids withhyperhydration, as for painful sickle crisis, **take care to avoid fluid overload; diuretics* are not helpful**
- Antibiotics IV ceftriaxone and oral azithormycin
- Beta 2 agonists**,** Salbutamol nebulisers, especially in known
- Incentive spirometry (+ device) with on-call physiotherapist ***(Appendix 9)***
- Blood Transfusion, either top-up (if early in illness with low Hb) or full exchange
- Discuss with transfusion laboratory staff; blood may need to come from NBTS
- Continuously monitor – SaO_2,pulse and respiratory rate blood gases as indicated

*NB. diuretics are contraindicated even though CXR and signs may mimic pulmonary oedema

E. Acute Severe Anaemia

Patients with SCD usually have a variable degree of anaemia at all times due to ongoing extravascular and intravascular haemolysis. A drop in Hb >20 g/L below steady state level or rapidly falling Hb may result in the symptoms of anaemia. Beware that patients with SCD usually run a **high** reticulocyte count.

Differential diagnosis includes:

1. Failure of Red Cell Production

- Acute transient red cell aplasia (often caused by acute Parvovirus B19 infection)
- Any other cause of bone marrow failure eg. severe sepsis, drugs

2. Sequestration - in spleen (usually), or occasionally liver, or rarely lung

3. Haemolysis

- Worsening of background haemolysis eg. sepsis / or prolonged VOC
- Haemolytic transfusion reaction

- G6PD deficiency, haemolytic episode
- Hyperhaemolysis (rare but severe, check HPLC of any haematuria, see page 45)

4. Bleeding

Management and Investigation

1. Admit
2. Assess Airway, Breathing and Circulation (ABC) during evaluation consider ;
   - Intravenous access
   - Rate of fall of Hb
   - Cardiovascular compromise
3. Full history and examination as per Sickle Assessment Proforma sheet ***(Appendix 1)***
   - Note size of liver and spleen
4. Inform haematology SpR/consultant on-call and consultant paediatrician
5. With senior paediatrician and haematogist, rapidly work out which is the most likely diagnosis as the treatments differ. Rapidly consider the following points:

Transfusion history

- Perform Group and Save and antibody screen, cross-match to achieve Hb at least as high as baseline

Reticulocyte count

- **Low (lower than steady state %)** implies **failure of production** or hyperhaemolysis
- **High** implies **sequestration** or **bleeding** (when it may be a delayed) or **haemolysis**

Bilirubin

- Unconjugated hyperbilirubinaemia is more common in sequestration and haemolysis

Other markers of haemolysis

- Visual inspection of urine colour
- Urine dip including urobilogen, urine microscopy; Haemoglobinuria is a rare but very important finding in hyperhaemolysis, request an HPLC on spun urine sample
- Raised LDH
- G6PD screen often difficult to interpret if high reticolucyte count
- Parvovirus serology

Treatment

Immediate red cell transfusion is necessary if Hb <50 g/L or if symptomatic, otherwise a top-up to level of steady state Hb ***see page 46-48***

Parvovirus B19 induced acute transient red cell aplasia

It is characterised by a drop in Hb >20 g/L below steady state level or rapidly falling Hb and a low level of reticulocytes (eg. only <5%) given the degree of anaemia. The main differential diagnosis is splenic sequestration with splenomegaly, high retic count and jaundice. The characteristic viral prodromal illness classically known as erythema infectiosum ('slapped cheek syndrome' aka 'fifth's disease') may be hard to recognize on a pigmented skin. **Please note *any child* suspected as having a parvovirus infection attending the paediatric department should be isolated to protect patients with haemolytic anaemia and pregnant women.** Aplastic crisis may affect multiple members of a family concurrently or consecutively, so make enquiries about siblings with specific reference to if any affected by haemoglobinopathy. Immunity to parvovirus is usually life-long, so second infections are very rare.

Diagnosis

- FBC shows a reticulocytopenia and absence of nucleated red blood cells on blood film despite low Hb
- Parvovirus IgM / PCR present

Management

- Urgent red cell transfusion is usually necessary (if Hb <50 g/L and/or symptomatic)
- Spontaneous recovery is heralded by return of nucleated RBCs and reticulocytes to peripheral blood

F. Neurological Manifestations

1. Stroke (Cerebro Vascular Accident or CVA)

Stroke is a devastating complication of SCD, most commonly occurring in HbSS. SCD is the overall commonest cause of stroke in childhood in the UK and occurs with an incidence of approximately 4% children with SCD (UK figures). Vaso-occlusive strokes are commonest in young children and older adults; haemorrhagic strokes occur in early adulthood.

Strokes of the middle cerebral artery territory are the most common presentation. Strokes will often occur as a complication of an ongoing crisis, in particular a chest crisis and so

staff should always be alert to any change in neurological status. Children with sickle cell stroke present in a variety of ways ranging from a mild transient weakness that resolves (eg. a Transient Ischaemic Attack or TIA) to presenting obtunded in a coma.

The acute management of a child with a stroke requires neurological and intensive care support and red cell exchange (see RCP Guidelines: Stroke in childhood http://www.rcplondon.ac.uk/pubs/books/childstroke/childstroke_guidelines.pdf).

In the long term children with risk factors for stroke eg. high TCD velocity >200cm/sec and or evidence or previous CVA on MRI & MRA should be placed in a chronic red cell transfusion programme aiming to keep the HbS <30%.

Symptoms and Signs

- Many and varied presentations, often include: severe headache, slurred speech, blurred vision, limp, abnormal behaviour or seizures
- Altered level of consciousness, hard neurological signs consistent with hemiplegia
- If in doubt, investigate as for a stroke

Investigations

- MRI / CT scan of brain without contrast should be performed to look for CVA and to exclude haemorrhage (infarcts may not be apparent on CT in the very early stages)
- MR Angiography should be performed later (see below)
- FBC, U+Es, creatinine, LFT, HPLC screen
- Group and Save for red cell phenotype (if not already done) and cross-match (30mls/kg amount of blood for exchange)
- Save serum for baseline virology – HBV, HCV, HIV
- Discuss with consultant if raised intracranial pressure (lumbar puncture may be necessary to exclude infection or haemorrhage)

Management - Acute

- Evaluate ABC and give high flow oxygen
- Admit to HDU and inform attending consultant paediatrician and haematologist
- Intravenous access and re-hydrate if dry
- Urgent neurological assessment and regular monitoring of neurological status
- Seizures may occur and require anticonvulsant therapy
- Exchange Transfusion:
    - This must be carried out urgently; this is usually performed in 2 / 3 stages with an interval of 4-8 hours between each exchange; the aim is to achieve an HbS level <20-30% and to raise the haemoglobin to 100-110g/L ***(Appendix 7&8)***
    - If the patient has had a neurological event in the context of a severe anaemia eg. splenic sequestration or aplastic crisis, or if exchange transfusion is going to be delayed for more >4 hours, then top-up transfusion should be undertaken
    - In children with a recently resolved TIA, it is not usually necessary to exchange transfuse urgently 'out of hours'; the decision to perform exchange transfusion should be taken if there is evidence that there is a new infarct or bleed and / or the child is clinically unstable. Discuss need with attending consultant paediatrician and haematologist on call
- **Urgent neurosurgical referral to GOSH should be considered in children with stroke who have a depressed or deteriorating conscious level or other signs of raised intracranial pressure**
- Discuss with paediatric neurology at GOSH
- As soon as possible after admission, all children should have an evaluation of their rehabilitation needs eg. swallowing safety, feeding and nutrition, communication, pain, moving and handling requirements, risk assess positioning requirements etc.
- All children with a stroke should have a multidisciplinary assessment within 72 hours of admission to hospital

Non-urgent management:

- MR angiography (to assess the pathogenesis, risk of recurrence and need for revascularisation) - the risk of recurrent neurological events is greatest in those with abnormal cerebral vasculature
- Recheck TCD
- Establish a monthly transfusion program to maintain the HbS level < 30%
- Children with moya-moya disease should be referred to the paediatric stroke clinic

at GOSH for consideration of re-vascularisation

- Advice should be offered regarding general measures for prevention of arterial disease particularly smoking, exercise and diet

2. Subarachnoid Haemorrhage

Uncommon in children and often associated with multiple intra-cranial aneurysms

Investigation

- CT scan without contrast
- Consider MR angiography later

Management

- Exchange transfusion should be arranged urgently as an operation may be advised
- Refer to neurosurgeons (GOSH)

3. Convulsions

Simple childhood febrile convulsions may occur with fever of any cause, however it is important to distinguish these from convulsions due to cerebro-vascular sickling. Convulsions are common following stroke.

Investigations

- CT *or* MRI
- Consider MR angiography
- Blood cultures and other infection screen, as clinically indicated
- EEG

Immediate Management

- Evaluate ABC and give high flow oxygen
- Anticonvulsant, usually Midazolam (Buccal) or Diazepam (PR) or Lorazepam (IV)
- Antipyretic (eg. paracetamol) if febrile
- Unless likely to be a febrile convulsion or the child is known to be epileptic, urgent intracranial imaging should be performed
- Discuss need for exchange transfusion with attending paediatric and haematology consultants on call. It is not usually necessary to exchange transfuse urgently 'out of hours'; the decision for exchange transfusion should be taken only where there is evidence that the seizures are associated with a new infarct or bleed and / or the child is clinically unstable

Definitive Management

- If no abnormality on EEG and CT / MRI and no recurrences, watch and wait
- If EEG abnormal, but CT / MRI and MR angiography are both normal, consider anticonvulsants
- If infarction on scanning, or vessel stenosis / occlusion on angiogram, exchange transfuse and consider hyper-transfusion regime

G. Sequestration Syndromes

1. Splenic Sequestration

Splenic sequestration is more common and most hazardous in infants and young children (< 5 years old) when it can be very rapid, however it can recur and it can happen slowly.

Symptoms and Signs

- Pallor and lethargy
- Abdominal pain (pulling legs up to abdomen)
- Abdominal distension with acute splenomegaly
- +/- fever due to associated sepsis
- Sudden drop in stable Hb > 20g / L

Investigations

- FBC and retics (raised / normal in sequestration, absent in aplastic crisis)
- Biochemistry (U+Es, Creatinine, LFTs, CRP)
- Blood cultures and other infection screen, as clinically indicated
- Cross-match half the patients estimated blood volume

Management

- Evaluate ABC and administer high flow oxygen
- Admit HDU and secure IV access and request urgent cross-match
- Immediate fluid resuscitation 20ml/kg 0.9% saline IV bolus (whilst awaiting blood)
- Emergency top-up transmission of packed cells
- Broad-spectrum IV antibiotics (Ceftriaxone)
- If the patient becomes tachypnoeic, develops chest signs, then check SaO_2 and treat as per Chest Crisis
- Paediatric sickle team (AWR and BD) will decide further management (eg. elective transfusions or splenectomy)
- Parental education (reinforce ability to look for and palpate splenic enlargement)

2. Hepatic sequestration

Symptoms and Signs

- Right hypochondrial pain, abdominal distension
- At risk of sudden life threatening cardiovascular circulatory collapse
- Pallor, shock (tachycardia, hypotension, tachypnoea)
- +/- fever due to associated sepsis
- Enlarging tender liver, increasing jaundice

Investigations

- As for splenic sequestration, NB. conjugated bilirubin may be very high
- Exclude gallstones / cholestasis using ultrasound

Management

- Evaluate ABC and administer high flow oxygen
- Admit HDU and secure IV access and request urgent cross-match
- Immediate fluid resuscitation 20ml/kg 0.9% saline IV bolus (whilst awaiting blood)
- Emergency top-up transmission of packed cells
- Broad-spectrum IV antibiotics (Ceftriaxone)
- If the patient becomes tachypnoeic, develops chest signs, then check SaO_2 and treat as per Chest Crisis

H. Priapism *(the persistence of an unwanted erection, usually painful)*

Stuttering Priapism

- Pain of variable intensity
- Erection lasting < 3 hours
- Penis may not be fully erect (corpus spongiosa [glans] not involved)
- Low risk of cavernosal fibrosis and impotence
- Recurrent
- Risk of subsequent fulminant attack

Fulminant Priapism

- Severe pain
- Duration >4 hours
- Penis fully erect (both corpus cavernosa and spongiosa involved)
- High risk of cavernosal fibrosis and impotence
- Urgent urological intervention indicated

General Principles of Management of Priapism

- Encourage patient to pass urine
- Try warm bath
- Hydration
- Analgesia - usually parenteral opiates
- Sedation may be required in severe cases

(Appendix 14): acute management of fulminant and stuttering priapism

General Points

Many boys with SCD and parents are not aware that priapism is a complication of SCD and may be reluctant to discuss it. Stuttering priapism is under-diagnosed, symptoms should be specifically asked for at outpatient clinic visits. Emphasise that it is vital to attend for treatment as early as possible, if simple measure fail to achieve detumescence. Delay may increase the risk of cavernosal fibrosis and impotence.

I. Renal Problems

1. Haematuria

Microscopic haematuria is common in SCD; macroscopic haematuria may be due to urinary infection or papillary necrosis. Passing of renal papillae may cause renal colic and ureteric blockage. Haematuria can occur in patients with sickle cell trait (HbAS).

