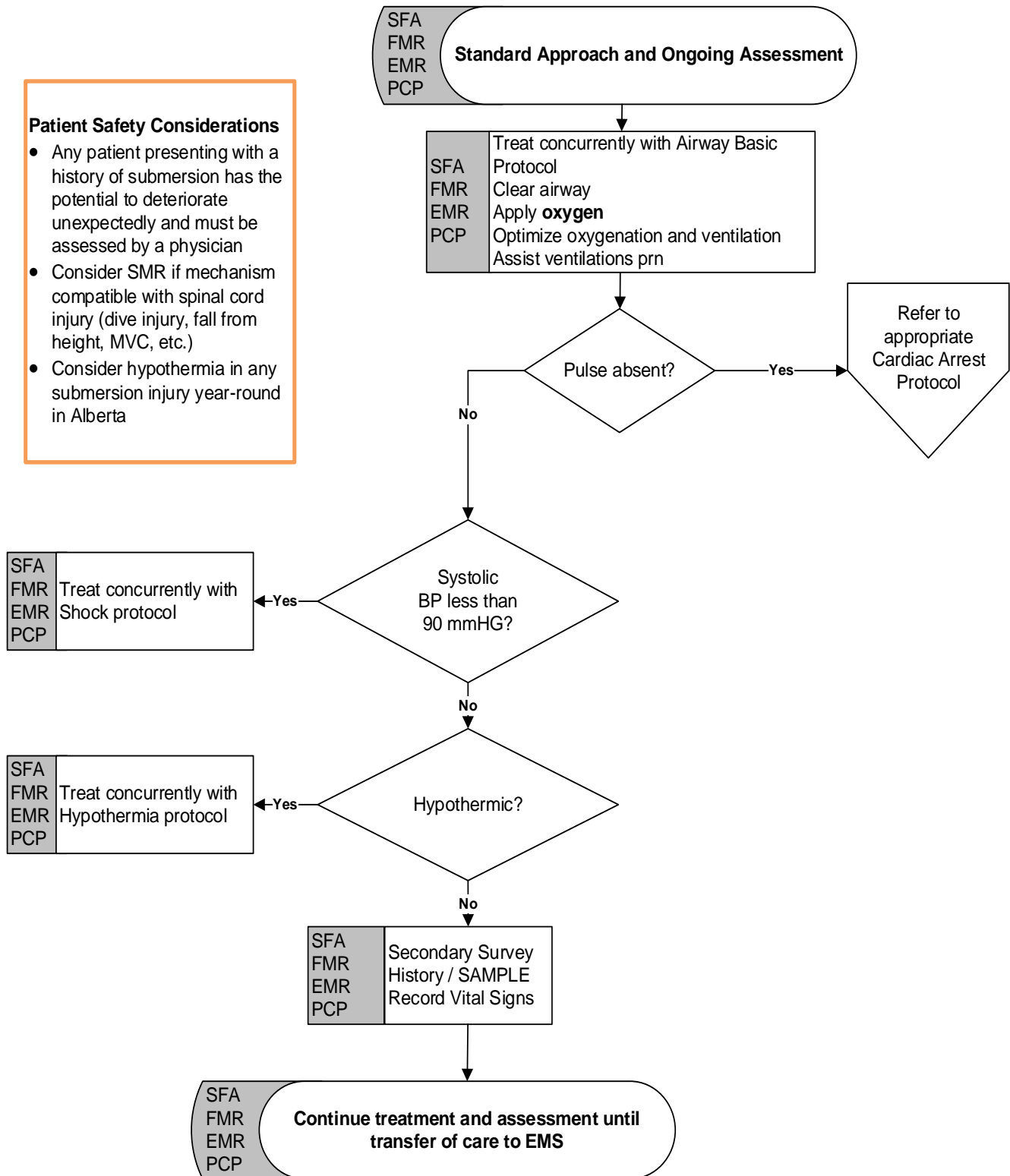


Patient Safety Considerations

- Any patient presenting with a history of submersion has the potential to deteriorate unexpectedly and must be assessed by a physician
- Consider SMR if mechanism compatible with spinal cord injury (dive injury, fall from height, MVC, etc.)
- Consider hypothermia in any submersion injury year-round in Alberta



Submersion

The most important consequence of prolonged, underwater submersion without ventilation is hypoxia. Therefore, restoration of ventilation and perfusion should be accomplished as rapidly as possible.

Every submersion victim, even one who requires only minimal resuscitation and regains consciousness at the scene, should be transferred to a medical facility for follow-up care.

Successful resuscitation with full neurological recovery has occurred in near-drowning victims with prolonged submersion in extremely cold water. Since it is difficult for rescuers to estimate length of submersion, resuscitation efforts should be initiated unless there is obvious physical evidence of death, such as decomposition or rigor mortis (DRIED).

