Clinical Management of Patients With Thalassemia Syndromes

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Background: Thalassemia is a chronic inherited blood disorder that reduces hemoglobin production, causing chronic hemolytic anemia. Patients often are diagnosed via newborn screening programs. Patients diagnosed with the most severe form of thalassemia often require chronic red blood cell transfusions to control their anemia. The side effect of chronic transfusions is cumulative iron overload for which chelation therapy is required. The incidence of thalassemia is low; therefore, care is best delivered at specialized treatment centers that offer multidisciplinary coordination.

Objectives: This article reviews the diagnosis, management, and curative options for thalassemia.

Methods: This review follows a hypothetical patient with thalassemia and his family through the major stages of the disease: diagnosis, treatment, long-term monitoring, and continued support from childhood through adulthood.

Findings: Increasing knowledge about thalassemia and its management among healthcare providers can improve patient outcomes and quality of life.

Thalassemia occurs in regions of the world where malaria is prevalent and can affect 5%–30% of the population (Rund & Rachmilewitz, 2005). A recent survey conducted by the Cooley’s Anemia Foundation estimates 1,000 individuals are affected by thalassemia in the United States. However, disease awareness remains low among nonspecialist healthcare providers (HCPs) who diagnose and treat these patients. Thalassemia is an inherited chronic autosomal recessive blood disorder resulting from impaired production of the alpha or beta subunit of hemoglobin (Muncie & Campbell, 2009). Symptoms vary depending on the amount and type of hemoglobin synthesized (Galanello, 2012; Muncie & Campbell, 2009), but chronic hemolytic anemia is common to all thalassemias (Cappellini, Poggiali, Taher, & Musallam, 2012; Children’s Hospital and Research Center Oakland, 2012; Eldor & Rachmilewitz, 2002; Rund & Rachmilewitz, 2005).

Two forms of thalassemia exist: major and intermedia (see Table 1). Thalassemia major (TM), the most severe form, is characterized by profound reduction in hemoglobin production, requiring lifelong peripheral red blood cell (RBC) transfusion therapy (Children’s Hospital and Research Center Oakland, 2012; Muncie & Campbell, 2009). Thalassemia intermedia (TI) is less severe than TM and usually is transfusion independent; however, transfusions may be intermittently required and may become chronic later in life (Children’s Hospital and Research Center Oakland, 2012; Galanello, 2012; Taher, Musallam, Karimi, & Cappellini, 2012). Some patients with TI remain asymptomatic until adulthood, whereas TM is typically diagnosed within the first few years of life (Taher, Isma’eel, & Cappellini, 2006). Complications such as extramedullary hematopoiesis, leg ulcers, gallstones, and thrombophilia are commonly associated with TI but rarely with TM (Taher et al., 2006).

Phenotypes range from mild to severe in both alpha and beta thalassemia. Alpha thalassemia is caused by deletions in the alpha-globin genes (α1 and α2) (Muncie & Campbell, 2009). Three deletions cause alpha TI, of which the most common form is hemoglobin H disease (Children’s Hospital and Research Center Oakland, 2012; Vichinsky, 2012). Four deletions cause...
alpha TM with nonimmune hydrops fetalis (Hb Bart), which is usually fatal (Galanello, 2012; Muncie & Campbell, 2009). Beta thalassemia is caused by a mutation in the beta-globin gene (Galanello, 2012) and affects about 60,000 newborns worldwide every year (Higgs, Engel, & Stamatoyanopoulos, 2012; Modell & Darlison, 2008). Two separate mutations lead to beta TI or TM, depending on the combination (Fucharoen & Weatherall, 2012; Galanello, 2012). These defects in hemoglobin production lead to anemia. Although chronic anemia contributes to the pathophysiology of thalassemia, including growth abnormalities, bone disease, and endocrine disorders, these clinical manifestations also may be related, in part, to the cumulative effects of treatment complications, including iron overload from repeated transfusions (Rund & Rachmilewitz, 2005).