Investigations

- MSU for culture to exclude infection
- Renal tract ultrasound scan

2. Nocturia and enuresis

Nocturia is more common in patients with SCD due to obligatory high fluid intake, coupled with reduced urinary concentrating capacity. Nocturnal enuresis occurs in those children who don't wake up to pass urine. It is not necessarily more common than similar aged children without SCD. Cultural and familial influences may play a part. Exclude urinary tract infection (UTI). Reassurance, patience, and measures such as reward systems, bell and pad training etc. may be required.

When both snoring and nocturnal sleep apnoea are also present, a sleep study at GOSH should be arranged from clinic. Consideration of referral for ENT, to the enuresis clinic or to the sickle clinical psychologist from age 7 years may be made in outpatients.

3. Urinary Tract Infections

Not uncommon in SCD, in either sex. It should be fully investigated and treated to prevent serious renal pathology. Haematuria, secondary to papillary necrosis, can precipitate UTI but other factors must be excluded. Any child with a urinary tract infection should be treated and then investigated according to Whittington Paediatric UTI Imaging guidelines.

4. Chronic Renal Failure

Common in adults with SCD but rare in children. Predictors include increasingly severe anaemia, hypertension, proteinuria, nephrotic syndrome, and microscopic haematuria. AWR will want early referral to paediatric nephrology in any SCD affected child presenting with nephritis.

Investigations

- U+Es, calcium, phosphate, bicarbonate, immunoglobulins and autoantibodies
- FBC and reticulocytes
- MSU for M, C + S; 24 hour urine collections for creatinine clearance
- Ultrasound of kidneys and bladder

Management

- Refer to GOSH nephrology team
- Consider erythropoietin and / or hypertransfusion regime

J. Biliary Tract

1. Gallstones

In patients with any cause of chronic haemolysis, who have a high bilirubin turnover (as in SCD), will lead to a high incidence of pigment gallstones. Most often in SCD they are asymptomatic but can precipitate painful abdominal crises and girdle syndrome. They can also cause:

- Acute cholecystitis
- Chronic cholecystitis
- Biliary colic
- Obstruction of the common bile duct
- Acute pancreatitis

Investigations

- Plain abdominal x-ray (approx 50% of stones are radio-opaque)
- Abdominal ultrasound

Differential Diagnosis of Right Upper Quadrant Abdominal Pain

- Biliary colic
- Cholecystitis
- Hepatitis
- Peptic ulcer
- VOC episodes
- Hepatic sequestration
- Chest syndrome

Management

Acute episode of cholecystitis

- Analgesia
- Hydration
- Antibiotics (discuss with King's College Hospital [KCH] Liver team)

Recurrent episodes of cholecystitis are an indication for cholecystectomy. Refer for KCH surgical opinion regarding elective cholecystectomy.

2. Intrahepatic Cholestatsis

Rarely some patients experience episodes of severe hyper-bilirubinaemia (conjugated and unconjugated) with moderately raised alkaline phosphatase, associated with fever and hepatic pain in the absence of demonstrable stones. These episodes are thought to be due to severe intra-hepatic sickling.

Management

- Analgesia *caution as opiates are metabolised in the liver*
- Hydration
- Antibiotics (discuss with KCH Liver team)
- Monitor LFTs as hepatic sequestration
- Hyperhaemolysis +/- sequestration may supervene, requiring frequent transfusion
- In severe cases, exchange transfusion may be needed

K. Avascular Necrosis and Orthopaedic problems

Avascular necrosis (AVN) of the proximal femur (or proximal humerus) may start in childhood or complicate adolescence and often gives rise to chronic pain and limitation of movement due to joint damage (rather than ongoing vaso-occlusion). Children with the HbSC genotype may be more prone to AVN.

Presentation

- Pain in the hip or groin and referred pain to leg or knee on movement; later at rest, repeated or prolonged pain (>8 weeks) should be investigated for aseptic necrosis Proximal humeral changes may be seen in shoulder joint as an incidental finding on CXR
- Limitation of movement; particularly abduction and external rotation of the hip joint and external rotation of the shoulder

Differential diagnosis

- Osteomyelitis
- Septic arthritis suggested by pyrexia, systemic illness and positive blood cultures

Investigations

- X-ray
- MRI (will show changes earlier than x-ray)

Management

- Non-steroidal anti-inflammatory agents +/- or codeine derivatives
- Rest and the avoidance of weight bearing (difficult to implement)
- Refer to Mr Aresh Hashimi-Nejad at RNOH Stanmore for orthopaedic assessment and treatment
- Disease modifying therapy, Hydroxyurea or Transfusion can't reverse the process but may prevent progression to the contralateral joint
- Pre-operative transfusion prior to tenotomy or osteotomy and for 3 months post-operatively to maximise bone healing

Types of Orthopaedic intervention for AVN of hip:

Tenotomy to improve range of movement or osteotomy and / or decompression surgery to improve joint prior to the end of adolescent growth phase. Major joint surgery may be necessary if pain is continuous (> 2 years) or very severe, or if the patient's mobility is seriously affected. Different types of prosthesis, hip fusion, or bone grafting are used depending on the individual case. Cemented prostheses are avoided (otherwise 're-do' surgery less possible). Loosening of the prosthesis is quite common. Infection is a common hazard. The possibility of failure, the likelihood of some residual pain, the potential life of the prosthesis, and the limitations imposed are discussed with the patient pre-operatively.

Osteomyelitis/ Septic Arthritis

The diagnosis of osteomyelitis in the context of SCD is often difficult and relies on factors such as:

- Positive blood cultures, persistent signs of inflammation around site, unusual swelling and / or pain
- Fevers may not be persistent. A high CRP / ESR may be non specific
- Ultrasound and MRI are helpful but Isotope scans may give ambiguous results
- X-ray changes in osteomyelitis do not appear until at least 10 days after the onset. Input from the orthopaedic team may be required. Joint aspiration may be useful in order to try to identify organisms if fluid has been seen on ultrasound (never aspirate an affected joint without prior discussion with a consultant.)

Salmonella previously was the commonest cause of osteomyelitis in SCD patients, but Staphylococcus aureus is now probably most common and S. pneumoniae is also seen. If the decision is taken to treat for osteomyelitis antibiotics should be chosen to cover these organisms eg. Ceftriaxone. Length of antibiotic treatment will depend on the certainty of diagnosis and clinical course and will involve input from the paediatric, microbiology and orthopaedic teams.

L. Growth, Puberty and Fertility

The well siblings and Afro-Caribbean peers of young people with SCD will often be earlier than their school mates of other ethnicities to go through the growth spurt and the physical changes of puberty. SCD affected individuals have a much higher incidence in delay, especially when they have a lower Body Mass Index (BMI) and when there are chronic nutritional and health concerns. The growth of all children (height and weight and Tanner staging when >10 yrs old) is monitored in clinic, in relation to their mid-parental (expected) height.

1. Delayed Puberty

- Common (often noticed more in boys)
- Related to lower body mass for age in children with SCD

Management

- Reassure, most will progress to puberty and achieve mid-parental height
- More frequent clinic review (eg. 4 monthly), careful clinical assessment of Tanner staging and testes volume in boys
- When BMI low or there are known nutrition concerns, take a dietary history and recommend improved quantity and quality of food (eg. to stop skipping breakfast) and refer to dietician
- Endocrine review as appropriate, if there are no signs of puberty by 13 years in a girl or 15 years in a boy, clinic team may well discuss and refer to endocrine team (Dr Joe Raine and Dr Yuva Moyo)

2. Fertility

Young women with SCD are normally fertile, however rates of miscarriage and low birth weight infants is more common as placental function is affected by sickling. Contraception advice should be made available (HEADSS questionnaire ***Appendix 13***).

Boys with HbSS (and HbSB°thal) have reduced sperm counts and reduced sperm motility - some may have erectile impotence because of previous priapism.

Genetic counselling should be provided. Pre-implantation of screened embryos (IVF technique) is now available on the NHS for couples at risk of an affected foetus, refer to UCLH Foetal Medicine team for eligibility. For information about pregnancy, contraception and termination of pregnancy discuss with the haematology consultant and refer to adult guidelines.

3. SCD patients on disease modifying therapy

Those children with SCD on Hydroxyurea and especially those on long term blood transfusion and chelation for iron overload need to be closely monitored from a growth and puberty perspective. Ideally, the minimisation of their potential to have SCD complications usually means that they 'catch up' with their growth and go into puberty as expected. Those whose iron overload has been hard to manage (especially on Desferrioxamine) are the most at risk of endocrinopathy (eg. hypogonadotrophic hypogonadism).

M. Eye Problems

The ocular complications due to SCD are uncommon in children until the end of the second decade; however retinal vessel occlusion may begin in adolescence (in particular in children with HbSC). All patients are referred for annual ophthalmological assessment from transition to adult clinic (usually between 17-18th birthday). Children on regular transfusion regimens receiving chelation require annual ophthalmological assessment.

Management

- Refer children to Mr Saurabh Jain Clinic 3D
- Transitioned adult patients are seen by Mr Riaz Asaria Clinic 3D

Laser therapy is the treatment of choice for proliferative sickle retinopathy. Vitreous haemorrhage and retinal detachment may occur. Surgical treatment should not be undertaken without prior exchange transfusion.

N. Transition to Adult Services

Transition is the planned movement of adolescent patients from a child centred environment to the adult service. It is a process (rather than a 'milestone') and usually an introduction starts at an early age (eg. 13-14 years) by talking about it and continues until the full transfer has occurred, usually between 17th-18th birthday.

The process is very important for this group of young people as it provides an opportunity to answer whatever questions they might have on their future health care and medical management as well as to provide support and give other information and services available.

Adolescents with SCD may have problems with adjustment during this process. It is therefore essential to set out guidelines to effectively manage the transition. This may be on individual basis.

Transition is considered complete once the patient has agreed a personalised written management plan with adult haematologists in clinic which is then held in a folder in ED. If the young person has not yet reached this point, then consider their Emergency Card as still valid and admit when necessary to Ifor ward.

Needs Assessment

- Target age group (13 to 17 years)
- Assess patients' knowledge and understanding of condition and update with relevant information
- Assess patients' self-management ability regarding medication, outpatient attendance, pain management and support (see transition questionnaire)

Liaison Between Child and Adult Services

- Discuss concerns about the transition process including health care in adult setup with the adolescent and family
- Have a dedicated adolescent clinic in paediatrics with the adult haematologist present from ages 13 to 17 years
- Have alternate clinic appointments with the adult team from age 15 years
- Final transfer date must be flexible to address specific needs of the adolescent

Information for Young People / Family

Provide information on health promotion regarding

- Dangers of smoking
- Healthy eating
- Alcohol abuse
- Substance misuse
- Sexual and reproductive health
- Vocational and educational opportunities
- Independent living
- Signposting to relevant services / websites when required
- Dealing with emergency situations e.g. when unwell.
- Hold workshop for adolescents and family (at least once a year)
- Tour relevant adult units (pharmacy, A&E, adult clinics, wards etc)
- Meet staff providing adult care including counsellors, social workers etc.
- Discuss expectations with adolescent patient and family
- Discuss role of staff
- Discuss coping strategies

Post Transition to Adult Team

- Adolescents to have access to the paediatric specialist nurse for 1 year
- Audit transition experience

SECTION 3

TRANSFUSION AND CHELATION

A. Transfusion

- Top up
- Exchange

B. Chelation

A. Transfusion

All staff involved with the prescription and administration of blood and blood products must be familiar with the Trust transfusion guidelines (on Intranet) and should have completed http://www.learnbloodtransfusion.org.uk/ training.

Transfusion will be administered either on Ifor Ward or Roses Day Unit. Elective transfusions are usually done on Roses and done either by the CNS or day unit staff. Emergency exchange transfusions should be carried out on HDU.

Elective cannulation is usually done by nursing staff, except in some very young or difficult to cannulate patients, when medical staff will be requested to do so. **No-one should have more than 2 attempts to cannulate before requesting more senior help.** The 'cold light' is available to assist cannulation in those trained to use it safely.

Top up Transfusion

1. Acute indications*:*
    - Acute splenic sequestration
    - Aplastic crisis
    - Early on in Acute Chest Syndrome with low Hb (e.g. < 80 g/L)

2. Elective management of chronic sickle problems for example:
    - CVA prevention or prophylaxis or for other CNS complications
    - Chronic organ damage such as chronic renal failure or chronic lung disease
    - Intractable or very frequent painful crises

Aim to keep the HbS level < 20-30% (depending on clinical situation). This can be achieved by regular top-up transfusions keeping the Hb between 100 -110 g/L, typically every 3-6 weeks.

