PROBLEMS RELATED TO THE PRONE POSITION FOR SURGICAL OPERATIONS

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PATIENTS who have been in a prone position on an operating table frequently complain of pain or soreness in the neck, shoulders, arms, chest and hips. The pain or soreness develops: (1) during the operative period in awake patients in areas not anesthetized by the regional anesthetic employed, or (2) during the postoperative period in patients who have received general anesthesia. In addition, patients operated upon in this position may demonstrate excessive venous oozing of the operative field.

This study was instituted in an attempt to improve operative conditions and patient comfort in the operating room.

METHOD

General Pattern: A questionnaire was sent to 214 anesthesiology resident teaching centers asking for a description of methods used to place patients in the prone position on the operating table. The 165 replies were analyzed and the basic method-patterns were determined. Each basic method-pattern was to be tried on awake volunteers for their subjective reactions to the positions, and on anesthetized patients for objective studies of the effects of the positions. From these test results we hoped to determine the requirements of a satisfactory prone position and, if possible, to develop a satisfactory method for placing the patient in the prone position.

Subjective Tests: Four volunteer awake subjects were used for these tests: an average-height obese male, weighing 275 pounds; a five foot tall obese female, weighing 194 pounds; an average-height male, weighing 166 pounds, and an average-height slender female weighing 115 pounds who had tender, above average sized breasts. Each of the awake volunteers tried each position for thirty minutes. Any position which produced discomfort was considered unsatisfactory. A satisfactory method for keeping a subject comfortable in a prone position had to meet the following criteria: (a) respiration as effortless as in the supine position ;(b) no sense of strain on any part of the body; (c) no pressure point discomfort on soft tissues or bony prominences; (d) no evidence of circulatory obstruction such as numbness, tingling, or coldness, and (e) no paresthesias.

Objective Tests: The effects of each of the positions on some vital functions were measured on five female patients, one obese and four of average weight. These patients were anesthetized with nitrous oxide, their tracheas intubated with the aid of succinylcholine chloride, and they were kept paralyzed with an infusion of succinylcholine. The following tests were applied:

(1) The position had to meet the requirements of the surgeon.

(2) In each patient, while in the supine position and then in the various prone positions, determinations were made for comparison of the pressure developed when a fixed volume of gas was forced into the lungs in a fixed time. A fixed volume ventilator * was used for this purpose.

(3) Venous pressure was measured in the feet and arms with the patients in the supine position, and findings were compared with those obtained with the patients in the various prone positions. (A water manometer was used to determine venous pressure.)

(4) Changes appearing in blood pressure as the patients attained each prone position were compared with blood pressures recorded in the supine position. (All blood pressures were taken by the standard auscultatory method.)

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* The fixed volume ventilator was made available to us by the Equipment and Engineering Department of the Ohio Chemical and Surgical Equipment Company.

Results

Analysis of Questionnaire: The 165 replies to the questionnaires yielded 192 modifications of the prone position.

A. Current Methods: Opinion of Those Replying

1. Satisfied: 80
2. Dissatisfied: 32
3. No comment: 53

B. Methods Used: Types of Support

1. Body support
   - a. Special frame 13
   - b. Rubber horseshoe 18
     - (1) Open cephalad 6
     - (2) Open caudad 12
   - c. Doughnut (rubber) 7
   - d. Three-point suspension 3
   - d. (Iliac spines and sternum)
   - e. Four-point suspension 8
     (Iliac spines and infra-clavicular fossae or clavicles)
   - f. Cloth rolls 139
     - (1) Transverse across chest 9
     - (2) Transverse at iliac spines 27
     - (3) Transverse at pubis 5
     - (4) Transverse at trochanters 1
     - (5) Vertical rolls 97
       Arranged as:

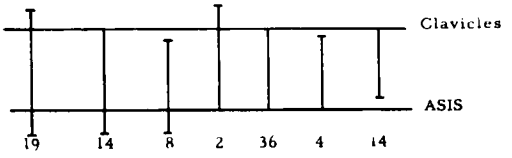

Fig. 1. Chart of arrangement patterns for vertical rolls in relation to the clavicles and anterior superior iliac spines (ASIS).

     - (6) Vertical plus transverse rolls 8
2. Head support
   - a. "Horseshoe" for face 5
   - b. Head turned to side 41
   - c. No comment 146
3. Arm support
   The sketch in the questionnaire did not lend itself well to a portrayal of arm position.
4. Leg and ankle support
   - a. Pillows under ankles 19
   - b. Rolls under knees 2
   - c. No comment 171

Analysis of Subjective Tests:

A. Transverse rolls placed anywhere under the body, except under the ankles, produced pain, and no subject could tolerate the pressure of transverse rolls at chest, iliac spines, pubis, or trochanters.

B. Female subjects could not be made comfortable with longitudinally placed rolls.

C. No subject could tolerate pressure from rolls, sandbags, or rubber pads in the infraclavicular fossae.

D. Male and female subjects alike objected to rolls, pads, or sandbags under the sternum, between the breasts, as in three-point suspension.

E. Any "blocking" method which raised the pelvis higher than the chest produced pain in the lower neck and upper back when the patient turned his head to either side.

F. When blocking was placed under the drawsheet, as at the iliac spines, the drawsheet acted as a sling and severely restricted abdominal excursions.

G. Blocking under the anterior superior iliac spines was least painful when it was accomplished by the use of sandbags "topped" with sponge rubber.

H. No subject could be made comfortable on the commercially available preformed 5-inch rubber "horseshoe."

I. The use of armboards was not satisfactory to awake subjects. If the arms were extended on the armboard, pain in the shoulders was noted within ten minutes. If the elbows were flexed and the forearms placed across well-padded armboards, the subjects complained of numbness of the hands in ten to twenty minutes.

