Guidelines for checking an anaesthesia machine

The anaesthesia machine should be checked by the anaesthesiologist prior to procedures under general anaesthesia, regional anaesthesia or monitored anaesthetic care. The guidelines are recommended for an anaesthesia system that consists of flowmeters and vaporisers to deliver anaesthetic gas via an ascending bellow ventilator and circle breathing circuit with carbon dioxide absorber.

1. Preoperative check of the anaesthetic machine
   1.1 The following checkout must be performed at the beginning of each working session, before the first patient.
   1.2 General inspection
      1.2.1 Look for gross damage of the anaesthesia machine.
      1.2.2 Check for proper connections of breathing circuit, ventilator and scavenging hose. Ensure carbon dioxide absorber canister is locked in position.
      1.2.3 Position the anaesthesia machine to provide adequate space between the machine and operating table. Put on the brake to prevent movement.
      1.2.4 Ensure the followings are available
         1.2.4.1 A self-inflating bag to serve as an alternative ventilator
         1.2.4.2 A stethoscope.
         1.2.4.3 A cylinder wrench to turn the cylinders on and off.
   1.3 Electrical power and power failure alarm
      1.3.1 Examine the integrity of the power cord and plug.
      1.3.2 Ensure the power cord is connected directly to an UPS (uninterrupted power supply) socket and turn the anaesthesia machine, gas and agent monitor on.
      1.3.3 Unplug the power cord with the anaesthesia machine turned on.
      1.3.4 Ensure the audio and visual power failure alarms are activated.
      1.3.5 Ensure the battery backup power (if available) is functioning.
      1.3.6 Reconnect the power cord to cancel the alarms.
   1.4 Scavenging system (active)
      1.4.1 Attach a test lung to the Y-piece of circle breathing circuit.
      1.4.2 Ensure adequate negative pressure as shown by the flow indicator.
      1.4.3 Fully open the APL (adjustable pressure limit) valve of the circle breathing system:
         1.4.3.1 With minimum O₂ flow, allow the reservoir bag and test lung to collapse completely and verify that the circuit pressure gauge reads approximately zero.
1.4.4 With \( \text{O}_2 \) flush, allow the reservoir bag and test lung to distend fully and verify that pressure gauge reads < 10 cm H\( \text{O}_2 \).

1.5. Prevention of hypoxic mixture
1.5.1 \( \text{O}_2 \) sensor calibration.
   1.51.1 Expose \( \text{O}_2 \) sensor to room air and calibrate the sensor to read 21% according to the manufacturer’s recommendations.
   1.52 Reinstall the sensor in the circuit to expose to 100% \( \text{O}_2 \) (aided with \( \text{O}_2 \) flush).
   1.53 Verify that the sensor reads greater than 90%.
   1.54 Adjust the \( \text{O}_2 \) alarm limits to appropriate settings.
   1.55 The sensor should be recalibrated periodically according to the manufacturer’s recommendations.

1.6 Anti-hypoxic linkage systems
1.6.1 Ensure the \( \text{O}_2 \) flow meter shows mandatory minimum flow as specified by the manufacturer.
1.6.2 Set \( \text{N}_2\text{O} : \text{O}_2 \) flow meters to deliver 4 : 2 L/min, respectively, and decrease \( \text{O}_2 \) flow and observe that \( \text{N}_2\text{O} \) flow drops accordingly.
1.6.3 Re-establish the flow in step 4.2.2, disconnect \( \text{O}_2 \) pipeline and observe both \( \text{N}_2\text{O} \) and \( \text{O}_2 \) flows to drop with the former more rapidly.
1.6.4 Ensure that the \( \text{O}_2 \) failure alarm is activated.

1.7 Low Pressure Leak Test in the Low Pressure System
1.7.1 Disconnect all pipelines.
1.7.2 Negative Pressure Leak Test (if recommended by the manufacturer)
   1.7.2.1 Check the leak test device by occluding the inlet of the device, remove all air from the bulb and observe that the bulb remains deflated for 60 seconds.
   1.7.2.2 Use the leak test device to test the anaesthesia machine with the following steps:
      1.7.2.2.1 Turn the anaesthesia system switch off.
      1.7.2.2.2 Turn on all the flow controls at least 2 turns, attach the test device to the common or auxiliary outlet after deflating the bulb.
      1.7.2.2.3 Having the bulb remained deflated for at least 10 seconds indicates no leak.
1.7.3 Test each vaporiser at a time.
   1.7.3.1 Check that the vaporisers are mounted onto the manifold and in-line to each other.
   1.7.3.2 Ensure that they are locked in position and contain sufficient anaesthetic agent.
1.7.3.3 Turn on the vaporiser and repeat step 1.7.2.2 above to keep the bulb deflated.