Because outcomes are better for patients whose care is coordinated by specialized thalassemia centers, disseminating information about this disease to ensure early detection, appropriate management, and prevention of complications is important (Children’s Hospital and Research Center Oakland, 2014). The following case study represents a patient with TM through the natural course of the disease and highlights standard-of-care guidelines at each stage to help implement procedures to identify, monitor, and support patients with thalassemia throughout their lives.

Case Study

First Stage: Diagnosis

Alex, a 9-month-old boy, was brought to the emergency department by his parents because of poor feeding, irritability, and pallor. A physical examination revealed hepatosplenomegaly and tachycardia. His white blood cell count was elevated, and pallor. A physical examination revealed hepatosplenomegaly and tachycardia. His white blood cell count was elevated. His serum ferritin level was low at 5.9 g/dl (normal range = 12–15.5 g/dl) and his hematocrit was 17.1% (normal range = 34.9%–44.5% for females; 38.8%–50% for males) and his hematocrit was 17.1% (normal range = 34.9%–44.5% for females; 38.8%–50% for males) (Mayo Foundation for Medical Education and Research, 2014a). Alex received a red blood cell (RBC) transfusion at this initial visit.

A detailed medical history and laboratory results ruled out potential causes of temporary anemia (e.g., viral illness, lead poisoning, folic acid or iron deficiencies) (Children’s Hospital and Research Center Oakland, 2012). Because both parents were of Greek descent, the consultant hematologist suspected thalassemia. An analysis of hemoglobin subunits was followed by genetic testing to confirm diagnosis.

Most patients are diagnosed during routine newborn screening rather than symptom presentation. Parents are given information about Centers for Disease Control and Prevention–funded thalassemia treatment centers in the United States and other support organizations, such as Cooley’s Anemia Foundation and Thalassemia Support Foundation, which provide counseling, assessment, and referrals to help cope with the diagnosis and disease, financial or insurance issues, and travel and lodging to visit specialists (Centers for Disease Control and Prevention, 2014). HCPs should discuss the possibility of stem cell transplantation (SCT) from a matched sibling at this early stage; studies have shown that early SCT, along with established medical treatments, results in a better outcome for the patient (Lucarelli, Isgro, Sodani, & Gaziiev, 2012; Sabloff et al., 2011).

Second Stage: Onset of Lifelong Transfusion Therapy

After DNA testing confirmed Alex had beta TM, the HCPs explained to his parents that thalassemia was the underlying cause of his symptoms, including the anemia and hepatosplenomegaly (Children’s Hospital and Research Center Oakland, 2012; Taher et al., 2006) and, if left untreated, bone

### TABLE 1. Clinical Profile of Patients With TM and TI

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta TM</th>
<th>Beta TI</th>
<th>Alpha TI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia</td>
<td>Severe</td>
<td>Moderate</td>
<td>Alpha TI</td>
</tr>
<tr>
<td>Hemoglobin level</td>
<td>Less than 8 g/dl</td>
<td>Moderate</td>
<td>Alpha TI</td>
</tr>
<tr>
<td>Serum ferritin</td>
<td>• Origa et al. (2007): 2,748 ng/ml (SD = 2,510)</td>
<td>• Origa et al. (2007): 627 ng/ml (SD = 309)</td>
<td>Rarely exceeds 1,000 ng/ml</td>
</tr>
<tr>
<td></td>
<td>• Haghpanah et al. (2010): 2,660 ng/ml (SD = 1,990)</td>
<td>• Haghpanah et al. (2010): 1,036 ng/ml (SD = 1,417)</td>
<td>rarely exceeds 1,000 ng/ml</td>
</tr>
<tr>
<td>Onset age</td>
<td>Less than one year (because adult hemoglobin fails to replace fetal hemoglobin)</td>
<td>Greater than two years (some remain asymptomatic until adult life)</td>
<td>Depends on the severity</td>
</tr>
<tr>
<td>Symptoms and complications</td>
<td>Anemia, pallor, abdominal swelling, hepatosplenomegaly, cardiomegaly, growth retardation, skeletal abnormalities, irritability, jaundice</td>
<td>Same as in TM, but milder; extramedul- lary hematopoiesis, leg ulcers, gallstones, thrombophilia</td>
<td>Hemolytic anemia, spleno- megaly, growth retardation, bone abnormalities</td>
</tr>
<tr>
<td>Transfusion therapy</td>
<td>Yes; otherwise, children do not develop normally and die during the first or second decade of life.</td>
<td>Generally not (at least in the first decade of life)</td>
<td>Depends on the severity</td>
</tr>
</tbody>
</table>