Signs and symptoms

Auscultation of the lungs may reveal crackles and rales. Coughing, foaming, bronchospasm and obvious respiratory distress may also be observed. The abdomen may be distended as autopsies have demonstrated patients will swallow between two and three litres of fluid during a fatal submersion event. Patients may demonstrate hypoxemia and central or peripheral cyanosis.

There is no observable difference between drowning in fresh water, salt water or chlorinated water. Foaming from the mouth or nose in the absence of CPR performance indicates the patient is still making a respiratory effort on their own.

Etiology

Drowning is a process resulting in primary respiratory impairment from submersion in a liquid medium (usually water). All outdoor water sources in Alberta are potentially classifiable as cold water, and being possible year-round in Canada, hypothermia should always be a consideration in submersion patients.

Successful resuscitations and neurologically intact survivors have been reported after prolonged submersion in cold water. Attempts at resuscitation should be strongly considered regardless of how long the patient was submerged.

Delayed pulmonary complications such as noncardiogenic pulmonary edema and hypoxic respiratory failure are common following submersion incidents. These complications may occur in patients with few initial complaints and a normal initial physical examination.

Both salt water and fresh water wash out the important surfactant in the lungs. Surfactant is a lubricant which prevents the alveoli, (where oxygen exchange occurs) from sticking together. Alveoli without surfactant can essentially close, preventing oxygenation even with a patent airway. Submersion can produce local lung injury, noncardiogenic pulmonary edema and the acute respiratory distress syndrome (ARDS).

Patients with noncardiogenic pulmonary edema, a condition caused by too much fluid being present in the lungs, may present with dyspnea, confusion, agitation, fatigue, and a progressive decline in their respiratory status.

Arrhythmias secondary to hypothermia and hypoxemia are often observed in patients who have sustained a submersion injury. Common initial arrhythmias include sinus tachycardia, sinus bradycardia, and atrial fibrillation. These can lead to malignant arrhythmias such as ventricular tachycardia and ventricular fibrillation. Taking frequent vital signs and keeping an AED nearby is well-advised when caring for a submersion patient.

Interventions

1. Spinal motion restriction should only be considered if there is suspicion or evidence of a traumatic injury (such as a fall from height or MVC).
2. Oxygen therapy as indicated. SpO₂ reading may not be reliable in this setting.
3. Securing intravenous access if the patient has been unconscious or seems unstable is prudent.
4. Suction as needed. Approximately 86% of patients will vomit after a submersion event, but foam does not require routine suctioning and airway management should not be interrupted for the suctioning of foam.

Rotary Wing Air Transport

While rotary-wing medevac does not typically respond to patients in cardiac arrest, they will consider transporting patients in cardiac arrest in the setting of submersion injury due to the potential of successful resuscitation, particularly in the context of hypothermia.

Pediatric considerations

Drowning is a significant cause of accidental death in children. Submersion events may occur in open water such as lakes, rivers, dugouts, swimming pools, hot tubs and in the home such as in a bathtub, washing machine, bucket or sink.

Approximately 90 per cent of submersion will result in the aspiration of fluid into the lungs – usually less than 4 ml of fluid per kilogram – which washes out surfactant from the patient's lungs.

Important history questions

It may be difficult to obtain the history of the event from the patient directly. Bystanders can play an important role in reconstructing a submersion timeline of events. It is helpful to know how long the patient was submerged for, and whether they have any history of cardiac or respiratory conditions. If the event was witnessed, ask whether the patient experienced any trauma such as diving headfirst into water.

Background and prognosis

There are 400-500 submersion deaths annually in Canada, based on statistics over the past 10 years. For every fatal submersion event, there are an estimated 4-5 submersion survivals. Males are much more likely to experience a submersion event, with 70-80% of submersion deaths attributable to males. Approximately 66% of drowning events in Canada occur between May and September. Leading contributing factors include not wearing a personal floatation device and alcohol consumption. Patients with a history of epilepsy are 15-20 times more likely to experience a submersion emergency.

The only predictor of survival is submersion time. For instance, statistics show that 90% of patients submerged less than five minutes will survive. Submersion of 5-10 minutes results in a survival rate of 44%. With a submersion time of 10-25 minutes, the survival rate drops to 12%, and submersions longer than 25 minutes are associated with a survival rate of just 0.1%.

What to expect when EMS arrives

When EMS arrives, they may ask for the most pertinent facts such as the length of submersion, whether the event was witnessed, and if there is any indication of trauma. Vital sign trending may be of note, particularly with respect to respiratory rate, oxygen saturation and heart rate.

The EMS crew may stabilize the patient further before transport, including the use of continuous positive airway pressure (CPAP). CPAP splints the alveoli open to prevent their collapse by continually supplying airway pressure, even during the exhalation phase of respiration.