3. Elective pre-operative preparation for surgery, in risk group 1 or 2 ***(Appendix 12)***

For top-up transfusions the volume of SAG-M blood required (ml) is:

(Hb desired - $Hb_{current}$)x Weight (kg) x 0.4 = Volume needed (mls)

Investigations to be performed prior to admission for transfusion

- FBC
- HbS % level (if recently transfused or on regular transfusion)
- Cross-match (ensure that extended RBC phenotype is already known)
- U+Es, Creatinine, LFTs
- Ferritin (if transfused regularly)
- Patients having elective transfusions must be vaccinated against Hep B
- Hepatitis C antibody status prior to embarking on regular transfusions

DO NOT attempt to raise the haemoglobin by more than 40 g/L at any one transfusion. The usual rate of transfusion is **2-3ml/kg/hour** and for elective transfusion should **never exceed a maximum rate of 150 ml/hour.**

- Post-transfusion, check FBC and HbA/S/F ratio

Additional annual investigations to be checked

- HBsAg, level of anti-HBs Ab (revaccinate if < 100 iu/ml)
- HCV Ab and save serum
- HIV Ab (with parental/guardian consent) at onset

Exchange Transfusion *(Appendix 7 & 8)*

- Full exchange transfusion (30mls/kg)
- Partial exchange transfusion (15mls/kg)

Exchange transfusion may be undertaken to rapidly reduce the percentage of sickle cells in the circulation when a patient develops a life-threatening complication of the disease. It is not to be undertaken lightly, as the possibility for complications are considerable.

An automated Exchange Transfusion can be performed using an Erythrocytophoresis machine is available at the Macmillan Cancer Centre, Huntley Street, UCLH.

Consider exchange transfusion for the following:

- Severe sickle chest syndrome (eg. low or falling PaO_2) or Girdle syndrome
- Acute new CVA
- Multi-organ failure eg. associated with systemic fat embolism
- Fulminant priapism (> 4 hours) unresponsive to pharmacological therapy
- Elective exchange transfusion may be indicated for preparation for surgery risk group 3 ***(Appendix 12)***

Aim

a) To reduce the HbS% level to < 20% over 2 - 3 days if acutely ill, when more rapid exchange may be appropriate

b) To keep Hb < 100g/L initially and by the end of the procedure (or at steady state level in those with higher baseline Hb, eg HbSC patients with Hb of 110-120 g/L

c) To maintain a steady state blood volume and Hb throughout the exchange

Exchange transfusions must be undertaken by experienced medical and nursing staff and must not be initiated without discussion with the responsible paediatric and haematology consultants

General Principles

- Patients must be well hydrated prior to starting an exchange transfusion. Adequate explanation must be given to the child and parents as to the indication for exchange and its potential risks and benefits and this should be documented in the notes
- Principle of asepsis should be maintained as much as possible throughout the procedure by using a closed circuit
- Record output and input on the exchange transfusion record chart ***(Appendix 8)***
- **DO NOT use diuretics**
- Continue to administer intravenous fluid at the standard rate between exchange transfusion cycle to keep child well hydrated
- Critically ill patients may require exchanges to be more frequent than daily
- If possible, leave a 4 - 8 hour break between exchanges
- Pay particular attention to PaO_2, CVP, acid base balance, U+Es, Ca^{++}, Mg, core temperature and clotting in sick patients
- As the patient's Hb is << the donor blood Hb, do not simply exchange patient blood for donor blood, or the patient's Hb may rise unacceptably (Hb > 120g/L is hazardous)
- Exchange transfusion should be an **isovolaemic** procedure and exchanges done in aliquots of approximately 5ml/kg (do not exceed 10ml/kg aliquots)
- The Hb should be <100g/L to reduce the risk of hyper viscosity
- Continue with exchange procedures ***(Appendix 8)*** until the HbS%<20

Preliminary investigations

- FBC
- Hb A/S ratio (not urgent at first exchange)
- Cross match approx 30mls/kg (average unit contains 220 -250mls)
- Request **exchange transfusion blood** from laboratory. This is SAG-M blood, which is the freshest available (to prolong its life in the patient and to decrease the potassium load). It will need to be ABO, Rh and Kell matched and sickle negative
- U+Es, Creatinine, LFTs, Ca^{++}
- Arterial blood gases in those with symptoms suggestive of acute chest or girdle syndrome
- Save Serum for Hepatitis B and C and HIV, if not done recently

Volumes required

Exchange transfusion in children requires a total exchange of 1.5x - 2x their blood volume, performed as 3 or 4 exchanges. Usually, equal volumes venesected and transfused, but must replace venesected blood as $^1/_3$ saline and $^2/_3$ packed cells to keep haematocrit stable.

Volume (ml) exchanged in each procedure can be calculated as:

30 x weight (in kg) = volume in ml *(Appendix 7)*

Worked Example:

25 kg Child, starting Hb = 70g/L @ 30ml/kg = 750mls blood required

Request 4 units for exchange (each unit is 220 – 250 mls)

Vascular access – 2 ports of venous access are required: one for venesection, the other for administering blood and saline. In certain cases an arterial line may be used for venesection.

Observations:

- Pulse, respiratory rate, BP and SaO_2 every 15 minutes
- Temperature hourly

Possible immediate complications (to any transfusion)

- **Transfusion Reaction** (see Trust blood transfusion guidelines)
- Tetany / twitching
- High Hb may cause sludging, worsening the sickling process. May cause

cerebral sludging particularly in patients with prior CNS problems

- Hypertension in patients with circulatory overload. If diastolic BP increases by > 20 mmHg above baseline recording.

Possible late complications

- ***Hyperhaemolysis*** is a poorly understood but a severe and lifethreatening that is rare and unpredictable. It is characterised by a delayed acute severe drop in haemoglobin following any transfusion, with evidence of destruction and haemolysis of both the patient's native red cells and the transfused blood. It is caused by an unidentified antigen-antibody interaction. Management requires transfer specialist haematologists with a PICU. Intravenous Immunoglobulin and high dose steroid therapy may enable successful top up transfusion.

Equipment / procedure *(Appendices 7 & 8)*

B. Chelation

Chelation therapy should commence after a child has received 15-20 transfusions or when the ferritin reaches >1000 µg/l. Ferritin is an acute phase reactant which rises with acute infection or inflammation, so it is important that the ferritin is checked at least on 2 occasions when the patient is well, prior to starting chelation therapy. A baseline liver iron MRI (Ferriscan) will also be checked. The decision to start chelation therapy will be made jointly by paediatric and haematology consultants and the CNS.

Desferrioxamine (DFO or Desferal)

Desferrioxamine is the chelator of choice. Desferrioxamine has a detrimental effect on skeletal growth so treatment should be deferred until the age of 2 unless iron overload is particularly severe.For patients on regular top-up transfusions with a rising ferritin, Desferrioxamine (DFO) is usually given as an overnight subcutaneous infusion. **The standard dose of DFO is 20-50 mg/kg/day up to 7 nights per week.** Patients on Desferrioxamine are prescribed **Vitamin C at a dose of 2 mg/kg/day (maximum 200 mg/day).** This is given on the days when the patient receives DFO. **This should not be commenced until the patient has been on DFO for one month. It should not be given to patients with cardiac dysfunction.**

Side effects

- Local reactions
- Allergy
- Abdominal pain or diarrhoea may indicate infection with Yersinia (stop Desferal, admit, discuss with microbiology consultant / registrar)
- Hearing and eye damage
- Skeletal problems

Additional Annual Investigations:

- Annual ophthalmology review
- Annual audiology review
- Glucose, HbA1C, cortisol
- TSH/T4, FSH/LH/oestradiol or testosterone
- ECG and ECHO or MUGA-scan
- MRI for estimate of liver / cardiac iron overload at intervals depending on compliance

Deferiprone (L1)

Deferiprone (as a single agent):the daily dose of Deferiprone that has been evaluated most thoroughly is 75 mg/kg/day,(max 100mg/kg/day), given in three equally divided doses. Most of these studies have assessed the safety of Deferiprone and found this dose to be effective in reducing the serum ferritin in some *but not all* patients. However there is great individual variation and some patients will be effectively chelated with Deferiprone monotherapy whilst others will not. Deferprone is not licensed for use in children below the age of 10 years in Europe.Children may be started on this as third line therapy or if there is evidence of severe myocardial loading.

All patients must be warned of the risk of neutropenia and severe agranulocytosis and how to access the hospital urgently if they develop a fever or sore throat.

Careful monitoring of the patient's clinical condition and laboratory examination during therapy with Deferiprone is essential. Weekly blood counts are highly recommended so that a falling white cell count can be detected early and treatment stopped. Liver iron quantification before and during therapy is advisable. In patients who have had an episode of neutropenia on Deferiprone, agranulocytosis is more likely and Deferiprone should be used only with extreme caution and frequent monitoring.

Side effects:

- Nausea, vomiting abdominal pain, increased appetite: 30%
- Joint pains predominantly knees, hips, elbows and wrists. Occasionally severe and can be destructive in nature
- Severe agranulocytosis or neutropenia (1% and 4%)

Formulation:

Tablets of 500g strength and Syrup formulation: 100mg/ml

Initial dosing:

Start with 50mg/kg/day for the first month and look carefully for side effects. Increase dose to 75mg/kg/day (25mg/kg/day TDS) thereafter. It is important that the total dose per day is divided into 3 and each dose is taken at least 4 hours apart

Monitoring:

- Weekly FBC
- Monthly LFTs
- Serum zinc every 3 months

Deferiprone with Desferrioxamine:

The side effects of both drugs will need to be monitored. This regime should be used only in children with severe iron overload or where there is myocardial iron loading. Initiation of Deferiprone should not occur until the patient is stable and clinically out of acute cardiac failure. It is often advisable to wait for 2 to 3 weeks before introducing Deferiprone in this setting.

Initiation should be at a total daily dose of 50mg/kg/day with an increase to 75 mg/kg/day after one month. The Desferrioxamine dose should be reduced when Deferiprone is introduced due to concerns around the potential for neutropenia to develop with this regimen at high doses. It is recommended that a maximum dose of 35mg/kg/day of Desferrioxamine be used and as the ferritin falls the dose should be reduced as quickly as possible in keeping with the therapeutic index and the actual liver iron burden as measured by MRI. In the presence of myocardial iron loading it is advisable to initially reduce total doses of Desferrioxamine. Once the liver iron or ferritin is satisfactory and the therapeutic index is being exceeded then reduction in number of days of infusion is the most appropriate.

Desfirasirox (Exjade)

Deferasirox is the newest licensed treatment for transfusional iron overload in patients with beta thalassaemia major aged >6 years, or those > 2 years of age in whom Desferioxamine is contraindicated or inadequate. It is also licensed for use in patients with other transfusion dependant anaemias where the transfusion requirement may be less frequent.

20mg/kg/day should be the starting dose for patients on regular transfusion regimes that require greater than 7ml/kg/month of packed red cells. In those patients with a less frequent transfusion regime the starting dose should be 10-15 mg/kg/day.

Increment in dose if required should be in the order of 5mg/kg/day and a decrease in the dose should occur as outlined above if the serum creatinine rises.

Formulation:

Dispersible tablets in: 125mg, 250mg and 500mg doses

Dissolved in 200ml of water, orange or apple juice

Dosing:

Initiation is with 20mg/kg/day taken each morning on an empty stomach half an hour before food. In children if there are no side effects then continue with this dose. If there are side effects, predominantly deranged LFTs or creatinine on initiation, then low dose introduction is advised with a gradual increase to therapeutic dose. Commonly re-initiation at 125 mg/day for a week and a slow increase at 125 mg adjustments until 30 to 40mg/kg/day is attained or max dose tolerated is attained.

Side effects:

- Nausea, vomiting and diarrhoea (30%)
- Rash: maculopapular and itchy (10%)
- Abnormalities on serum creatinine (30%)
- Abnormalities in LFTs

Monitoring:

- Serum creatinine weekly for first 4 weeks and after any dose change
- LFTs weekly for first 4 weeks and after a dose change
- Annual audiometry and ophthalmology check

Maintenance:

In the management of patient's chelation with Deferasirox, the interpretation of the monitoring blood tests and resultant dose changes are overseen by the CNS, haematology and paediatric teams working closely together.

Some summary guidance given below:

The dose should be adjusted in keeping with the rate of *transfusional iron loading* mg/kg/day of iron (units of blood* 200/ weight*365) and the iron burden as measured by the serum ferritin or liver iron. The average dose for a child will be in the region of 25-30mg/kg/day.

Mild rises in the serum creatinine were observed in 30% of patients and these resolved on dose reduction.

For patients aged >15 years old: if the creatinine increases by 33% or greater on at least 2 occasions more than 2 weeks apart, the dose should be reduced by 5 mg/kg if the total dose is 20mg/kg/day or less, and by 10 mg/kg/day if greater than 20mg/kg/day.

In children < 15 years old: changes that result in the creatinine rising above the age related upper limit of normal (ULN) and are more than 33% of the baseline value on

more than 2 consecutive occasions greater than 2 weeks apart will require a dose reduction similar to that outlined above. Increases in the serum creatinine that are above the ULN and less than 33% of the baseline do not require a reduction.