**Note.** Both beta and alpha thalassemia include syndromes that range from mild to severe, and the symptoms presented here, for example, may vary in intensity or number.

**Note.** Based on information from Higgs et al., 2012; Hoffman et al., 2008; Kohne, 2011; Muncie & Campbell, 2009; Taher et al., 2006.
deformities could develop (e.g., prominent forehead, flattened nasal bridge, paraspinal masses, osteoporosis) as early as age 5 (Martin, Foote, & Carson, 2004). However, these manifestations can be prevented with early, regular use of transfusion therapy (Children's Hospital and Research Center Oakland, 2012). The physician assessed Alex’s transfusion needs, taking into consideration his growth failure, lack of activity, early appearance of skeletal change, and hemoglobin levels. Bilirubin, transaminase, and serum ferritin levels also were measured to ensure adequate hepatic and cardiac functions at baseline. It was confirmed that Alex had completed his hepatitis B vaccine course and would receive his first hepatitis A vaccine dose at 12 months of age (Centers for Disease Control and Prevention, 2015). Hepatitis A and B vaccinations are recommended for patients with thalassemia receiving transfusions because of the risk for transfusion-transmitted infections (Children's Hospital and Research Center Oakland, 2012).

Alex started a course of packed RBC transfusions every 2–4 weeks at 10 months of age to improve anemia and counteract hemolysis. Standard of care guidelines recommend initiating routine transfusions when hemoglobin is less than 6 g/dl or decreases to less than 7 g/dl twice, two weeks apart (Children's Hospital and Research Center Oakland, 2012) (see Figure 1). The most widely accepted transfusion protocol aims to maintain pre-transfusion hemoglobin levels at greater than 9–10 g/dl (Higgs et al., 2012).

During each transfusion, Alex was closely monitored for potential adverse reactions. Hepatitis B/C and HIV testing were performed before the first transfusion and annually because of the risk for transfusion-transmitted infections (Children's Hospital and Research Center Oakland, 2012; Vichinsky et al., 2013). Total body iron was monitored to avoid toxicity. Annual assessment of cardiac and hepatic iron by magnetic resonance imaging (MRI), liver biopsy, or superconducting quantum interference device should be considered (Kwiatkowski et al., 2012). Serum ferritin measurements with each transfusion, and at least quarterly, can provide iron trend information. Iron accumulation can generally be detected in the liver after about one year of monthly transfusions, but cardiac iron loading typically takes 8–10 years (Children's Hospital and Research Center Oakland, 2012). Patients with TM often require regular transfusions in their first year to develop normally.

Some patients with TI, particularly those with hemoglobin H (an alpha thalassemia generally characterized by the deletion of 3 of the 4 alpha globin genes), may never require transfusions; they should be maintained on folic acid supplements to help build healthy RBCs (Fucharoen & Weatherall, 2012; National Heart, Lung, and Blood Institute, 2014), and be monitored regularly for hemoglobin levels, iron accumulation, bony changes, growth, and cardiac status (Fucharoen & Weatherall, 2012). Some patients with TI may not require transfusions until they reach their teens or older based on symptoms and hemoglobin levels (see Figure 2).

