- Surgery may be indicated for NF-1 pts with tumors (e.g., neurofibromas, pheochromocytoma), tibial pseudarthrosis, scoliosis, and/or vascular abnormalities.
- NF-2, also known as MISME, is a genetic disorder with bilateral vestibular schwannomas, cataracts, hearing loss, and cranial nerve, meningioma, spinal astrocytoma, and ependymoma tumors.

Etiology

- NF-1 and NF-2 are both autosomal dominant; about 50% of cases represent new mutations.
- The gene for NF-1 resides on the long arm of chromosome 17, *17q11.2*.
- The gene for NF-2 resides on chromosome 22.

Usual Treatment

- Radiation and surgical treatment for various tumors involved

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT*	Pharyngeal compression Laryngeal compression Vocal cord and arytenoid involvement Airway obstruction	Dyspnea, dysphonia, stridor, and voice changes	Evaluation of the airway	X-ray CT of neck
CV	Renal vascular Htn Pheochromocytoma Autonomic dysfunction	Headache and perspiration		BP/HR Urinary catecholamines
RESP*	Restrictive lung disease Cor pulmonale Interstitial lung disease Hypoxemia	Exercise tolerance	Cyanosis Clubbing	CXR ECG ABG PFTs (rare)
GI	Carcinoid tumor			
GU*	Obstruction and uremia			
CNS	Mental retardation Seizures Intracranial tumors and increased ICP Paraspinal tumors			MRI of brain and spine for neuraxial technique
MS*	Kyphoscoliosis Macrocephaly Craniofacial dysplasia Cervical dislocation Pectus excavatum			X-ray of the neck

*In severe cases.

Key References: Hirsch NP, Murphy A, Radcliffe JJ: Neurofibromatosis: clinical presentations and anaesthetic implications, *Br J Anaesth* 86(4):555–564, 2001; Fox CJ, Tomajian S, Kaye AJ, et al.: Perioperative management of neurofibromatosis type 1, *Ochsner J* 12(2):111–121, 2012.

Perioperative Implications

Preoperative Preparation

- Evaluation of the airway for laryngeal, pharyngeal, and mediastinal masses in NF-1.
- Increased skeletal abnormalities including scoliosis should be considered in NF-1.
- Frequent end-organ vasculopathies impair or alter end-organ function and reserve in NF-1.
- Controversially, NF-1 may be associated with hypertrophic obstructive cardiomyopathy.

Monitoring

- Routine
- Arterial line monitoring for pheochromocytoma and/or vascular stenoses/aneurysms

Airway

- Consider awake fiberoptic intubation or awake tracheotomy if laryngeal and pharyngeal involvement or known mediastinal mass is present.

Preinduction/Induction

- Consider potential for increased ICP.
- Consider potential of vascular stenoses and/or aneurysms, including risk of ischemic infarct.
- Consider potential of restrictive scoliotic lung disease.

Maintenance

- Maintain cardiovascular stability and optimize ventilation.

Extubation

- Routine considerations

Postoperative Period

- Pain management may be critical and challenging.

Regional Anesthesia

- Asymptomatic paraspinal neurofibromas can make identification and entry into epidural and subarachnoid spaces very difficult. Preemptively carefully examine the back.
- Paraspinal and intracranial tumors are exacerbated during pregnancy.
- Consider potential for epidural hematoma, tumor trauma, and brainstem herniation.
- Recommend MRI of brain and spine for tumor assessment before using a neuraxial technique.

Anticipated Problems/Concerns

- Difficult airway
- Presence of pheochromocytoma or vascular abnormality
- Potential for increased ICP with expanding intracranial tumor
- Difficult epidural or spinal placement; potential for complications due to tumor involvement

Neuroleptic Malignant Syndrome

Lyndsay M. Hoy | Lee A. Fleisher

Risk

- Incidence of 0.01–0.02%
- Mortality rate of 10%
- 2000 cases of NMS diagnosed annually in USA hospitals
- Pharmacologic:
  - Typical/"first generation" antipsychotic
  - Rapid dose titration/switching agents/abrupt medication withdrawal/high cumulative dose
  - IM depot/IV administration
  - Multiple concurrent antipsychotics or antipsychotic with lithium/carbamazepine
- Demographic/miscellaneous:
  - Advanced age
  - Psychiatric/medical comorbidities
  - Anemia
  - Dehydration/malnutrition
  - Pt history of NMS
  - Hot climate/high ambient temperature

Perioperative Risks

- Pulm aspiration
- Cardiovascular lability
- Rhabdomyolysis

Worry About

- Potentially life-threatening if left untreated
- Increased risk of recurrence in pts requiring chronic antipsychotic therapy with Hx of previous NMS

- Increased off-label use of antipsychotics
- Differentiating NMS from serotonin syndrome, malignant hyperthermia, drug-induced extrapyramidal reactions, and substance-abuse withdrawal

Overview

- Rare, iatrogenic hypermetabolic reaction characterized by fulminant or insidious development of muscular rigidity, altered sensorium, dysautonomia, and high fever.
- Triggered by antidopaminergic agents or DA agonist withdrawal.
- More common in pts with psychiatric Hx of schizophrenia, schizoaffective disorder, bipolar disorder, mental retardation, Parkinson disease, dementia, and psychosis.
- Despite declining frequency likely due to more widespread recognition and earlier diagnosis/treatment, NMS remains a significant source of morbidity and mortality for pts taking antipsychotics.
- Shares striking clinical similarities with but is otherwise pathophysiologically distinct from malignant hyperthermia; to date, no definitive evidence demonstrating that NMS increases the risk of malignant hyperthermia under general anesthesia.

