period of several days and then discontinuing it.

When the withdrawal syndrome occurs, prompt treatment should be instituted. Reduction in blood pressure may be life-saving; deaths from hypertensive encephalopathy have been associated with clonidine withdrawal. We chose sodium nitroprusside for initial control of our patient's marked hypertension, while clonidine was simultaneously administered orally. The onset of action of clonidine given orally is within 30 to 60 minutes, with a peak antihypertensive effect within 3 to 5 hours. Alpha-adrenergic receptor blocking agents, such as phentolamine or phenoxybenzamine, and a beta-adrenergic receptor blocker, such as propranolol, can also be used, since the syndrome is probably due to rebound overactivity of the sympathetic system.

With the introduction of clonidine into clinical practice, the anesthesiologist must be aware that interference with regular dosage schedules can have serious consequences. The case we have described illustrates the potential danger of precipitating an acute clonidine withdrawal syndrome by withholding a single dose of the drug preoperatively. We suggest either a gradual weaning and then replacement of clonidine with another antihypertensive agent several days before operation, or b) continuing oral administration of clonidine without interruption throughout the entire hospitalization, including the morning of operation.

REFERENCES


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Effect of Posture on Functional Residual Capacity Postoperatively

H. O. Hsu, M.B., B.S.,* and R. F. Hickey, M.D.†

Functional residual capacity (FRC) is known to decrease following abdominal operations. This decrease is associated with airway closure and accounts in part for the increase in alveolar–arterial oxygen tension gradient seen postoperatively. Posture affects FRC. A simple maneuver to increase FRC is assumption of the upright position. In normal man changing from the supine to the sitting position increases FRC by 0.68 l. (Sitting/supine FRC = 130 per cent). However, it is not known how this position change will affect FRC in patients after laparotomy. This group of patients is particularly prone to airway closure and atelectasis postoperatively. We report here the effect of this simple maneuver on FRC in postoperative patients.

METHOD

Twenty-eight patients undergoing various operative procedures were studied. They were free of cardiopulmonary disease by history, physical examination, and forced vital capacity measurements. We measured FRC by closed-circuit constant-volume helium-dilution technique, in duplicate. We made measurements with the patients in both sitting and supine positions, preoperatively and one, three, and five days postoperatively, or until FRC had returned to control.

RESULTS AND DISCUSSION

In patients who had operations on extremities (n = 6), FRC was not changed in
sitting or supine positions on postoperative day 1 compared with preoperative values. In those who had lower abdominal operations (n = 3), FRC decreased by 10 per cent in both positions on postoperative day 1 and returned to preoperative values by day 3.

In patients with upper abdominal operations FRC was reduced in both positions on day 1 and day 3 and returned to control values by day 5 (table 1). Changing body position (supine to sitting) increased FRC after laparotomy, but less than before operation (table 2). The ratio of FRC (sitting/supine) was not affected by laparotomy, indicating the proportionate reductions in both positions associated with operation (table 2).

The decrease in FRC following laparotomy is presumably secondary to abdominal distention and pain resulting in increased abdominal pressure. The reason assumption of an upright posture increases FRC has been examined by Sjöstrand, who measured change in trunk volume with change in body position using a corset plethysmograph. His findings indicated that about 40 per cent of the increase in FRC on moving from the supine to the erect position is accounted for by an increase in thoracic volume. The remainder of the increase is attributed to a reduction in thoracic blood volume. Undoubtedly similar mechanisms operate after laparotomy.

The mean increase in FRC produced by a change in body position on the first postoperative day was 0.66 l. We may speculate and compare this increase in FRC with that obtained by the use of positive end-expiratory pressure (PEEP). To do this we must make the assumption that in other reported studies the increase in FRC is proportional to the PEEP applied over the range of pressures studied. Making this assumption, a similar increase in FRC (0.66 l) can be obtained by the use of 8–10 cm H₂O PEEP in healthy volunteers. A PEEP of 11–13 cm H₂O would be necessary to produce a similar volume change in patients in acute respiratory failure. It might be expected that after laparotomy the lung–thoracic compliance might be intermediate between that of healthy volunteers and that of patients in acute respiratory failure. Thus, on the first day after laparotomy the gain in FRC on changing from the supine to the sitting position might roughly be equated to 10 cm H₂O PEEP. The relative merits of different ways of increasing lung volume (PEEP in the supine position versus change in body position) are not known. The increase of FRC produced by sitting up provides a physiologic basis for the postoperative stir-up regime and early ambulation.

**REFERENCES**


**Table 1. FRC after Laparotomy as Percentage of Preoperative Value**

<table>
<thead>
<tr>
<th></th>
<th>Postoperative Day 1</th>
<th>Postoperative Day 3</th>
<th>Postoperative Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>77 ± 1.8*</td>
<td>87 ± 1.4*</td>
<td>97 ± 0.7</td>
</tr>
<tr>
<td>Supine</td>
<td>76 ± 1.9*</td>
<td>89 ± 1.3*</td>
<td>95 ± 1.1</td>
</tr>
</tbody>
</table>

Results are percentages of preoperative values in the same positions (means ± SE).

* Significantly different from preoperative value (P < 0.01).

**Table 2. Volume Increases in FRC Produced by Sitting Position before and after Laparotomy**

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative Day 1</th>
<th>Postoperative Day 3</th>
<th>Postoperative Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRC, sitting–supine (liters, mean ± SE)</td>
<td>0.83 ± 0.07</td>
<td>0.66 ± 0.09*</td>
<td>0.67 ± 0.11*</td>
<td>0.81 ± 0.10</td>
</tr>
<tr>
<td>FRC, sitting/supine (per cent, mean ± SE)</td>
<td>133 ± 2.5</td>
<td>133 ± 2.3</td>
<td>130 ± 3.0</td>
<td>137 ± 2.8</td>
</tr>
</tbody>
</table>

* Significantly different from preoperative value, P < 0.01.