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Howard et al does an excellent job of discussing many details for children with cerebral palsy and severe scoliosis. Treatment of progressive scoliosis may be indicated in more involved GMFCS IV and V patients, but these patients also have significant comorbidities.<sup>1</sup>

Surgical correction of

scoliosis has been reported to improve the quality of life in these patients,<sup>2,3</sup> and patients and caregivers report high satisfaction rates after surgical correction of scoliosis. These satisfaction rates remain high despite an increased complication rate. It is the responsibility of the treating surgeon to accurately assess the risks and benefits of surgery. A team approach is best used to minimize the risk of complications and with a shared decision-making process between the medical team and the patient/caregiver.

A wise clinical decision-making process is needed because of the known high complication rate of scoliosis surgery in GMFCS IV and V patients. In a literature review by Legg et al.,<sup>4</sup> the reported complication rate after scoliosis surgery varied from 10% to 70%, with a mortality rate between 2.18% and 19%. When only the most recent studies were included, the mortality rate was 5%. The respiratory complication rate ranged from 26% to 57%, and infection rate from 2.5% to 56%.

McCarthy et al.<sup>1</sup> cited an overall complication rate between 44% and 80%, a mortality rate between 0 and 7%, major pulmonary complication rate of 21% and wound problems in 8.7%. Watanabe et al.<sup>5</sup> reported 3

intraoperative cardiac arrests in their series of 84 patients, highlighting the fragility of these patients. The treating surgeon should also assess hospital and support services that are available during and after surgery. Toovey et al.<sup>6</sup> reported that the mean ICU stay after neuromuscular scoliosis surgery was 4.4 days (range 1.7-6.7) and mean hospital stay was 16.9 days (range 8.7-24.5).<sup>6</sup>

With the goal to decrease complications into an acceptable rate (< 10 %), with ICU stays of <24 hours, and hospital stays <7 days, we have utilized a comprehensive care team approach. The team assesses the risk factors and takes steps to decrease them prior to surgery while including the patient and caregivers in the discussion. Preoperative evaluation by a high-risk anesthesia team and ICU physician will allow for any unanticipated problems that can be addressed prior to surgery. When embarking on treatment for these patients at your institution, a series of questions ought to be considered. The first questions to be answered are, “Do you have the appropriate resources at your hospital to safely perform the surgery or should this be referred to another institution? Is there another experienced spine surgeon to assist with case?” Shrader et al. reported decreased complication rates, surgical time, and length of hospitalization if an experienced second surgeon was present during the surgery.<sup>7</sup> Having the assistance of a plastic surgery to aid in wound closure has been shown to decrease wound complications.<sup>10</sup>

Pulmonary complications are common after scoliosis surgery and the pulmonary service should be actively involved in both preoperative optimization and postoperative care to minimize the risk of pulmonary complications. Khirani et al. reported that non-invasive pulmonary techniques and coaching before surgery, decreased respiratory complications and decreased the need for prolonged intubation.<sup>9</sup> ENT evaluation for management of excessive drooling also may decrease the

risk of aspiration. Patients are often malnourished, and their nutritional status should be improved preoperatively. Jevsevar and Karlin found an increase in complications if albumin was  $< 35\text{g/l}$ , and total blood lymphocyte count was  $< 1.5\text{ g/l}$ .<sup>9</sup> Gastrointestinal and general surgery consultation may be needed for possible G-tube placement and management. Gastric fundoplication might be considered to prevent or decrease the risk of reflux and aspiration. The endocrine service might require consultation prior to surgery in patients with a history of severe osteoporosis and bone fragility. Optimizing bone health preoperatively will allow for better fixation of the implants used to correct scoliosis and potentially less hardware failure. Valproic acid has been shown to increase bleeding times and interfere with clotting, and an alternative seizure medication may be needed before surgery.<sup>1</sup>

Finally, the social worker and wheelchair vendors should be aware of postoperative needs. Adjustments to the wheelchair commonly are needed after surgical correction of the scoliosis. The social worker can assist the parents with home care issues once the patient is discharged.

The treating orthopedic surgeon is responsible for coordinating all of these services and for the preoperative work-up. If we are attentive to these details before surgery, the surgeon, patient, and family can expect good results from the surgery and improved quality of life for the patient with an acceptable risk of complications. Not all patients can be optimized medically for surgery. If this is the case, a clinical decision shared by the medical team and the patient/caregiver about proceeding with surgery is necessary. Shirley et al. developed a shared decision aid for neuromuscular scoliosis that resulted in 9 of 11

families proceeding with surgery.<sup>11</sup> It should be the goal of the treating surgeon to optimize all cerebral palsy patients needing scoliosis surgery, but this may not always be possible.

## References

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