Management of skin rash:

Tends to appear within the first 3 weeks of therapy and is macular-papular. If the rash is of mild / moderate severity and relatively asymptomatic Deferasirox can be continued and the rash will resolve spontaneously over the next couple of days. If the rash is moderately severe then Deferasirox should be discontinued and re-initiated at 50% dose reduction once the rash has resolved. The dose can be escalated slowly back to full treatment dose over several weeks provided the rash does not reoccur. If the rash is severe (distressing symptoms requiring systemic steroids for symptom relief) or if it reoccurs on re-introduction at 50% dose reduction treatment should stop until complete resolution and re-introduction attempted at 25% of the initial dose. At this time systemic steroid cover should be used and the dose of Deferasirox increased at 25% increments at 4 weekly intervals provided that the rash does not reoccur

References

NHS Antenatal and Newborn Screening Programmes
Sickle Cell and Thalassaemia
Sickle Cell Disease in Childhood
Standards and guidelines for clinical care
Detailed guidance
(2010-11)

NHS Antenatal and Newborn Screening Programmes
Sickle Cell and Thalassaemia
Transcranial Doppler Scanning for Children with Sickle Cell Disease
Standards and Guidance
(March 2009)

Clinical outcomes in children with sickle cell disease living in England: a neonatal cohort in East London
Telfer P, Coen P, Chakravorty S, Wilkey O, Evans J, Newell H, Smalling B, Amos R, Stephens A, Rogers D, Kirkham F.
Haematologica. 2007 Jul;92(7):865-71.

SickleCell Disease by **Graham** R. **Sergeant** (OUP, 3rd edition 2001)

Geok-Liew Ong (2005), Incentive Spirometry for Children with Sickle Cell Disorder. Improving practice through patient focussed research – Barts and the London NHS.

Lewis L , Batts B, Rau .J (2005) Positive Expiratory Pressure Device Acceptance by Hospitalised Children With Sickle Disease is Comparable to incentive Spirometry. Respiratory care. Volume 50 No 5

Compliance monitoring

Compliance will be monitored using the full audit cycle with the results presented at the paediatric departmental meetings. In addition, there will be external monitoring of compliance via peer review.

SECTION 4 – APPENDICES

- **Appendix 1** - Assessment Proforma
- **Appendix 2** - Pain Assessment Chart
- **Appendix 3** - Pain Prescribing Guidelines
- **Appendix 4** – Hydroxyurea informatio
- **Appendix 5** - Formulary
- **Appendix 6** - New Patient GP Info Sheet
- **Appendix 7** - Vaccination Schedule
- **Appendix 8** - Exchange Transfusion Calculation
- **Appendix 9** - Exchange Transfusion Record Chart
- **Appendix 10** - Incentive Spirometry / Record Chart
- **Appendix 11** - TCD Information
- **Appendix 12** - Contact Details
- **Appendix 13** - General Surgery
- **Appendix 14** - HEADSS adolescent questionnaire
- **Appendix 15** - Priapism management flowchart
- **Appendix 16** - Annual Review Sheet
- **Appendix 17** - Guidelines for Bone Marrow Transplant referral for children with Sickle Cell Disease (SCD) and Thalassaemia Major (TM)
- **Appendix A** - Plan for Dissemination and implementation
- **Appendix B** - Equality Impact Assessment Tool

Paediatric Sickle Cell Assessment Proforma

Whittington Health NHS

Children's Department, Magdala Avenue, London, N19 - 5NF tel. 020 7288 3560

Name
DOB

Whitt no:

GP Dr
GP Address

GP tel.

Family tel.

Date:

Old notes? N / Y ? Location: *HV Clinic / School*

Consultant Attending: +/- also known to

Time Arrived: S/B doctor decision to admit / send home @

Source GP A&E Home PACU Other

Presenting Problem(s):

History of Presenting Problem(s):

Analgesia & medication recently administered

Activity in recent hours	*Normal*	*Definitely Reduced*	*Very little*
Fluid Intake in recent hours	*Normal*	*Definitely Reduced*	*Very little*
Food taken in recent hours	*Normal*	*Definitely Reduced*	*Very little*
Urine & stool output in recent hours	*Normal*	*Definitely Reduced*	*Very little*

Previous Medical History

Pregnancy, Delivery & Birth Weight

Regular medication **Penicillin V** **Folic Acid**
Others

Allergies?

Previous significant crises

Previous attendances

Last Clinic Attendance
Steady state Hb
Baseline SaO_2

Diet

Development

Parental Concerns?
School Attendance & Progress

Immunisations

BCG / DTP / Polio / Hib / MenC / PCV / MMR / preSB / HepB / HPV

Check 'Red Book' & list what has been given
Date of last Pneumovax

Family History

Please draw a family tree

Annotate with names, ages and any health problems for family members

Social History

Parent(s) occupation

Languages at home
Interpreter needed?

School or Nursery

Housing:

Smoking or Pets?

Recent Travel / Travel Plans?

Examination & Observations

Weight ____ kg Height / Length ____ cm OFC ____ cm

T ____ °c Pulse ____ RR ____ SaO2 ____ %
Axillary/buccal/rectal

How ill is the Child?
Be descriptive

Growth Centiles *(Inc Tanner Stage when > 10yrs)*

4 RED FLAG SITUATIONS

Other Comments
Eg rashes / Lymphadenopathy

CVS

Perfusion /Cap refill

Blood Pressure
Murmur ?

Signs of shock?
Extreme Pallor?
Tachycardia?

Possible Acute Severe Anaemia
Section E p 22

Respiratory

Signs of respiratory distress

Chest clear

Respiratory Distress?
Chest pain?
Low SaO2 ?
Chest signs?

Possible Chest Crisis
Section D p 20

ENT
Inc Teeth

Abdomen

Hepatosplenomegaly?
Measure (cm)

Masses

Testes both palpable

Signs of shock?
New Splenomegaly?
New Hepatomegaly?

Possible Sequestration
Section G p 29

Priapism?
Section H p 32

CNS
Conscious Level A V P U

Altered LOC ?
Severe Headache?
Slurred Speech ?
Facial weakness ?

Possible Stroke / CVA
Section F p 25

Use pain score and be descriptive
in assessment of pain
Section A p 17-20
Appendix 2 p53-54

Pain

NO PAIN = 0 *MILD PAIN = 1* *MODERATE PAIN = 2* *SEVERE PAIN = 3*

Other

Paediatric Sickle Cell Assessment Performa: OUTCOME

Diagnosis & Problem List:

Name
DOB Whitt no:

Management Plan *(including record of initial investigations / results & observations):*

1st Hour Drugs Prescribed and administered as soon as assessed by nurse:

DATE	DRUG	DOSE	ROUTE & TIME	DOCTOR	TIME GIVEN	NURSE	PHARMACY
	Paracetamol (20mg/kg as stat dose)		PO/PR				
	Ibuprofen (7.5mg/kg)		PO				
	Diclofenac Sodium (1mg/kg)		PO/PR				
	Dihydrocodeine Tartrate(1mg/kg)		PO				
	Oral Morphine (400mcg/kg)		PO				
	Intranasal Diamorphine (100 mcg/kg)		IN				
	Naloxone (100mcg/kg)		IM/IV				

Completed By:

Signed ***PRINT*** ***Doctor***

Signed ***PRINT*** ***Nurse***

Discharge and Follow up arrangements

Home ☐ Admitted for or CAU ☐ please circle Follow up? on

Appendix 2 : Pain Assessment Chart

PAIN ASSESSMENT CHART

If pain score 2 or above:
Call the Acute Pain Team
Bleep: 2688 office hours
Bleep: 3301 out of hours

SEVERE PAIN (3)

"Hurts as much as I can imagine"

- Unable to distract
- Crying, screaming, aggressive
- *May* complain of pain
- Not moving freely, body looks rigid
- May touch or guard painful area
- Abnormally still
- May be constantly awake or in restless, exhausted sleep

MODERATE PAIN (2)

"Hurts more"

- Distracted for short periods
- Miserable, withdrawn, moaning/crying
- May complain of pain
- Reluctant to move.
- Looks tense on moving and may touch/guard painful area
- Unsettled, irritable or restless

MILD PAIN (1)

"Hurts just a little bit"

- Easily distracted
- Withdrawn, miserable or moaning but content wher distracted
- Moves reasonably freely, but may seem tense
- May sleep for short periods, contented sleep
- May be contented or slightly irritable

NO PAIN (0)

"Happy because I don't hurt at all"

- Happy/playing
- No cry, contented, gurgling/chatting, smiling
- Moves freely without signs of discomfort
- Contented sleep/relaxed

APS 2006

SEVERE PAIN

INJURY / SURGERY: appendicitis / appendicectomy, laparotomy, finger tip amputation, Limb #

- **PARACETAMOL** Oral / Rectal / Intravenous

+

- **NSAID** (unless contraindicated)

+

- **STRONG OPIOID**
  e.g. Morphine
  Oral / Intravenous (PCA/NCA) / Intranasal

MODERATE PAIN

INJURY / SURGERY:
small burn/scald, distal limb #s, hernia repair

- **PARACETAMOL** Oral / Rectal / Intravenous

+

- **NSAID** (unless contraindicated)

+

- **WEAK OPIOID**
  e.g. Codeine phosphate Oral

MILD PAIN

INJURY / SURGERY: small graze, laceration, tonsillitis, circumcision

- **PARACETAMOL** Oral / Rectal / Intravenous

+ (if required)

- **NSAID** (unless contraindicated)
  e.g. Ibuprofen Oral
  Diclofenac Oral / Rectal

SEDATION SCORE

0 – Awake
1 – Sleepy, easily roused
2 – Difficult to rouse
3 – Unrouseable
S – Normal sleep

Appendix 3

Prescribing Guidelines in Paediatric Sickle Cell Pain

MILD PAIN (score 1)

- oral hydration
- **Paracetamol** 20mg/kg STAT, **then** 15mg/kg 4-6 hourly, regula Max 75mg/kg daily)
- **reassess after 30-60 min** if pain controlled - discharge on usual analgesia and refer to CNS
- if pain NOT controlled treat according to pain score (2-3)

MODERATE PAIN (score 2)

- oral hydration
- treat as **mild** pain **AND**
- regular **Diclofenac** 1mg/kg 8hrly (max 150mg/day) **OR Ibuprofen** 7.5mg/kg 6-8hrly (max 400mg TDS)
- Consider **Dihydrocodeine** 0.5 – 1mg/kg, 4-6 hrly in those >12years without respiratory signs.
- **Reassess after 30-60min**
- if pain controlled – discharge on usual analgesia and refer to CNS
- if pain NOT controlled treat as **severe** (3)

SEVERE PAIN (score 3)

- oral/intravenous hydration
- treat as **moderate** pain **AND**
- **Intranasal diamorphine STAT (100mcg/kg- see separate intranet guideline)**
- **Oramorph**, STAT dose 400mcg/kg **(up to max dose of 20mg)**
- **reassess after 30 min / 1 hour**
- if pain controlled – treat as moderate **AND** PRN Oramorph 400 mcg / kg, 3 hourly (max 20mg)
- if **pain NOT** controlled – prescribe current analgesia and **second dose** ofOramorph 300 mcg / kg
- Investigate – FBC, U&Es, Group & Save (oxygen if sats below 95%)

Pain (associated with complications**),** sepsis, respiratory problem, severe anaemia, neurological problems, priapism (see Protocol)

See also Analgesia Administration chart for dosages (Appendix 4)

Start MST 1mg/kg Bd (max. 70mg /dose) if had more than 3 doses of Oramorph over 24hrs
May need Oromorph 200mcg/ kg 3hrly PRN for breakthrough pain

Reassess after 30-60 min

↓

Pain not controlled

Prescribe third dose Oramorph, 300 mcg /kg (max. 20mg), unless respiratorydepression

Reassess

↓

Pain still not settling

- if pain NOT controlled – contact Acute Pain Team (APT) Blp 2688 out of hours 3301
- APT to commence Patient Controlled Analgesia (PCA) or continuous inf.
- Infusion if under 6 years old

Opioid Administration

Do not give if patient is sedated above or equal to 2**, OR** showing any signs of respiratory depression.
Only prescribe **NSAID** if not contra-indicated.

Dose increase

- Review in 24 hrs
- If more than 3 doses of Oramorph is needed for breakthrough pain increase MST to 1.5mg/kg 12 hourly
- Review in 48 hrs. If more than 3 doses required increase MST to 1.75mg/kg 12 hourly **OR** change to PCA

Dose Reduction

MST dose can be reduced once Oramorph requirements for breakthrough pain are less than 4 doses in 24 hrs.
When reducing MSTR

- 0.5/kg BD
- 0.2mg/kg BD**, then** Stop

Observation / Pain Assessment

- See appendix for pain tool
- Acute pain team to review daily if on PCA (see protocol)

PCA Morphine;

Setting - see guidelines PCA and Nurse Controlled Analgesia (NCA)

If pain intolerant to morphine, fentanyl can be used. See guideline PCA / NCA

NCA - used for children who are unable to use PCA where there is one to one nurse available and trained to use NCA

Monitoring:

- If any regime does not provide sufficient pain control please contact the paediatric Sickle Cell CNS / Pain team
- The acute pain team will review all patients with a PCA and advise on discontinuation
- Analgesic review should occur on a daily basis

Avoid Oral route of opioid in

- Severe Acute Chest Syndrome (see protocol)
- Girdle syndrome
- Vomiting

Other Medications

The following should be routinely prescribed when on opioids

1. Naloxone

Must be prescribed for all patients on opiates

1mth - 12yrs 10mcg / kg
(repeat dose of 100mcg/kg if no response)
>12yrs 1.5 - 3 mcg / kg
(if inadequate response increase to 100mcg every 2 minutes)

2. Stool softeners eg.

Lactulose (see BNF for dosage)

or

Movicol (see BNF for dosage)

3. Anti-emetic

Ondansetron 0.1mg/kg IV / PO 8 hourly (maximum dose 4mg)

4. Anti-pruritic

Chlorpheniramine Maleate *(Piriton)*
(see BNF for dosage)

Appendix 3

Appendix 4
HYDROXYUREA (HYDROXYCARBAMIDE)

Hydroxyurea is a cytotoxic drug which have been found to be beneficial in reducing the frequency of pain episodes in majority of sickle cell patients (Hbss) when taking over a period of time

Criteria (which patients are prescribed Hydroxyurea)

Patients with repeated severe pain episodes (> 3 admissions to hospital per year).