### Third Stage: Onset of Chelation Therapy

During the two years after initiating transfusion therapy, Alex’s serum ferritin levels kept rising, raising concerns about iron overload toxicity, and were approaching 1,000 ng/ml, the threshold for initiating chelation therapy (normal range = 11–307 ng/ml for females; 24–336 ng/ml for males) (Children's Hospital and Research Center Oakland, 2012; Mayo Foundation for Medical Education and Research, 2014b).

Iron overload, characterized by free iron accumulation in the endocrine glands, liver, and heart, is common to TM and TI (Aessopos et al., 2007; Musallam, Cappellini, Wood, & Taher, 2012). Iron overload occurs more slowly with transfusion-
Deferoxamine
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IV or subcutaneous for 8–12 hours, 5–7
Deferiprone
Oral tablets
40%–60% fecal
Deferasirox
90% urinary
90% fecal
Short (8–30 minutes), which is why sub
20–60 mg/kg per day (averaged during a
Deferasirox also is approved in tablet form, with a starting dose of 14 mg/kg for transfusional iron overload.

In case of adverse events, the patient should discontinue treatment until the adverse event is resolved and then restart treatment at a lower dose. Alternatively, another treatment may be prescribed.

Note. Based on information from Children’s Hospital and Research Center Oakland, 2012; Martin et al., 2004; Neufeld, 2010; Rachmilewitz & Giardina, 2011.

TABLE 2. Properties of Deferoxamine, Deferasirox, and Deferiprone

<table>
<thead>
<tr>
<th>Variable</th>
<th>Deferoxamine</th>
<th>Deferasirox†</th>
<th>Deferiprone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical dosing</td>
<td>20–60 mg/kg per day (averaged during a week if not given daily)</td>
<td>20–40 mg/kg per day once daily, or divided twice daily (dependent on transfusion rate)</td>
<td>75–100 mg/kg per day, generally in three divided doses</td>
</tr>
<tr>
<td>Administration</td>
<td>IV or subcutaneous for 8–12 hours, 5–7 days per week</td>
<td>Oral suspension</td>
<td>Oral tablets</td>
</tr>
<tr>
<td>Plasma half-life</td>
<td>Short (8–30 minutes), which is why subcutaneous infusions are preferred</td>
<td>Long (11–18 hours; shorter in young children)</td>
<td>Intermediate (1.5–4 hours)</td>
</tr>
<tr>
<td>Potential advantages</td>
<td>Long-term safety record; continuous treatment indicated for patients with life-threatening cardiac siderosis</td>
<td>Oral administration; well tolerated by a majority of patients; higher doses provide 24 hours of coverage to prevent free iron accumulation</td>
<td>Oral administration</td>
</tr>
<tr>
<td>Potential disadvantages</td>
<td>Subcutaneous administration; local skin reactions limit tolerability in many patients; patient adherence to the course of therapy may be challenging; may chelate other metals from the body</td>
<td>GI symptoms limit MTD in some patients; about 30% of patients have inadequate response at MTD; may not reduce cardiac siderosis in the most severe cases (T2* less than 6 msec)</td>
<td>Side effect profile limits use in many patients (e.g., GI or joint symptoms); rare agranulocytosis and infrequent neutropenia require weekly complete blood count monitoring</td>
</tr>
<tr>
<td>Excretion</td>
<td>40%–60% fecal</td>
<td>90% fecal</td>
<td>90% urinary</td>
</tr>
<tr>
<td>Common adverse events§</td>
<td>Local skin reactions; hearing loss and bone problems (mostly in older patients who were treated with high doses when younger); local reactions/allergy</td>
<td>Rash (treatment interruption seldom required); GI upset, diarrhea (dose related); mild abnormalities in creatinine or proteinuria; transient elevation in transaminases; ocular and auditory toxicity</td>
<td>GI distress; joint pain and erosive arthritis (particularly in South Asian patients); neutropenia</td>
</tr>
<tr>
<td>Severe or dangerous adverse events§</td>
<td>Siderophore for some bacteria (e.g., Listeria); retinopathy and acute pulmonary disease are possible when given in excess of iron burden; growth retardation</td>
<td>Peptic ulcers; liver dysfunction, including failure; renal dysfunction, including failure; hepatitis</td>
<td>Agranulocytosis (less than 1%)</td>
</tr>
</tbody>
</table>

†Deferasirox also is approved in tablet form, with a starting dose of 14 mg/kg for transfusional iron overload.

