

# Smoke Inhalation Injury

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**Keywords:** Fire, inhalation, smoke, burn, shortness of breath, respiratory

**Procedures:** Intubation

**Additional Equipment:** Airway box/cart

## LEARNING OBJECTIVES

1. Recognize a critically ill patient and potential for impending conditions
2. Understand the potential medical complications in caring for patients in fires
3. Airway escalation and management in burn victims
4. Fluid resuscitation in burn victims
5. Indications for transfer to a burn center

## CRITICAL ACTIONS

- ✓ IV access x2 large bore peripheral IVs
- ✓ Place patient on monitors with continuous oxygen saturation monitoring
- ✓ Place patient on continuous end-tidal capnography
- ✓ Ask for a full set of vital signs including HR, BP, oxygen saturation, and temperature
- ✓ Early intubation for impending respiratory compromise
- ✓ Ask for and interpret appropriate labs (VBG/ABG, co-oximetry)
- ✓ Order a CXR
- ✓ Must examine skin and airway
- ✓ Administration of IV fluids with use of Parkland formula
- ✓ Tdap administration
- ✓ Initiation of transfer to burn center
- ✓ Closed-loop communication
- ✓ Synthesis of the case
- ✓ Disclose appropriate information to the patient/family

## CASE ONE-LINER

55-year-old male presents with shortness of breath following a house fire

## PRESENTATION

|                          |  |
|--------------------------|--|
| SETTING                  | Hospital ED  |
| ADDITIONAL ROLES         | Sim operator, sim RN, debrief manager<br>CONSULTANTS: Burn Center, Anesthesia (optional backup)  |
| PATIENT                  | 55yo male  |
| CHIEF COMPLAINT          | Shortness of breath for 1 hour after being in a house fire   |
| Hx of PRESENTING ILLNESS | A 55-year-old male otherwise healthy is brought to the ED by EMS after being in a house fire while asleep. Son is in the waiting room now.<br>EMS Report: Patient was trapped in an upstairs bedroom for 30 minutes before we were able to extricate him from the house fire. We saw a space heater that was left on and looked pretty bad. He's been coughing and complaining he's short of breath. His belly and back have some burns but he just seems to be focused on his breathing. His shirt may have caught fire; hard to say. |
| ROS                      | (+) Weakness, cough, dyspnea<br>Denies LOC, trauma, obvious skin burns, abdominal cramps, myalgias   |
| PMH/PSH                  | None   |
| MEDICATIONS              | None   |
| ALLERGIES                | None   |
| SOCIAL Hx                | Denies alcohol, tobacco, or drug use. Mother has history of DM and HTN   |

## INITIAL VITAL SIGNS

| HR  | BP     | RR | PULSE OXIMETRY | TEMP   | WEIGHT |
|-----|--------|----|----------------|--------|--------|
| 135 | 112/90 | 26 | 88%            | 100.5F | 80 kg  |

## PHYSICAL EXAM

Items in red need to be verbalized

### PRIMARY SURVEY

- **AIRWAY:** Soot in nares, moustache, oropharynx; **stridor**
- **BREATHING:** Tachypnea, gasping
- **CIRCULATION:** 2+ pulses
- **DISABILITY:** Burns on torso

**GENERAL:** AAOx3, **gasping**

**HEENT:** Normocephalic, atraumatic, PERRL, tongue midline. Soot in posterior oropharynx. Singed nasal hairs (*must specifically look for/ask for this finding*)

**NECK:** No JVD, no crepitus

**CV:** **Tachycardic, regular rhythm, no murmurs**

**PULM:** CTAB in all fields on initial presentation, coughing, tachypnea

**ABD:** Soft, non-tender/non-distended, +BS

**EXT:** Warm, well-perfused, no edema, 2+ pulses throughout, no deformities

**NEURO:** Normal

**GU:** Normal

**SKIN:** **2nd and 3rd degree burns on the abdominal wall and upper back** (*must specifically look for/ask for this finding*), **insensate**