Frequent severe pain episodes managed at home (sufficient severity to interfere with school and quality of life)

More than two chest crises or one chest syndrome requiring ventilatory support (PICU admission)

Severe symptomatic anaemia

Benefits: Randomized double- blind placebo controlled trial showed decreased:

Painful episodes
Hospitalization for painful episodes
Acute chest syndrome
Reduction of units of blood transfused by 50% in patients on transfusion
Reduced mortality and morbidity

How does it work?

Increase in MCV & RBC water content reducing the sickling process.
Increases HbF levels and reticulocytes
IIncreases the haemoglobin level by 10-20 g/L
Reduction in inflammation, decrease in raised white blood cells & platelets .

What to consider before treatment?

Education of parents- provide information. (at least 3 meetings)
Signed consent.
Blood counts- FBC, HbF%, U&E, Creat, LFTs
Willingness to comply and follow treatment recommendation/ blood test monitoring.

Dosage/ monitoring:

Dose: Start at 10-15mg/kg/day (single daily dose) then increase every 12 weeks by 2.5mg - 5mg/kg if no major toxicity until desired result (max dose of 35mg/kg /day). The dose should be maintained as long as the patients respond to therapy either clinically or haematologically.

Monitoring: FBC every 2 weeks for the first 2 months or after dose increase, then every 8 weeks thereafter. If the FBC shows toxicity effects eg:
Haemoglobin <45g/L Neutrophils < 2.0 x 10^9/L Platelets <100 x 10^9/L
Hydroxyurea dose can be temporarily reduced or discontinued for about 2 weeks until FBC recovers.

Cautions and adverse effects:

Patients with renal / hepatic compromise
Teratogenic effects
Myeloproliferative disorders (increase incidence leukaemia)
Reduction in sperm density and motility
Nutropenia and thrombocytopenia, reticulocytopenia
Headache, skin reactions eg cutaneous pigmentation

Appendix 5

Clinic Formulary

NB Pneumococcal Prophylaxis = Antibiotics + Immunisation

Penicillin V

Age	Dose	Frequency
Up to 1 year	62.5mg (2.5mls)	Twice daily
1-5 years	125mg (5mls)	Twice daily
>5 years	250mg (syrup or tablet)	Twice daily

If allergic to penicillin, give **Clarithromycin**

Age	Dose	Frequency
Up to 1 year	62.5mg (2.5mls)	Twice daily
1-5 years	125mg (5mls)	Twice daily
>5 years	250mg (10mls or 1 tablet)	Twice daily

Other medications

Folic Acid

Age	Dose	Frequency
<12 months	1.25 mg (2.5mls)	Once daily
1-3 years	2.5mg (5mls)	Once daily
> 3 years	5mg (10mls or 1 tablet)	Once daily

Always use BNF for children when prescribing any other medication and consider potential side effects

New Patient notification for GP

Appendix 6

Paediatric Sickle Cell Clinic

Children's Department, Magdala Avenue, London, N19 - 5NF tel. 020 7288 5321

UCL MEDICAL SCHOOL

Name
DOB

Whitt no:

GP Dr
GP Address GP tel.

Family tel.

Date:

New Patient notification for GP

Your patient has been diagnosed as having Sickle Cell Disease

Write genotype here and indicate how diagnosis made

They will be offered regular follow up in our multidisciplinary clinic until adulthood. They will have been issued with an Emergency Card, enabling access to our paediatric services 24/7.

You will receive comprehensive clinic letters after every appointment, copied to the family and others in the community as well as notification of acute admissions to hospital.

Please ensure they are provided with repeat prescriptions for Penicillin V and Folic acid (at doses specified on clinic letter) and that they attend for all routine scheduled childhood immunisations.

We will give Pneumovax from 2nd birthday and every 5 years and may ask you to provide Hepatitis B and annual influenza vaccinations.

The family have been given the contact details for the Clinical Nurse Specialist, Mrs Edith Aimiuwu, telephone 020 7288 3017, who can provide further information and support for families and other healthcare staff, as well as for schools and nursery.

Yours sincerely
Dr Andrew Robins Consultant Paediatrician 020 7288 5616
Dr Bernard Davis Consultant Haematologist 020 7288 5035

Appendix 7 – Vaccination Schedule

Children with SCD should receive all childhood immunisations as currently advised by the Department of Health. It is very important that immunisations do not fall behind schedule.

Primary vaccination schedule (Universal+Sickle specific)

Vaccine	Age
DTaP/Hib/IPV + PCV + Rotavirus	2 months
DTaP/ Hib/IPV + MenC + Rotavirus	3 months
DTaP/Hib,/IPV + PCV	4 months
Influenza	*>6 months; annually*
Hib/Men C	12 months
MMR +PCV	13 months
Hep B	18 months, 19 months, 24 months
Pneumovax	2 years
DTaP/ IPV + MMR	3 years 4 months
Pneumovax	7 years
Pneumovax	12 years
HPV	Girls ages 12-13 years
DT/ IPV + MenC	14 years
Pneumovax	17 years

For more details about the universal schedule and individual vaccines please see:
www.immunisation.nhs.uk

Protection against Pneumococcal infection by immunisation

1. Pneumococcal Conjugate Vaccine (PCV) is provided by a 13-valent conjugate pneumococcal vaccine (*Prevenar*). This is now part of the primary immunisation for all infants. It is a similar technology as Men C and Hib, giving long term immunological memory and immunity.

If immunisation is not performed with the primary vaccinations then:

- *Infants aged 7-11 months of age*: 2 doses, each 0.5 ml, with an interval of at least 1 month between doses. A 3rd dose should be given after their 1st birthday and at least 1 month after the 2nd dose
- *Children aged 12-23 months of age:* 2 doses, each of 0.5 ml, with an interval of at least 2 months between doses
- *Children aged 24 months -5 years*: one single dose

2. Pneumovax is the 'older technology' 23-valent polysaccharide vaccine (*Pneumovax II*) and is given after the 2nd birthday and boosted every 5 years for life.

Immunisation against Hepatitis B:

All children with sickle cell disease should be immunized against Hepatitis B by their 2nd birthday. Thereafter antibody levels should be checked every 5years and re-immunisation performed when the HbsAb titre is <100 iu/dl.

Immunisation against Influenza:

All children with SCD should be offered annual vaccination against influenza, especially if they have had previous chest crisis or significant burden of crises. This should be as recommended schedule by the DOH every autumn and provided by the family's GP.

Immunisation against Tuberculosis (TB)

Infants may be vaccinated against Tuberculosis, with the BCG, as part of the universal schedule in some London Boroughs. In those cases it is not universally offered, then it should be discussed and strongly encouraged to be taken up.

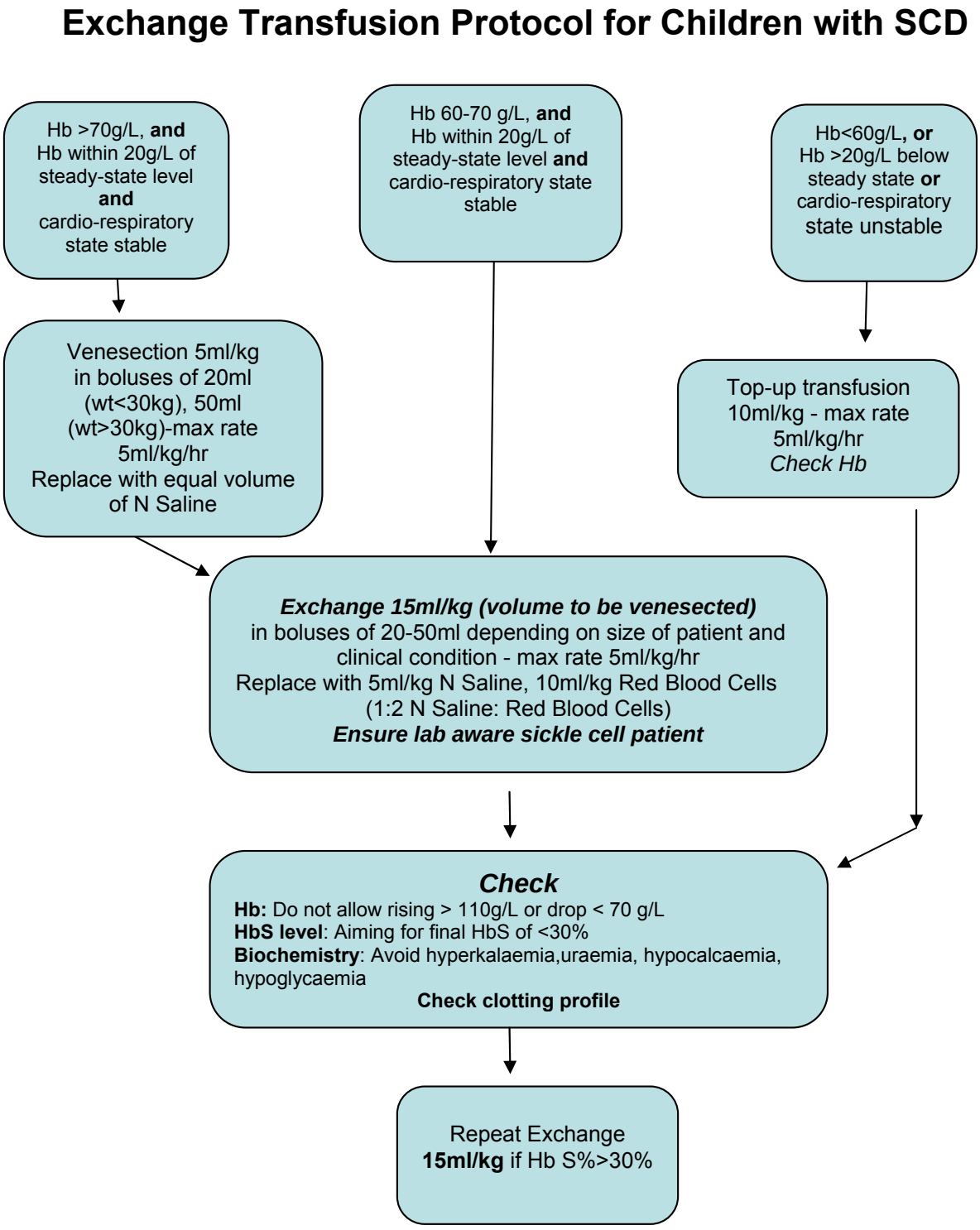
Travel Requirements

Families affected by SCD should not feel inhibited from travelling abroad. There should be specific consideration given to the destination, duration of the flight and previous health of the affected child. Specifically:

- When travelling to endemic areas for Meningococcus, offer Meningovax ACWY (in clinic)
- MALARIA prophylaxis* for the WHOLE family (provided by GP)
- Hepatitis A , Cholera, Typhoid, Yellow fever etc. (provided by GP)
- If long haul flight is considered a potential hypoxia risk (because of previous lung disease) arrange *Fitness to Fly* test at GOSH respiratory lab

*G6PD status should be known

Appendix 8: Exchange Transfusion / Calculations



Exchange transfusion in children requires a total exchange of 1.5x – 2x their blood volume, performed as 3 or 4 exchanges. Usually, equal volumes are venesected and transfused, but need to replace blood venesected with 1/3 saline and 2/3 packed cells to keep haematocrit stable.