‡In case of adverse events, the patient should discontinue treatment until the adverse event is resolved and then restart treatment at a lower dose. Alternatively, another treatment may be prescribed.

Note. Based on information from Children’s Hospital and Research Center Oakland, 2012; Martin et al., 2004; Neufeld, 2010; Rachmilewitz & Giardina, 2011.

FIGURE 2. Indications for Red Blood Cell Transfusions in Patients With Thalassemia Intermedia

Note. Based on information from Taher et al., 2006.
Alex’s parents. Three iron chelators are currently approved for use in the United States: deferoxamine (Desferal®), deferasirox (Exjade®), and deferiprone (Ferriprox®) (Children’s Hospital and Research Center Oakland, 2012; Kwiatkowski, 2011) (see Tables 2 and 3). In prospective studies involving more than 7,000 patients, deferasirox effectively lowered hepatic and cardiac iron levels with an acceptable tolerability profile (Higgs et al., 2012). Deferiprone tablets were approved in 2011 as second-line therapy related to the risk of life-threatening neutropenia, gastrointestinal complications, and joint pain (Higgs et al., 2012; Neufeld, 2010; U.S. Food and Drug Administration, 2011). Clinical trials are evaluating whether various combinations of deferasirox, deferoxamine, and deferiprone (Ain Shams University, 2012; Children’s Hospital and Research Center Oakland, 2009; Grady et al., 2013; Neufeld, 2010; Novartis Pharmaceuticals, 2010) can be beneficial in patients with severe cardiac iron load (Ha et al., 2011; Tanner et al., 2007, 2008).

First-line chelation therapy should be started about one year after initiating chronic transfusions, but may be delayed in young children to avoid adverse events associated with iron chelators (Children’s Hospital and Research Center Oakland, 2012). Target serum ferritin levels are 1,000–2,500 ng/ml in patients with thalassemia, but several programs aim for 500 ng/ml in adults. The potential benefits of lower body iron should be weighed against the side effect risks associated with iron chelators. For Alex, first-line chelation therapy was started at the age of 2. HCPs monitored Alex for signs of drug toxicity, such as auditory or visual changes, cataracts, renal dysfunction, growth failure, and symptoms of iron deficiency.

Alex’s parents were asked about his adherence to the prescribed chelator, as poor adherence compromises effectiveness of treatment and can negatively affect patients’ outcomes (Porter, Evangelgi, & El-Beshlawy, 2011). Poor results may be misinterpreted as inefficacy, resulting in an unnecessary therapy change that could limit future options. Adherence may be particularly challenging for teenagers given more responsibility for their treatment.

As patients with thalassemia enter adulthood, fertility, marriage, and insurance often become major issues. Complications such as diabetes, hypogonadism (treatable with testosterone or estrogen), hypothyroidism, osteopenia, and pain also emerge in young adulthood. Pain commonly occurs in the back, legs, and head, and becomes more prevalent with age: 79% of patients aged 35 years or older reported pain during the previous four weeks in one study; etiology of this pain is unknown (Haines et al., 2013; Oliveros et al., 2013). Pain medications, including opioids, are commonly used (Haines et al., 2013).

### Long-Term Monitoring

Historically, patients with thalassemia did not live into adulthood. Although they are now living longer, they eventually develop complications (despite transfusion and chelation therapies) and require additional interventions. Patients with thalassemia should annually visit specialty care centers in addition to receiving routine thalassemia care by their primary care provider. Adult patient care has become available in some parts of the country, usually at thalassemia medical centers. Patients may develop vascular complications in response to hypercoagulability and hemolysis (Aessopos et al., 2007). Thromboembolic events occur more frequently in patients with TI (5.2%) than in those with TM (4.3%), and even more frequently in transfusion-independent splenectomized patients with TI (29%) compared with regularly transfused patients with TM (2%) (Aessopos et al., 2007). Antiplatelet or antithrombin therapy with aspirin or low-dose warfarin may be indicated in some cases (Children's Hospital and Research Center Oakland, 2012).