**PHASE 1: INITIAL PRESENTATION**

| TIME        | CLINICAL PROMPT  | EXPECTED MANAGEMENT  | CONSEQUENCES   | CRITICAL ACTIONS  |
|-------------|--|--|--|---|
| 00:00-03:00 | 55-year-old male brought in with shortness of breath from a house fire | <ul style="list-style-type: none"> <li>Order full set of vital signs, cardiac monitor, continuous oxygen saturation monitoring</li> <li>Place pt on continuous end-tidal capnography</li> <li>Order 2 large bore IVs</li> <li>Obtain a focused history and physical exam</li> <li>Assess airway and identify inhalation injury</li> <li>Prepare for difficult airway</li> <li>Perform fiberoptic laryngoscopy and intubate (describe procedure).</li> <li>Request cricothyrotomy set up to be available</li> <li>Order post-intubation sedation</li> </ul> | <ul style="list-style-type: none"> <li>RN prompts, "Do you want vitals/patient on the monitor/ IV access?" if not requested</li> <li>RN prompts, "I'm worried about his breathing" if no intubation conducted; RN grows increasingly insistent on definitive airway</li> <li>If direct laryngoscopy attempted, no success. If direct laryngoscopy attempted more than 2x, surgical airway will be the only method of securing the airway possible (must be described by candidate)</li> <li>RN prompts, "Do you want sedation?" if post-intubation sedation not ordered</li> </ul> | <ul style="list-style-type: none"> <li>Obtained a complete set of vital signs?<br/>I P N</li> <li>Obtained a focused history?<br/>I P N</li> <li>Performed a primary survey?<br/>I P N</li> <li>Applied supplemental O2?<br/>I P N</li> <li>Placed ETCO2 monitoring?<br/>I P N</li> <li>Recognized impending airway compromise?<br/>I P N</li> <li>Performed fiberoptic intubation?<br/>I P N</li> <li>Requested cricothyrotomy set up as backup?<br/>I P N</li> <li>Ordered post-intubation sedation?<br/>I P N</li> <li>Ordered 2-large bore IVs?<br/>I P N</li> <li>Recognized abnormal VS?<br/>I P N</li> </ul> |

**PHASE 2: REASSESSMENT AND SECONDARY INTERVENTION**

| TIME      | CLINICAL PROMPT   | EXPECTED MANAGEMENT  | CONSEQUENCES  | CRITICAL ACTIONS   |
|-----------|---|--|---|--|
| 3:01-6:00 | <p>Patient continues to require management of burn injuries</p> <p><b>Repeat Vital Signs (if intubated and IV fluids initiated)</b><br/>BP: 115/92<br/>HR: 100<br/>RR: 16<br/>Pox: 100% on vent</p> <p><b>Repeat Vital Signs (if intubated but NO IV fluids initiated)</b><br/>BP: 88/65<br/>HR: 145<br/>RR: 16<br/>Pox: 100% on vent</p> <p><b>Repeat Vital Signs (if NOT intubated at 3:01)</b><br/>Cardiac arrest; unable to obtain VS</p> | <ul style="list-style-type: none"> <li>• Order STAT CXR</li> <li>• Order STAT EKG</li> <li>• Order STAT labs (including blood gas, co-oximetry)</li> <li>• Order tdap</li> <li>• Conduct thorough secondary survey</li> <li>• Administer IV fluids by Parkland formula calculation (must verbalize amount and rate)</li> </ul> | <ul style="list-style-type: none"> <li>• If no intubation conducted by 3:01, only cricothyrotomy possible to secure airway.</li> <li>• RN to prompt, “Did you want to confirm the tube?” if no CXR ordered.</li> <li>• RN to prompt, “Any other labs?” if no blood gas or co-oximetry ordered</li> <li>• RN to prompt, “How much IV fluid should I give?” if no clear order.</li> </ul> | <p><b>Ordered STAT CXR?</b><br/>I P N</p> <p><b>Ordered STAT EKG?</b><br/>I P N</p> <p><b>Ordered STAT labs?</b><br/>I P N</p> <p><b>Ordered IV fluids?</b><br/>I P N</p> <p><b>Applied Parkland formula appropriately?</b><br/>I P N</p> <p><b>Administered tdap?</b><br/>I P N</p> |