Acute Large Volume Exchange Transfusion (30mls/kg)
Consists of removing the patient's own blood and replacing it with an equal volume of transfused red blood cells (RBCs) and normal saline (NS)

Partial Exchange Transfusion
Similar principle as with acute large volume exchange transfusion, usually no more than 15ml/kg is required. Used for chronic exchange transfusion programmes in designated unit

Red Cell Volume (RCV) = Haematocrit (Hct) x Total Blood Volume (TBV)

Assume TBV is 70ml/kg if > 20kg & 85ml/kg if < 20kg

Blood volume to be exchanged = RCV x 2

Calculation Example 1

A child weighing 20 kg will require:

RCV = Hct x weight x estimated TBV = HCT x 20 x 70

If Hct = 0.20 then Estimated TBV = 0.20 x 20 x 70 = *280mls*

Therefore blood required for exchange = 280 x 2
(i.e. two times the blood volume)
= 560 ml

Calculation Example 2

Volume (ml) of bloodremoved*for each procedure* should be:

Each exchange procedure should be calculated at 30 ml/kg

A child of 20 kg x 30 = **600 mls**

If the child's Hb = 70 g/L, then start with saline 10 ml/kg = 200 ml saline in and 200 ml blood out

Then 20 ml per kg of blood = 400 ml blood in and 400 ml out

Therefore blood required for exchange = **600 ml**

Equipment / Procedure

Preparation

- Emergency exchange transfusions may take between 4 - 8 hours to carry out and therefore the patient should be comfortable and stable
- This should be done by experienced staff that are familiar with the procedure
- It should be done on HDU, especially if there is concern about the stability of the patient
- Emergency equipment should be available
- Close monitoring of the patients every 15 minutes including HR, RR, SaO_2 and BP

Equipment

- Protective Clothing
- Blood giving sets
- Tourniquet
- Sharps bin
- Patient monitoring device for HR, RR, Temp, SaO_2 and blood pressure
- Cannulae - wide bore
- 'T' pieces
- Syringes
- Needles
- Normal saline flushes
- Heparinised saline flushes
- Venesection bags
- Gloves
- IVAC pump
- Three way taps
- Bung
- Intravenous giving set

Venesection bag

Venous access

- Two ports of venous access are required; one for venesection, the other for administering blood and crystalloid; in certain circumstances, an arterial line may be used

- Connect the venesection cannula to a 'T' piece and a three way tap and to the other two ports of the three way tap; connect the venesection bag and the syringe

- The venesected blood can be discarded into a venesection bag via a 3-way tap. If patient is >25kg a tourniquet (or BP cuff) could be applied above and released intermittently and help the blood venesected flow via gravity

- Venesection bags are kept in the haematology laboratory

Procedure 1a:

- Venesect 10 ml/kg in aliquots of 10 - 50 ml using a large syringe
- If starting Hb <60 g/L then infuse **10 ml/kg blood** simultaneously at the same rate
- If starting Hb >60 g/L then infuse **10ml/kg of normal saline** simultaneously at the same rate

Procedure 1b and 1c:

- Continue venesecting the remaining volume (approx 20 ml/kg)
- Replace with blood at a rate of 7.5ml per kg per hour (red cells in SAG-M) instead of normal saline
- This process should take about 160 min, depending on the rate of flow of blood and the clinical condition of the patient
- If HbS >20% at end of procedure then proceed to a second exchange procedure

Procedure 2 and onwards:

- For the second and subsequent exchange procedures, it may be necessary to use a ratio of 50% saline: 50% blood (rather than 30:70) in order to prevent the Hb from rising too high. This should be discussed with the haematology SpR or consultant when planning the procedure
- A top-up transfusion can be given at the end of the final exchange procedure to give a final Hb of 100-110 g/L

Appendix 9: Exchange Transfusion Record Chart

Weight……. Hb…. S%……

Date

Haematologist prescription/ guidelines of procedure:

Time	*Saline in*	*Blood in*	*Blood out*	*Balance*	*Observation*	*Comments*

Appendix 10: Incentive Spirometry in children with SCD

Incentive spirometry is a technique used to try and prevent and treat children with SCD at risk of a Sickle Chest Syndrome / Crisis, which can be a life threatening complication.

It should be instituted by either the nursing or medical teams with the involvement with the ward (or on call) physiotherapist, using a device and record sheet.

- **Inclusion criteria;** Children age 6 and above admitted with a sickle cell crisis and the following symptoms:
  - Chest pain
  - Back pain above the level of the diaphragm
  - Acute Chest Syndrome
  - Chest infection
  - Worsening chest x-ray
  - Reduced SaO_2 (< 2% from baseline)
  - Pain score less than 1 (mild)

- **Guidelines for use of Incentive Spirometer:** Incentive Spirometers can be obtained from Ifor ward or from the Respiratory Physiotherapists Bleep 2632.

  - Ask the patient about their pain. If the pain score is less than 1 (Mild) continue
  - If equal to or greater than 2 (moderate to severe), administer analgesia. Wait for it to be effective and then continue
  - If patient is on δ35% oxygen, then oxygen should be given via nasal cannulae
  - The patient should be sat upright in bed or lying on their side

  Patient's instructions
  - Breath out completely and place lips around the mouthpiece
  - Inhale slowly keeping the yellow disk in the "smiley face" OR between the yellow line positions
  - Inhale as deep as possible

    There is no maximum target for incentive spirometry. Children should aim for maximal inspiratory effort and a prolonged breath, without causing excessive pain

  - Repeat 10 times, with resting breaths between each maximal effort
  - Use the spirometer hourly (8am -10pm) and when the patient is awake

    (do not wake the patient up during the night for procedure)
  - Document on the Sickle Cell Observation Chart (see below)
  - Give the patient and the parents an information leaflet
  - Continue exercises until criteria for use has resolved

    (on x-ray /oxygen saturations /auscultation)

INCENTIVE SPIROMETRY OBSERVATION CHART
FOR SICKLE CELL CHILDREN (AGE 6+)

Date

CRITERIA FOR INCENTIVE SPIROMETRY:

Chest pain □ Acute Chest Crisis □ Back pain above the diaphragm □
Bed rest □ Chest infection □

Pain score MUST be 0-1 If score is 2-3, more analgesia is needed

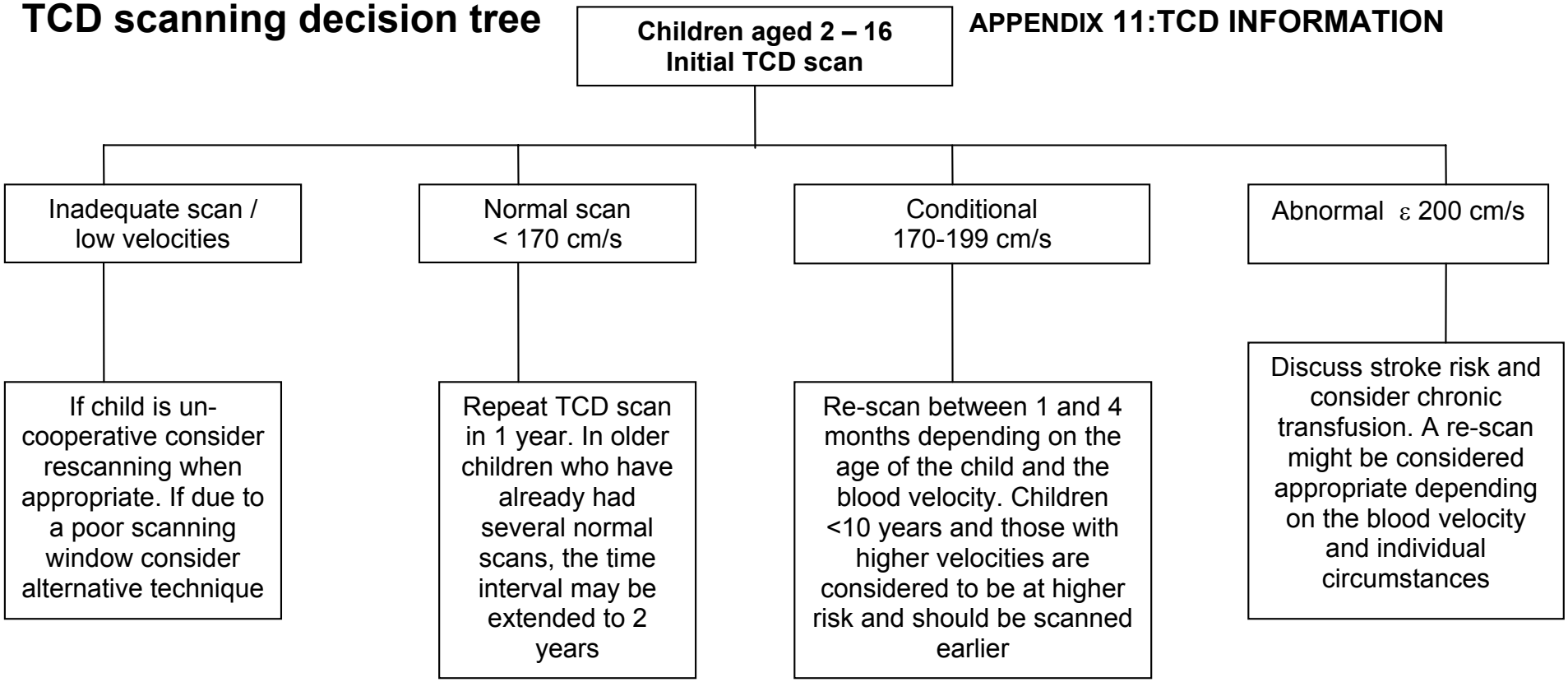
TIME	PAIN SCORE	OXYGEN litres/min/%	O_2 SATS	RESP. RATE	NUMBER OF I.S. BREATHS	HIGHEST I.S. READING	COMMENT
08:00							
09:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
24:00							

Information

Effective pain relief must be obtained (NB must have a pain assessment chart)
Refer all chest crisis patients to physiotherapy. Patients should be seen daily
If more than 35% O_2 is needed then nasal specs should be used during incentive spirometry
The patient should be sitting upright for incentive spirometer exercises (where medically safe)
Patients to do 10 breaths with incentive spirometer
Continue exercises until criteria for use has resolved (on Xray/O_2 Sats)
Patient to do exercises every 1-2 hours
Record commencement and discontinuation in medical notes (a nursing care plan is required

TCD scanning decision tree

APPENDIX 11:TCD INFORMATION



Velocities are TCD non-imaging, time averaged, maximal meanvelocities (TAMMV)
Decisions apply to TAMMVs in the distal ICA, bifurcation and / or MCA only
For bilateral or multifocal TAMMVs ε 170 cm/s, choose the highest single value for the decision tree
Recurrent inadequate scans or low velocities may indicate severe stenosis. Consider using other imaging techniques
For any particular child, detailed clinical knowledge and judgement may override this guidance

NHS Antenatal and Newborn Screening Programmes March 2009

APPENDIX 12: CONTACT DETAILS

Contacts (inside and outside the Trust including out-of-hours contacts)

Whittington Hospital Switchboard: 020 7288 3070		
Dr. Andrew Robins *Clinic lead for*	Consultant Paediatrician ***Paediatric Sickle and Thalassaemia***	Mobile 07786 518 699 Secretary: ext 5616 andrewrobins@nhs.net
Dr **Sara Hamilton** *Deputy clinic lead for*	Consultant Paediatrician ***Paediatric Sickle and Thalassaemia***	Mobile 07799 340687 Secretary ext 5616 sara.hamilton2@nhs.net
Dr. Bernard Davis *Clinic lead for*	Consultant Haematologist ***Paediatric Sickle***	Mobile 07854 070253 Secretary: ext 5437 Bernard.davis1@nhs.net
Dr. Farrukh Shah *Clinic lead for*	Consultant Haematologist ***Paediatric Thalassaemia***	Secretary: ext 5034 Mobile 07830 344425 farrukh.shah@nhs.net
Dr. Ali Rismani *Clinic lead for*	Consultant Haematologist	Secretary: ext 5437 Mobile 07881 821762 a.rismani@nhs.net
Haematology SpR (out-of-hours)	See Rota on Intranet	Ext 5756 & bleep 3060/3037 (Home number via switch)
Paediatric SpR (24 hours a day)	See Rota on Intranet	Bleep 3111
Paediatric SHO (24 hours a day)	See Rota on Intranet	Bleep 3342
Mrs Edith Aimiuwu	Roald Dahl Paediatric Clinical Nurse Specialist (CNS) for Haemoglobinopathy	Voicemail / ext: 3017 Pager: 07699 784 917 Mobile: 07799347161 edith.aimiuwu@nhs.net
Ella Beeson	Clinical Psychologist to Paediatric Clinic	ella.beeson@nhs.net
Deborah Wellington	Consultant Family Psychotherapist	Secretary Ext 5356 deborahwellington@nhs.net
Emma Prescott	Thalassaemia CNS for Adults	Ext 3042 Bleep 2866 emma.prescott@nhs.net
Diana Waterton & Jasmina Davies	Pain team Clinical Nurse Specialists	020 7288 5277 Bleep 2688

Community Counsellors & Matron for Haemoglobinopathy		
Matty Ashante-Owusu	Community Matron for SCD Adults (Islington PCT)	020 3316 8853/8854 Mobile 07920 711210 matty.asante-owusu@nhs.net
Tukiso Manonga	Haemoglobinopathy Counsellor Camden and Islington, 17a Hornsey Street, Islington, N7 8GG	020 3316 8860 020 3316 8853/8854 tukiso.manonga@nhs.net
Nasser Roheemun	Haemoglobinopathy Counsellors George Marsh Centre, St Annes Hospital, Haringey, N15 3TH	020 8442 6230 nasser.roheemun@nhs.net
Sickle Cell Society:	54 Station Rd, Harlesden NW10 4UA	0208 961 7795/4006 www.sicklecellsociety.org sicklecellsoc@btinternet.com