1.7.3.4 Attempt to turn on the other vaporiser to check the interlock system (Avoid using force).

1.7.4 Remove the test device and reconnect fresh gas hose or turn off the auxiliary gas outlet.

1.7.5 Keep the test device with the anaesthesia machine.

1.7.6 Turn the system switch on.

1.8 Backup Cylinder Supply

1.8.1 Turn off all the flow meters.

1.8.2 Open each cylinder valve.

1.8.3 Pressure reading > 6900 kPa (> 1000 psi) for O\textsubscript{2} cylinder indicates at least half full.
   1.8.3.1 Replace with a full cylinder when pressure reads < 4000 kPa (< 600 psi).

1.8.4 Check the air cylinder as for O\textsubscript{2} cylinder.

1.8.5 Pressure reading 5000 kPa (745 psi) for N\textsubscript{2}O cylinder indicates at least a quarter full.
   1.8.5.1 Replace with a full cylinder when pressure reads < 5000 kPa (< 745 psi).

1.8.6 Test one cylinder at a time (if 2 cylinders of a gas are installed).

1.8.7 Close all cylinder valves.

1.9 Pipeline Supply

1.7.1 Connect O\textsubscript{2} remote probe to pipeline supply securely.

1.7.2 Perform the “tug test” on the probe.

1.7.3 Turn on all flow meters (3 L/min) and check that only O\textsubscript{2} flow meter displays evidence of flow and O\textsubscript{2} sensor showing appropriate reading while the other flow meters show no flow.

1.7.4 Check the auxiliary oxygen flow meter for sufficient flow.

1.7.5 Turn off all flow meters and connect the other pipeline supplies.

1.7.6 Check the pipeline pressures 310-380 kPa (45-55 psi).

1.10 Mechanical Ventilator

1.10.1 Adjust appropriate ventilator settings.

1.10.2 Adjust O\textsubscript{2} to desired flow and switch on the ventilator.

1.10.3 Verify that
   1.10.3.1 Mechanical ventilator starts.
   1.10.3.2 Preset parameters are delivered.
   1.10.3.3 The bellow and test lung moves accordingly during mechanical ventilation.
1.10.3.4 The ventilator alarm functions.
1.10.3.5 The one-way valves in the breathing circuit move accordingly during respective respiratory cycle.

1.10.4 Test the ventilator circuit for leaks
1.10.4.1 Turn off all flow controls.
1.10.4.2 Turn the anaesthesia system switch to off or stop the mechanical ventilator.
1.10.4.3 Push O\textsubscript{2} flush to fill the bellow.
   1.10.4.3.1 The pressure must not increase to >15 cm H\textsubscript{2}O.
1.10.4.4 Stop flushing to check if the bellow falls more than 100 mL, which indicates significant leak.

1.10.5 Turn the system switch on.

1.11 Circle Breathing Circuit
1.11.1 Switch the breathing circuit to manual ventilation mode. Fully close the APL valve.
1.11.2 Test the breathing circuit for leaks
   1.11.2.1 Turn off all flowmeters.
   1.11.2.2 Occlude the Y-piece of breathing circuit.
   1.11.2.3 Pressurised the circuit to 30 cm H\textsubscript{2}O (using O\textsubscript{2} flush).
   1.11.2.4 Release the flush button and check that the pressure remains at 30 cm H\textsubscript{2}O for at least 10 seconds.
   1.11.2.5 The test is repeated with and without bypassing CO\textsubscript{2} absorber.
1.11.2 Test the adjustable pressure limiting (APL) valve
   1.11.2.1 Occlude the Y-piece of breathing circuit.
   1.11.2.2 Fully close the APL valve.
   1.11.2.3 Set the O\textsubscript{2} flow to 3 L/min and check that the pressure gauge reads < 80 cm H\textsubscript{2}O.
   1.11.2.4 Fully open the APL valve. Check that the pressure gauge decreases to near 0.
   1.11.2.5 Push the flush button and check that the pressure gauge stays near 0.
1.11.3 Check CO\textsubscript{2} absorber
   1.11.3.1 Check for the presence of adequate and fresh CO\textsubscript{2} absorbent.
   1.11.3.2 Check that the drain plug for condensate drainage (if available) is screwed tightly.

2. Preinduction check of anaesthesia machine
2.1 The following checkout must be performed before anaesthetising each patient.

2.1 Check that:

2.1 Vaporiser turned off.
2.2 Ventilation selector switched to “Reservoir Bag” ventilation mode.
2.3 APL valve fully opened.
2.4 New particulate filter and clean facemask are attached to the Y-piece.
2.5 Test the negative pressure of suction apparatus to ensure adequate flow for suction of airway secretions

References:
1. Safety Guidelines in Anaesthesia, Singapore Society of Anaesthesiologists, 1992

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