For Alex, his hepatic, endocrine, cardiac, and pulmonary functions should be monitored routinely throughout his life. Serum ferritin testing is convenient, inexpensive, and positively correlated with body iron levels, but can underestimate iron load, particularly in patients with transfusion-independent TI (Musallam, Cappellini, et al., 2012). Annual MRI measurement of liver iron concentration (LIC) is recommended. LIC values greater than 11 mg/g dry weight (DW) have been reported in patients with TI and TM (normal range = 0.3–1.4 mg/g DW) (Oriña et al., 2007). LIC should be 3 mg/g DW or greater before starting chelation therapy and less than 7 mg/g DW thereafter (Children’s Hospital and Research Center Oakland, 2012). More information can be found at [http://thalassemia.com/SOC/index.aspx](http://thalassemia.com/SOC/index.aspx).

### TABLE 3. Toxicity Monitoring Parameters by Chelator

<table>
<thead>
<tr>
<th>Variable</th>
<th>Deferoxamine</th>
<th>Deferasirox</th>
<th>Deferiprone</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANC, CBC</td>
<td></td>
<td></td>
<td>Weekly</td>
</tr>
<tr>
<td>Liver function tests</td>
<td>–</td>
<td>Every 3–4 weeks</td>
<td>Every 3 months</td>
</tr>
<tr>
<td>Creatinine</td>
<td></td>
<td>Every 3–4 weeks</td>
<td>Every 3 months</td>
</tr>
<tr>
<td>Urine protein/creatinine</td>
<td>Every 3 months</td>
<td>Every 3–4 weeks</td>
<td></td>
</tr>
<tr>
<td>Urine microalbumin/creatinine</td>
<td>Every 3 months</td>
<td>Every 3–4 weeks</td>
<td></td>
</tr>
<tr>
<td>Urine glucose</td>
<td></td>
<td>Every 3–4 weeks</td>
<td></td>
</tr>
<tr>
<td>Zinc, copper, calcium, and magnesium</td>
<td>Annually</td>
<td>Annually</td>
<td>Annually</td>
</tr>
<tr>
<td>Electrolytes</td>
<td></td>
<td>Every 3–4 weeks</td>
<td></td>
</tr>
<tr>
<td>Eye examination</td>
<td>Annually</td>
<td>Annually</td>
<td>Annually</td>
</tr>
<tr>
<td>Audiogram</td>
<td>Annually</td>
<td>Annually</td>
<td>Annually</td>
</tr>
<tr>
<td>Sitting height</td>
<td>Biannually</td>
<td>Biannually</td>
<td>Biannually</td>
</tr>
<tr>
<td>Height/weight</td>
<td>Every 3–4 weeks</td>
<td>Every 3–4 weeks</td>
<td>Every 3–4 weeks</td>
</tr>
<tr>
<td>Clinical symptoms (nausea, diarrhea, color/ vision change)</td>
<td>Every 3–4 weeks</td>
<td>Every 3–4 weeks</td>
<td>Every 3–4 weeks</td>
</tr>
</tbody>
</table>

ANC—absolute neutrophil count; CBC—complete blood count

Note. Based on information from Children’s Hospital and Research Center Oakland, 2012; Martin et al., 2004; Neufeld, 2010; Rachmilewitz & Giardina, 2011.
Bilirubin, aspartate transaminase, alanine transaminase, and alkaline phosphatase are measured with each transfusion. Starting at age 5 (or after three years of transfusions), annual endocrinology screening should measure thyroid hormones, fasting glucose, bone density, and trace elements. Although monthly cardiac assessments during transfusions can detect irregular heart rate and rhythm and edema, an annual echocardiogram starting at 8–12 years of age will check for increased cardiac output and pulmonary hypertension (Aessopos et al., 2007; Children’s Hospital and Research Center Oakland, 2012). Conventional echocardiography may fail to predict early cardiac dysfunction (Barbero, Destefanis, Pozzi, Longo, & Piga, 2012); therefore, cardiac MRI tests also are recommended (Aessopos et al., 2007). Cardiac iron varies inversely with T2* values: 20 msec or greater is normal; less than 20 msec indicates detectable cardiac iron (Anderson et al., 2006).