University College Hospital: Switchboard: 0845 155 5000		
Professor John Porter	Consultant Haematologist ***Sickle and Thalassaemia***	020 7380 9638 Mobile via switch j.porter@ucl.ac.uk
Ms Lucia Geoffrey	PA to Prof Porter & department	Extension: 79638 Direct line: 0203 447 9638 Fax: 0203 447 9911 Lucia.Geoffrey@uclh.nhs.uk
Dr Sara Trompeter	Consultant Haematologist ***Sickle and Thalassaemia***	020 7380 9638 Mobile via switch sara.trompeter@uclh.nhs.uk
Dr Perla Eleftheriou	Consultant Haematologist ***Sickle and Thalassaemia***	Mobile via switch Perla.Eleftheriou@uclh.nhs.uk
Haematology SpR (out-of-hours)	0845 155 5000	In hours: Bleep 7085 Out of hours: via switch
Vacant Post	Clinical Nurse Specialist (CNS) for Paediatric Haemoglobinopathy	
Paediatric SpR (out-of-hours)	0845 155 5000	Bleep 5301
Dr Joanna Begent	Consultant Paediatrician Lead for Sickle Cell	joanna.begent@uclh.nhs.uk Mobile via switch

Duty Consultant Paediatrician	0845 155 5000	Mobile via switch
Ms Bernadette Hylton	Clinical Nurse Specialist for Haemoglobinopathy (Adults)	Telephone: 0203 447 9702 Email: Bernadette Hylton@uclh.nhs.uk
Dr Malcolm Walker	Consultant cardiologist Hatter Institute Chenies Mews	020 7573 8888 x6051 Malcolm.walker@uclh.nhs.uk PA rachel.ward@ucl.ac.uk
Dr Mary Petrou	Consultant Clinical Geneticist	020 7380 9458 mary.petrou@uclh.nhs.uk
Mr Suks Minhas	Consultant Urologist	020 7380 9288
Kirsty Phillips	PA to Mr Minhas	020 7380 9190 kirsty.phillips2@uclh.nhs.uk
Urology SpR	0845 155 5000	Bleep 1038
RNOH Stanmore: switchboard 020 8954 2300		
Mr Aresh Hashimi-Nejad	Consultant Orthopaedic Surgeon, Catterall Unit	020 8909 5802 020 8954 4566 (fax) nejadsecretary@rnoh.nhs.uk
King's College Hospital : switchboard 020 3299 9000		
Paediatric Liver SpR.	020 3299 9000	bleep 426
St Mary's Hospital W2 : switchboard 020 3312 6666		
Dr Josu de la Fuente Dr Subarna Chakravorty	Peadiatric Haematologists, St Marys Hospital	020 3312 6164 Josu.delaFuente@imperial.nhs.uk Subarna.chakravorty@imperial.nhs.uk Mobile via switch
Paediatric Haematology SpR	020 3312 6666	Bleep 2261 or 2262
Catherine Mkandawire	CNS Paed Haematology	020 3312 3346 07795651153 catherine.mkandawire@imperial.nhs.uk
Royal London Hospital: switchboard 020 7377 7000		
Dr Paul Telfer	Consultant Paediatric Haematologist	020 3246 0352 paul.telfer@bartsandthelondon.nhs.uk Mobile via switch

Dr Banu Kaya	Consultant Paediatric Haematologist	020 3246 0352 banu.kaya@bartsandthelondon.nhs.uk Mobile via switch
Paediatric SpR	020 7377 7000	Bleep via switch
Kim Newell	CNS Paed Haematology	Aircall 07659 152 0945
North Middlesex Hospital: switchboard 020 8887 2000		
Dr Olu Wilkey	Consultant Peadiatrician	020 8887 2945 Mobile via switch olu.wilkey@nmh.nhs.uk
Dr Marilyn Robrts-Harewood	Consultant Haematologist	XXXXXXXX Mobile via switch marilyn.roberts-harewood@nhs.net
Dr Anne Yardumian	Consultant Haematologist	020 8887 2428 Mobile via switch anne.yardumian@nmh.nhs.uk
Linda Kier	Clinical Nurse Specialist Paediatric Haematology	020 8887 3303 Linda.keir@nmh.nhs.uk

Great Ormond Street Hospital: switchboard 020 7405 9200	
Preadmission Nurse Urology: **Felicity Southworth**	Ext 7969 (answerphone) or 0629. felicity.southworth@gosh.nhs.uk
Waiting list administrator ENT: **Frances Beckwith**	Ext 5226 frances.beckwith@gosh.nhs.uk
Preadmission Nurse ENT & Dental: **Sarah Carmichael**	Ext 5984. Blp 1014 sarah.carmichael@gosh.nhs.uk
Pre-admission Nurse Orthopaedics: **Penny Howard**	Ext 8132 Bleep 1028 penny.howard@gosh.nhs.uk
Pre-admission Nurse Spinal Surgery: **Lucy Howlett/Rory Philbin**	Ext 8238 Bleep 0371 lucy.howlett@gosh.nhs.uk. rory.philbin@gosh.nhs.uk.
Waiting List Coordinator for Maxfax & Dental: **Fatima Ali** (temp)	Ext 5685 fatima.ali@gosh.nhs.uk
Lead Dental Nurse: **Katherine Knott**	Ext 1115 katherine.knott@gosh.nhs.uk
Pre-admission nurse General Surgery & Maxfax **Rose Fitzgerald**	Ext 7969 (answerphone) or 1022. Bleep 0394 rose.fitzgerald@ gosh.nhs.uk

General Surgery **Joe Curry** **Paolo De Coppi**	Secretary Ext 5871 joe.curry@gosh.nhs.uk Secretary Ext 5619 paolo.decoppi@gosh.nhs.uk
On call General Surgery SpR	Bleep 0777 or Cisco phone – x1777
ENT Surgeon **David Albert**	david.albert@gosh.nhs.uk
Sleep Lab &'Fitness to Fly' test **Dr Francois Abel**	Ext 5372 Fax:020 7829 8634 fabel@nhs.net
Urology **Peter Cuckow**	Ext 5918 peter.cuckow@gosh.nhs.uk
On-call Urology SpR	Bleep 0102
Orthopaedic Surgery **Miss Debbie Eastwood**	Ext 8451/8240 deborah.eastwood@gosh.nhs.uk
Paediatric intensive care unit Dr Quen Mok	Ext 8213 quen.mok@gosh.nhs.uk
Haematology Reg	Ext 5394 Bleep 0381

Appendix 13

Guidelines for SCD children needing elective surgery at GOSH

Children and young people with SCD may require emergency or elective surgery that may be due to the complications of SCD or not. This guideline only deals with elective surgery. Indications for elective surgery include splenectomy, tonsillectomy and adenoidectomy, dental and orthodontic work and hip surgery.

Patients with SCD who require surgery have increased risk of perioperative complications and therefore careful consideration should be taken for each patient. Patients with severe complications such as severe chest crises, CNS disease or frequent painful crises must be identified as these patients are at increased risk.

The perioperative management of patients with SCD requires good communication between the surgeons, anaesthetists, haematologists and paediatricians. **This can be challenging when it involves several hospitals**. The referring team are informed in advance, usually 4 weeks before the date of the elective surgery, to arrange preoperative transfusions.

Groups at increased risk of perioperative complications include:

- Those with a history of severe SCD related problems such as acute chest syndrome, CNS disease, frequent painful crises requiring admission
- Those undergoing major surgery such as thoracic or neurosurgery
- Those with severe obstructive sleep apnoea; *this may be relieved using a nasopharyngeal prong airway*

Recommendations

The policy at Great Ormond Street is a three-tiered approach dependent on the severity of the child's disease and the nature of the surgery, such that:

- **Children at low risk have NO transfusion (Group 1)**
- **Children at intermediate risk have TOP-UP transfusion (Group 2)**
- **Children at high risk have EXCHANGE transfusion (Group 3)**

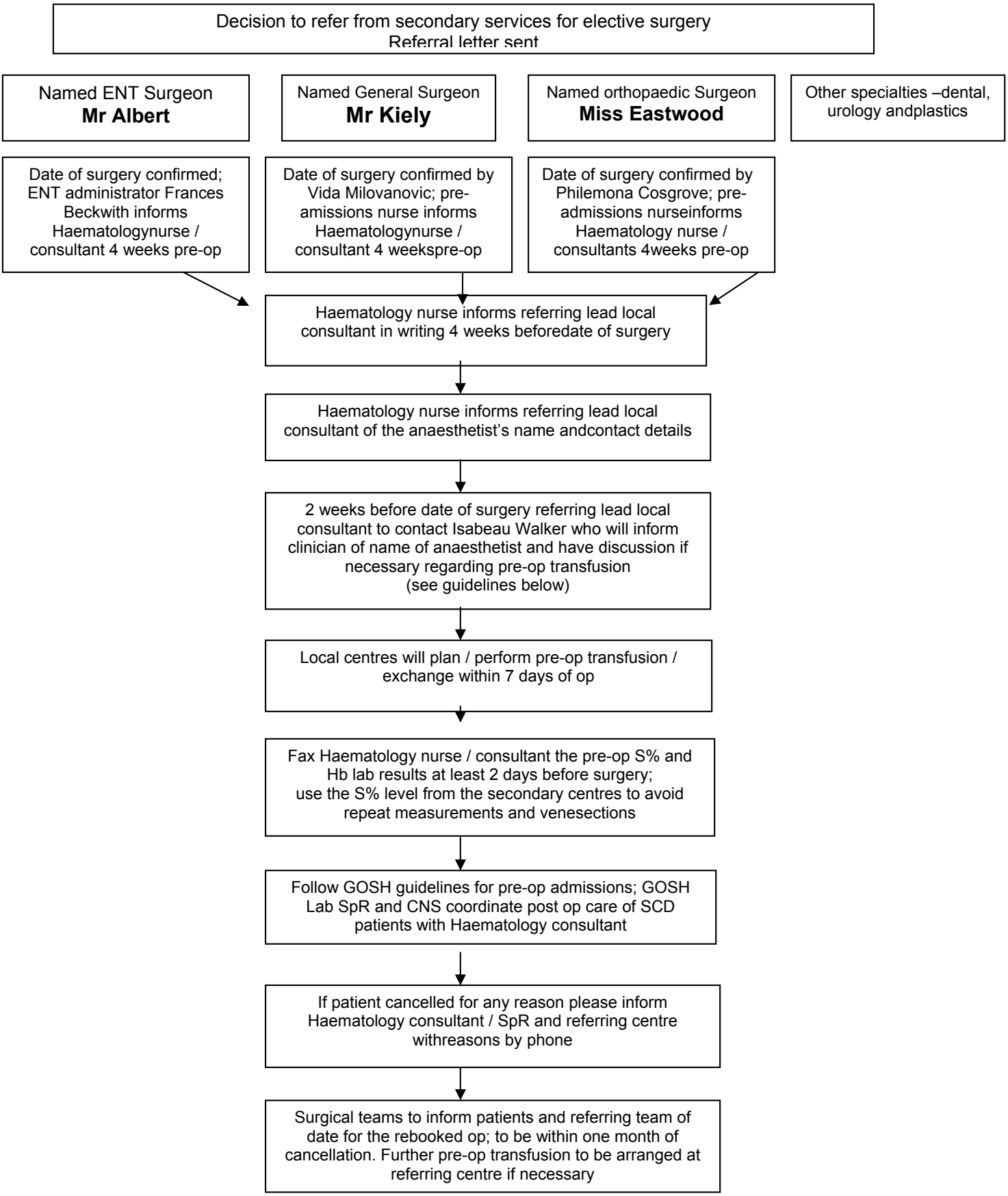
See below for definitions of risk groups. Any queries should be discussed with the anaesthetic team and / or haematologists.

Group 1 Children with no special risk factors, having short procedures with low risk of perioperative complications,eg. insertion of grommets
Top-up transfusion only if Hb <60g/L to Hb 90-110g/L, irrespective of HbS level

Group 2 Children with no special risk factors, having intermediate risk surgery eg. herniorrhaphy or tonsillectomy
Top-up transfusion to Hb 90-110g/L; %HbS level will remain elevated. Total Hb should not exceed 120 g/L

Group 3 Children who have a history of stroke (usually on a regular transfusion programme), acute chest syndrome or suffer frequent painful crises (requiring 3 or more hospital admissions / year) or children having major or high-risk surgery eg. thoracic, neurosurgery, revascularisation or intra-abdominal (including laparoscopic) surgery
Exchange transfusion to achieve HbS level <30%, Hb should not exceed 120 g/L

Draft Care Pathway for Secondary Sickle Cell Elective Surgery



Appendix 14: HEADSS Questionnaire for Adolescents

The ***HEADSS*** assessment is a screening tool for conducting a comprehensive psychosocial history and health risk assessment with a young person. It provides information about the young person's functioning in key areas of their life:

H – Home Environment

- *Where do you live?*
- *Who lives with you?*
- *How does each member get along?*
- *Who could you go to if you needed help with a problem?*
- *Parent(s) jobs? Recent moves? Run away? New people at home?*

E – Education / Employment

- *What do you like / not like about school / work?*
- *What can you do well / what areas would you like to improve on?*
- *How do you get along with teachers / other students?*
- *Grades, suspensions? Changes?*
- *Many young people experience bullying at school – have you ever had to put up with this?*

Eating / Exercise

- *Sometimes when people are stressed they can over eat / under eat. Have you ever experienced either of these?*
- *In general, what is your diet like?*
- *In screening more specifically for eating disorders, you may ask about body image, the use of laxatives, diuretics, vomiting or excessive exercise and rigid dietary restrictions to control weight.*

A – Activities and Peer Relationships

- *With peers? (What do you do for fun? Where? When?)*
- *With family?*
- *Sports – regular exercise?*
- *Hobbies? Tell me about the parties you go to.*
- *How much TV would you watch a night? Favourite music?*
- *Crimes? Arrests?*

D – Drugs / Cigarettes / Alcohol

- *Many people at your age are starting to experiment with cigarettes / alcohol. Have any of your friends tried these or maybe other drugs like marijuana, IV drugs, etc. How about you, have you tried any? Then ask about the effects of drug taking / smoking or alcohol on them, and any regrets. How much are they taking, how often and has frequency increased recently*?