Etiology

- Central D_2 receptor antagonism triggers a cascade of disrupted DA receptor–mediated signaling pathways with resultant autonomic dysregulation and end stage hypermetabolic syndrome.
- Known triggering scenarios include DA antagonists, DA-agonist withdrawal, and GABA-agonist withdrawal.

- Once NMS is diagnosed and the triggering agent discontinued, NMS is generally self-limited, and full resolution can be expected to occur within 1 wk to 10 d, with appropriate supportive therapy.

Usual Treatment

- Dx of exclusion; rule out alternate causes of symptoms.
- Immediate discontinuation of triggering medication.
- Consider use of benzodiazepines, dantrolene, DA agonists, or electroconvulsive therapy.
- Supportive care including airway protection, hemodynamic stabilization, temperature regulation, fluid resuscitation, and lyte correction as indicated.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Dystonia	Increased facial tone with involuntary contractions Excess saliva	Oculogyric crisis, trismus, blepharospasm, dysarthria, and dysphagia Sialorrhea Facial flushing	
RESP	Pulm aspiration Hypoxemia Acute pulm edema Pulm embolus	Respiratory distress Dyspnea	Lung-field consolidation Tachypnea	CXR and CT scan ABG Bronchoalveolar lavage V/Q scan
CV	Dysautonomia Reversible dilated cardiomyopathy	Diaphoresis, chest pain, dyspnea, and palpitations	Tachydysrhythmias and labile BP	ECG, ECHO, and coronary angiogram
CNS	Delirium Hyperthermia Extrapyramidal symptoms Metabolic encephalopathy	Disorientation Fever	Altered mental status and agitation Choreiform/dyskinesia	CT/MRI CSF analysis and EEG
RENAL	Myoglobinuria Acute kidney failure Metabolic acidosis	Dark-red urine	Oliguria	Electrolytes, UA, BUN, and Cr
HEME	Leukocytosis DIC			CBC Fibrinogen and coagulation

Key References: Strawn JR, Keck PE Jr, Caroff SN: Neuroleptic malignant syndrome, *Am J Psychiatry* 164(6):870–876, 2007; Mustafa HI, Fessel JP, Barwise J, et al.: Dysautonomia: perioperative implications, *Anesthesiology* 116(1):205–215, 2012.

Perioperative Implications

Preoperative Preparation

- Conduct a thorough review of home medications/inpatient regimen with particular attention to antipsychotics and confirmation of date/time of last dose.
- If concern exists for active NMS, postpone any elective procedure until pt is clinically stable.

Monitoring

- Arterial line if indicated
- Urine output for myoglobinuria

Airway

- Anticipate copious secretions w/ possible dysphagia and muscular rigidity in pts with active NMS.
- Consider full stomach precautions.

Preinduction/Induction

- Pt may exhibit exaggerated hemodynamic response to induction medications and volatile agents.

Maintenance

- Vigilant management of blood pressure and volume status
- Neuromuscular blockade to reverse severe muscular rigidity if indicated
- Diuresis

Extubation

- Keep intubated if concern for airway protection exists.

Postoperative Period

- May require a higher level of care

Anticipated Problems/Concerns

- Periop autonomic dysfunction
- Increased risk for aspiration and periop pulm complications
- Clinical presentation similar to malignant hyperthermia but with no pharmacologic crossover

Niemann-Pick Disease

Thomas Schilling | Alf Kozian

Risk

- Incidence in live births: 1:100,000-120,000
- Affects equally males and females of all ethnic groups
- NP-D type A frequent in the Ashkenazi-Jewish population
- No curative therapy, although several symptomatic manifestations are treatable
- Associated with a decrease in life expectancy, although many pts survive until late adulthood

Perioperative Risks

- NP-D pts require a multitude of diagnostic and therapeutic procedures (e.g., medical imaging, lumbar puncture, intrathecal chemotherapy injection, auditory brainstem response measurements, and skin biopsies). General anesthesia with endotracheal intubation is often required.
- Pts at increased risk of aspiration, especially those with severe lung involvement, recurrent aspiration, and chronic cough.
- Perianesthetic morbidity includes need for tracheal reintubation; pneumonitis, hypothermia, and seizures.

Worry About

- Severe visceral, pulmonary, and neurologic involvement
- Hepatomegaly, ascites, coagulation disorders, and hypersplenism with thrombocytopenia