As mentioned, all patients with thalassemia should receive an annual echocardiogram to assess for pulmonary arterial hypertension, and regular pain assessments and an annual evaluation by a registered dietitian for adequate intake of calcium, vitamin D, folate, trace minerals (copper, zinc, selenium), and antioxidants (vitamins C and E), as nutritional deficiencies are common with thalassemia (Children’s Hospital and Research Center Oakland, 2012; Fung et al., 2012). Because emotional health affects psychological and physical well-being, particularly in young patients transitioning to adulthood (Mednick et al., 2010), support groups can provide valuable assistance for patients and their families.

**Emerging Therapies**

Allogeneic SCT, the only potentially curative treatment for thalassemia, requires referral to specialized centers. In one study, disease-free survival (DFS) was 80%–90% in children receiving human leukocyte antigen (HLA)-matched related stem cells before developing iron overload (or viral hepatitis) (Higgs et al., 2012). However, HLA-matched related stem cells often are unavailable, and DFS is lower with transplantations from HLA-matched unrelated or haploidentical donors (20%–70%) (Higgs et al., 2012). Cord-blood transplantation can overcome the need for HLA-matched stem cells (despite susceptibility to graft rejection), with DFS of about 90% (Higgs et al., 2012). With the initiation of cord blood storage in 2005, families with a thalassemia-affected child may choose to store cord blood from unaffected siblings to use for SCT in affected children.

Gene therapy is another promising approach, but many technical challenges remain before it becomes available to patients outside clinical trials (Higgs et al., 2012). Another potential treatment is synthetic hepcidin, which could prevent iron overload by reducing serum iron concentrations (Andrews, 1999; Silvestri, 2013). Ferroportin, which transports iron from cells into the bloodstream, is targeted for degradation by hepcidin, but hepcidin expression is decreased in thalassemia (Andrews, 1999; Silvestri, 2013).

**Conclusion**

Patients with thalassemia, like Alex, will experience at least three major treatment stages during their lifetime. After diagnosis, RBC transfusions are the mainstay of care in TM and part of the comprehensive management of TI (Children’s Hospital and Research Center Oakland, 2012; Taher et al., 2012). After initiating transfusion therapy, the toxic cumulative effects of iron overload become a major concern (Lambing, Kachalsky, & Mueller, 2012). Chelation therapy to minimize iron toxicity should be considered in all thalassemia cases with elevated iron levels. Timely monitoring of hepatic, endocrine, cardiac, and pulmonary functions, along with nutrition and treatment adherence, is critical to preventing complications.

Patients with thalassemia have diverse cultural backgrounds and ways of coping with intrusive treatments, and require lifelong follow-up. At thalassemia treatment centers, nurses play an important role in coordinating care from a multidisciplinary team that includes specialists, psychosocial and other professionals, and support programs (see Figure 3). Nurses also educate patients and families and promote adherence to recommended treatments and follow-up care. This collaborative approach helps to address social, developmental, and behavioral issues and provide patients with the best care (Children’s Hospital and Research Center Oakland, 2012).

**Implications for Practice**

- Be aware of the low but rising incidence of thalassemia, and how coordinated care is best delivered at specialized treatment centers by multidisciplinary teams.
- Collaborate with a multidisciplinary team that includes medical, nursing, and psychosocial professionals to address social, developmental, and behavioral issues that affect patients with thalassemia.
- Increase the awareness of thalassemia diagnoses and management among all healthcare providers to improve patient outcomes and quality of life.
References