**PHASE 3: REASSESSMENT, TERTIARY INTERVENTION, RESULTS, RESOLUTION**

| TIME       | CLINICAL PROMPT  | EXPECTED MANAGEMENT  | CONSEQUENCES  | CRITICAL ACTIONS  |
|------------|--|--|---|---|
| 6:01-10:00 | <p>Patient intubated and sedated</p> <p><b>Repeat Vital Signs (if intubated and IV fluids initiated)</b><br/>BP: 115/92<br/>HR: 100<br/>RR: 16<br/>Pox: 100% on vent</p> | <ul style="list-style-type: none"> <li>• Call burn center to transfer patient and give hand off to specialist</li> <li>• Formulate a broad set of considerations including: CO toxicity, CN toxicity, requirement of escharotomy, etc.</li> <li>• Update the patient’s family</li> </ul> | <ul style="list-style-type: none"> <li>• Labs result at 6:30</li> <li>• RN to prompt, “Staying or going?” if no clear disposition</li> <li>• RN to prompt, “What did the imaging/labs show?” if no interpretation or no follow up</li> <li>• RN to prompt, “What’s the plan with this patient? His son is asking” if no family update provided</li> </ul> | <p><b>Formulated broad set of considerations?</b><br/>I P N</p> <p><b>Interpreted test results accurately?</b><br/>I P N</p> <p><b>Interpreted imaging correctly?</b><br/>I P N</p> <p><b>Called consultant/burn center?</b><br/>I P N</p> <p><b>Presented case to specialist succinctly and directly?</b><br/>I P N</p> <p><b>Updated patient’s family at any point?</b><br/>I P N</p> |

## PHASE 4: CONCLUSION & DEBRIEFING

| TIME        | ACTIONS  |
|-------------|--|
| 10:00-20:00 | Debrief<br>Q&A Session/Teaching<br>Evaluations |

## DEBRIEFING POINTS

| GENERAL POINTS   | SCENARIO-SPECIFIC POINTS  |
|--|---|
| <ul style="list-style-type: none"> <li>• What went well?</li> <li>• What are some opportunities for improvement?</li> <li>• Did you identify any gaps in knowledge?</li> <li>• Was there any delay in treatment?</li> <li>• How was communication between team members?</li> </ul> | <ul style="list-style-type: none"> <li>• Airway assessment in burn victims</li> <li>• Airway management and escalation in burn victims</li> <li>• Other medical considerations in the management of burn victims (eg, CO toxicity, cyanide toxicity, etc.)</li> <li>• Parkland formula for fluid resuscitation</li> <li>• Role of antibiotics in burn victims</li> <li>• Transfer criteria for burn center</li> </ul> |

## ORAL BOARDS PEARLS

- Have a format for how you would like to approach each case
- Remember to make the patient NPO, re-assess the vital signs, re-assess after each intervention, and follow up on any studies.
- Remember to explain to the patient/family the same way you would in real life
- If the examiner attempts to cue you or ask “anything else”, take a moment to synthesize what has been done to help organize your thoughts (this may be your final chance to correct something you forgot!) and ensure the examiner recorded all of your intended actions
- Remember the Tdap, post-intubation sedation, and end-tidal capnography!

## SCENARIO STIMULI

| Complete Blood Count  |  | Coagulation Profile |                             |
|-----------------------|--|---------------------|-----------------------------|
| WBC                   | 10.0 (Normal 5.0 - 14.5 x 10 <sup>3</sup> /mL) | PT                  | 12 (Normal 11-13.5 seconds) |
| Hemoglobin            | 10.5 (Normal 11.5-15.5 gm/dL)                  | PTT                 | 25 (Normal 25-35 seconds)   |
| HCT                   | 31.5 (Normal 35%-45%)                          | INR                 | 1.5 (Normal 0.8-1.1)        |
| Platelets             | 220 (Normal 150-450 x 10 <sup>3</sup> /mL)     |                     |                             |
| MCV                   | 84 (Normal 76-90 fL/red)                       |                     |                             |
| Basic Metabolic Panel |  | VBG with Lactate    |                             |
| Sodium                | 136 (Normal 136-145 mEQ/L)                     | pH                  | 7.4                         |
| Potassium             | 4.0 (Normal 3.5-5.5 mEQ/L)                     | pCO <sub>2</sub>    | 30                          |
| Chloride              | 105 (Normal 95-105 mEQ/L)                      | pO <sub>2</sub>     | 62                          |
| CO <sub>2</sub>       | 23 (Normal 17-29 mEQ/L)                        | HCO <sub>3</sub>    | 26                          |
| BUN                   | 14 (Normal 5-20 mg/dL)                         | pO <sub>2</sub>     | 35                          |
| Creatinine            | 0.9 (Normal 0.5-1.1 mg/dL)                     | Lactate             | 1.7                         |
| Glucose               | 95 (Normal 70-110 mg/dL)                       | ADDITIONAL          |                             |
|                       |  | CO                  | 2.5                         |
|                       |  | Cyanide             | Negative                    |
|                       |  | Troponin I          | <0.02 (Normal <0.08 ng/mL)  |
|                       |  | Type/Cross          | Type A Negative             |

## IMAGING

### Representative EKG



### Representative CXR