S – Sexuality

- *Some people are getting involved in sexual relationships. Have you had a sexual experience with a guy or girl or both?*
- *Degree and types of sexual experience*
- *Number of partners*
- *Masturbation*
- *Contraception?*
- *Knowledge about STDs*
- *Has anyone ever touched you in a way that's made you feel uncomfortable or forced you into a sexual relationship? (History of sexual or physical abuse?)*
- *How do you feel about relationships in general /about your own sexuality?*

S – Suicide / Depression / Mood Screen

- *How do you feel in yourself at the moment on a scale of 1-10?*
- *What sort of things do you do if you are feeling sad / angry / hurt?*
- *Is there anyone you can talk to?*
- *Do you feel this way often?*
- *Some people who feel really down often feel like hurting themselves or even killing themselves. Have you ever felt this way?*
- *Have you ever tried to hurt yourself or take your own life? What have you tried? What prevented you from doing so? Do you feel the same way now?*
- *Have you a plan… etc.*

S – Safety · *Immunisation, bullying, carrying weapons*

S – Spirituality · *Beliefs, religion, music, what helps them relax, etc*.

Appendix 15: Priapism Management Flowchart

Management of Fulminant Priapism in boys with SCD

Hydration: 100ml/kg/day +/- 20ml/kg saline bolus
Analgesia: morphine (see PCA and MST protocols)
Sedation: consider diazepam 2-5mg tds, max 10mg/day
X-match blood, check FBC, U+Es
Call GOSH Urology SpR in <10yr olds:
Call UCLH Urology SpR in >10yr olds:

No detumescence within 30 mins

Top-up transfusion to Hb 100< 110 g/L over 2 hours
(11-Hb) x wt(kg) x 0.4 ml
Prepare to transfer to Urologists at GOSH or UCLH

No detumescence within 2 hrs

Theatre under GA for:
Intracavernosal Etilefrine 5mg undiluted (0.5ml)
NB close monitoring of BP and HR
(Etilephrine may cause >BP &>HR, caution if previous CVA)

If no response and BP and pulse maintained, repeat after 10 minutes

No detumescence in theatre

Winter's Cavernosal shunt - with additional epidural block

- Suprapubic catheter

If no response (!) consider proximal shunts
Consider exchange transfusion post-op

Etilefrine injection 10mg in 1ml

Dose: INJECTION-
Paediatrics age<16 years – Acute Fulminant Priapism, lasting >4hrs
5mg (0.5ml) undiluted injected by intra-cavernosal route

Adults/>16yrs: 5-10mg undiluted, by intra-cavernosal injection under local anaesthetic (done by urology team)

Management of Stuttering Priapism in boys with SCD

Stuttering Priapism – diagnosed when recurrent pain of variable intensity, erection lasts <3hours, penis may not be fully erect, low risk of cavernosal fibrosis / impotence, risk of subsequent fulminant attack

Etilefrine 25mg capsules and Etilefrine 5mg tablets

Treatment and prophylaxis
0.5mg/kg at night OR 0.25mg/kg bd (depending on when onset of symptoms is more common eg. night only or throughout the day and night)

- Continue for a total of 4 weeks and then stop / wean depending on recurrences
- Monitor blood pressure (follow up at 1 week and then monthly)

Monitoring

During therapy, patients should be seen weekly on day care ward, for assessment of response and of side effects. Blood pressure should be checked and treatment stopped if blood pressure >150 systolic, >90 diastolic, or experiencing increased headaches or any symptoms suggestive of TIA

Other treatment options (under direction of urologist)

For prophylaxis against stuttering and fulminant episodes include using anti-androgens such as:

- Flutamide 250 mg tds
- Bicalutamide 150 mg OD, or Zoladex 3.6 mg s/c monthly

Note: these treatments are expected to cause impotence for the duration of therapy

Contacts

UCLH	**020 7380 9288**	secretary to **Mr Suks Minhas** Consultant Urologist
UCLH	**0845 155 5000**	**Bleep 1038** Urology SpR
GOSH	**020 7405 9200**	On-call Consultant Urologist
GOSH	**020 7405 9200**	**Bleep 0102** Urology SpR

Appendix 16

Paediatric Sickle Cell Annual Review Sheet

PATIENT DETAILS				
Patient Name				
Date of Birth				
NHS Number				
Unit Number				
Diagnosis				
treatment				
hydroxyurea				
blood transfusions total per annum				
rate of transfusional iron loading				
chelation therapy				
desferioxamine mg/kg/day				
exjade mg/kg/day				
other chelation protocol				
Year	**2015**	**2016**	**2017**	**2018**
Height				
Weight				
tanner stage				
Haemoglobin				
HbF%				
serum urea				
serum creatitine				
urine albumin				
AST/ALT				
bilirubin				
LDH				
Virology				
Hep BsAb titre				
HCV antibody				
BP				
Oxygen Saturations				
TCD				
SPECIALTY REVIEWS				
Ophthalmology Review				
VACCINATIONS				
Hepatitis B				
Pneumococcal				
HIB				
Meningococcal				
Influenza				
KEY CLINICAL EVENTS				
sickle stroke				
chest syndrome				
priapism				
Aplastic crisis				
transfusion reactions				
other life threatening events				

Appendix 17

Guidelines for Bone Marrow Transplant referral for children with Sickle Cell Disease (SCD) and Thalassaemia Major (TM)

Introduction:

Although advances in long term transfusion, iron chelation therapy and supportive care have dramatically improved life expectancy in TM (and transfused SCD), patients, they continue to suffer disabling symptoms, particularly in adulthood, and many die prematurely from complications of the disorders and/or their treatment.
Bone Marrow Transplant, now best referred to a Haemopoetic Stem Cell Transplant (HSCT) is the only proven cure for both TM & SCD, effecting both resolution of symptoms and freedom from life-long, emotionally and physically demanding treatments. The decision to undergo HSCT is often difficult since these disorders are not usually immediately life-threatening.

Indications for HSCT in SCD

SCD is very heterogeneous in the severity of it's manifestations. Most clinicians will offer HSCT only to patients with specific complications of SCD which predict a poor prognosis. Some centres may also offer HSCT to families wishing to return to countries without reliable access to good medical care. Although all patients have impaired Quality of Life (QoL) because of unpredictable pain and progressive organ damage, there are specific clinical features that best identify SCD patients with a poor prognosis. For them HSCT offers both improved QoL and, since 50-60% of adults with SCD fail to reach their 50s, better prospects for long-term survival.

Referral for HSCT in SCD:

One or more of the following clinical complications:

1.CNS disease:

- **Stroke**
- **Abnormal TCD and silent infarct or abnormal psychometric tests/poor school performance formally assessed**
- **Silent infarcts with cognitive deficiency**
- **Significant abnormalities in MRA despite transfusions**
- **Abnormal TCD and generation of red cell alloantibodies**
- **CNS disease requiring transfusions leading to significant iron overload despite best attempt at adequate management**

2. **Recurrence of acute chest syndrome despiteHydroxyurea** (HU, also referred to as hydroxycarbamide) , or where HU is contraindicated.

3. VOC despite HU: >4 episodes a year requiring hospitalisation or impacting in schooling despite HU treatment. Also, where HU is contraindicated.

4. Recipient aged 2 ≤ 16 years

5. Age of donor: ≥2 years.

6. HLA-matched family donor **(1:4 chance of HLA match with FULL sibling)**

7. Problems relating to future medical care **(e.g. unavailability of adequately screened blood products, in a developing country)**

Pre-HSCT assessment must include

- Neurological assessment (MRI/MRA, Transcranial Doppler studies (TCD) and Neuro-cognitive testing. This may reveal unanticipated severe cerebral vasculopathy ('Moya- Moya'), which increases TRM and morbidity. Such cases must be discussed with experts in SCD before proceeding to HSCT.
- Need to have HLA-matched sibling donor. The referring centreshould be checking the siblings to see whether an HLA-match exists. This can be achieved by sending blood samples to the 'Antony Nolan' BMT centre, North London. It would still be possible to refer determined patients without an HLA-match, if the family is very keen. This is because it often helps families to come to terms with it better, if they hear the same message directly from the BMT unit and may also help those who want to consider having another child.
- Need to delay the HSCT until both patient and donor are ≥2 years.
- Discussion with family about the potential adverse effects on future fertility for the recipient of HSCT

SCD is more heterogeneous; the patients predicted to benefit most from HSCT are those with CNS disease or recurrent chest syndrome despite HU. Long-term Event Free Survival (EFS) after HSCT for SCD in childhood is 82-86%, almost identical to recent US data on survival in SCD with medical treatment. Future prospects include effective regimens, which currently have unacceptably high rejection rates in haemoglobinopathies, and gene therapy.

Guidelines for BMT referral for beta-Thalassaemia major

The aim of HSCT is to improve long-term survival and/or quality of life (QoL). This is particularly true for patients with poor compliance; few survive to age 40 and for them HSCT offers not only improved QoL, but also increased long-term survival. However, it is often very difficult to predict which children will accumulate iron in their organs, sometimes despite adequate chelation.

Indications for HSCT in TM

For most major thalassaemia syndromes the likely need for transfusion dependence and long term chelation therapy is more easy to predict before the age of 2 years.

***1. Definite indication for HSCT**:*

- Transfusion-dependent ⟨- or ®□thalassaemia major; transfusion-dependent HbE/®-thalassaemia
- Age 2 ≤ 16 years
- HLA-identical family donor. The referring centreshould be checking the siblings to see whether an HLA-match exists. *This can be achieved by sending blood samples to the 'Antony Nolan BMT' centre, North London. It would still be possible to refer determined patients without an HLA-match, if the family is very keen. This may helps families to come to terms with their situation better, if they hear the same message directly from the BMT unit.*
- Age for of donor: ≥2 years.

2. Candidates who may be considered for HSCT in special circumstances:

- Transfusion-dependent thalassaemia majorin adults aged 17-35 years
- Thalassaemia relapsing after previous HSCT
- Transfusion-dependent S-b^0 thalassaemia
- Thalassaemia intermedia

Adapted from:
I. Roberts and J. de la Fuente, HSCT in the haemoglobinopathies
EBMT Handbook Chapter44

Appendix A

Plan for Dissemination and implementation plan of new Procedural Documents

To be completed and attached to any document which guides practice when submitted to the appropriate committee for consideration and approval.

Acknowledgement: University Hospitals of Leicester NHS Trust

Title of document:	**Sickle Cell Disease in Childhood**		
Date finalised:	**September 2010** **Reviewed and re-issued March 2015**	**Dissemination lead: Print name and contact details**	**Dr A Robins** **Sister E Aimiuwu**
Previous document already being used?	**No**		
If yes, in what format and where?	**N/A**		
Proposed action to retrieve out-of-date copies of the document:	**N/A**		

To be disseminated to:	**How will it be disseminated/implemented, who will do it and when?**	**Paper or Electronic**	**Comments**
Ifor Ward medical and nursing staff	**Via intranet/ email and departmental meeting**	**E**	
Paramedical staff treating SCD in children	**Via intranet/ email**	**E**	
ED paediatric medical and nursing staff	**Via intranet/ email**	**E**	
Is a training programme required?	**Ongoing**		
Who is responsible for the training programme?	**Dr A Robins**		

Appendix B

Equality Impact Assessment Tool

To be completed and attached to any procedural document when submitted to the appropriate committee for consideration and approval.

Impact (= relevance) 1. Low 2. Medium 3. High	Evidence for impact assessment (monitoring, statistics, consultation, research, etc	Evidential gaps (what info do you need but don't have)	Action to take to fill evidential gap	Other issues
Race	**1**			
Disability	**1**			
Gender	**1**			
Age	**1 – Paediatric guideline**			
Sexual Orientation	**1**			
Religion and belief	**1**			

Once the initial screening has been completed, a full assessment is only required if:

- The impact is potentially discriminatory under equality or anti-discrimination legislation
- Any of the key equality groups are identified as being potentially disadvantaged or negatively impacted by the policy or service
- The impact is assessed to be of high significance.

If you have identified a potential discriminatory impact of this procedural document, please refer it to relevant Head of Department, together with any suggestions as to the action required to avoid/reduce this impact.