Analysis of Objective Results:

A. The pressures required to produce adequate ventilation were the same for the supine position and any of the modified prone positions tried, if movement of the abdomen was not restricted.

In the obese patient, lying supine, 1,000

cc. of gas forced into her lungs in one and one half seconds produced a "back-pressure" of 16 mm. of mercury. This same patient in the prone position, lying flat on the table, responded to the same volume-time pattern with a "back-pressure" of at least 50 mm. Hg. When her chest and pelvis were supported, freeing the abdomen, the resistance was 16 mm. Hg. Comparable results were obtained in the studies on the other patients of the series.

B. Venous pressure in the foot was unchanged if the body position did not obstruct the femoral veins or the inferior vena cava.

C. Hypotension was not seen except when the inferior vena cava was obstructed. This produced a 25 mm. Hg. systolic pressure decrease in one obese patient who had been placed on a transverse 8-inch diameter cloth roll at the level of the anterior superior iliac spines.

The Development of a Satisfactory Method for Placing the Patient in the Prone Position: None of the methods tested satisfied both the subject and the surgeon. By combining the best features of some of the methods studied, we developed the following criteria for a satisfactory prone position: (1) The anterior superior iliac spines and the chest must be elevated to allow the abdomen to move without restriction; (2) The back and neck must be in the same plane to allow the head to be turned painlessly to either side; (3) The patient's arms should rest on the table "above" his head (fig. 2) to prevent discomfort; (4) The inferior vena cava and the femoral vessels must not be compressed; (5) The infra-clavicular fossae must be free of pressure points, and (6) The female patient's breasts must be displaced laterally.

We named the method developed by using these criteria the "Georgia Prone Position." It can be achieved by following these instructions:

(1) Fold several bed sheets to a twenty-inch width and a forty-inch length; place as many under the patient's chest as are needed to allow free movement of the abdomen.

FIG. 2. The arm position "above the head."

The caudad end of the pile of sheets should be at the patient's xiphoid process. The sheets support the patient's chest, support the back and neck in the same plane, permit the female patient's breasts to be displaced laterally, and provide a comfortable and adequate position for the arms.

(2) Place short, narrow sandbags topped by sponge rubber under the anterior superior iliac spines. The sandbags must be from six to twelve inches thick, varying with the size and weight of the patient, and they must not encroach on the femoral vessels, the abdominal wall or the costal margins. The elevation of the chest wall and the iliac spines must be nearly equal to allow freedom of abdominal movement and permit the head and neck to be in the same plane.

(3) Attach the *foot extension piece* at right angles to the *foot section* of the table to form a right angle with the remainder of the table. The *foot extension piece* forms a shelf on which the patient kneels. Pad the *foot extension piece* and raise it to support the patient's knees. Place the patient's feet on an adjustable stool with a pad under the

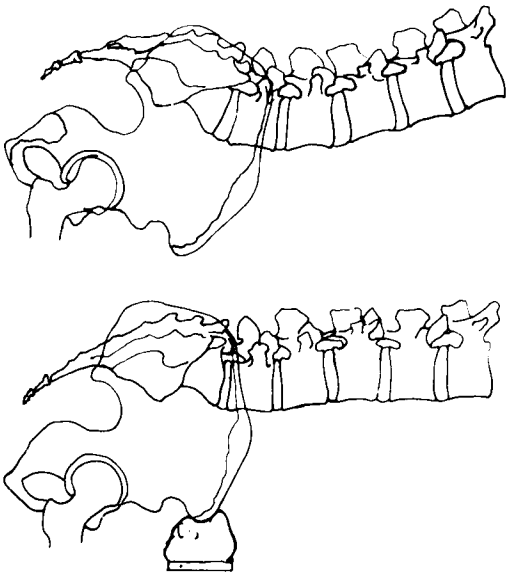

FIG. 3. Drawings from lateral roentgenogram of the spine. The lower sketch shows the effect of lowering the thighs to rotate the pelvis backward and down ward around the axis of the anterior superior iliac spine supported by blocking which rests on the operating table. This lumbar spine is perfectly flat, and can be made to arch above the flat plane by lowering the knee rest even more.

FIG. 4. The Georgia Prone Position.

ankles. Strap the thighs to the *foot section* in a manner to avoid compression of the popliteal vessels. The adjustment of the *foot extension piece* for each patient will allow much of the weight of the patient's hips and thighs to rest at the end of the femurs. The blocking under the anterior superior iliac spines will act as a fulcrum over which a portion of the weight of the hips and thighs acts to flex the back of the patient and allow the lumbar curve to flatten (fig. 3).

Discussion

Our objective results show conclusively that the method of placing a patient in the prone position did not matter if: (1) the abdominal movements were not restricted, and (2) the femoral vessels and the inferior vena cava were not compressed.

However, the subjective tests revealed that none of the methods suggested could make the patient comfortable while he was awake on the table. Furthermore, we could not discount the probable development of postoperative pain or discomfort from pressure points that occurred while the patient was in the prone position under general anesthesia.

The position we found to be satisfactory has several advantages over most of the other methods recommended: (1) freedom from danger of injury to the unconscious patient, (2) comfort during and after surgery, (3) a perfectly flat lumbar spine, and (4) definitely diminished venous oozing of the operative field.

The position (fig. 4), it must be pointed out, is not easily attained. It requires adjustment to get proper weight distribution on the ends of the femurs. The iliac spine blocking must be placed carefully to avoid obstruction to the femoral vessels and the inferior vena cava. The thighs must be strapped to the table to avoid shifting of the body, and the strap must be adjusted to prevent a tourniquet effect.

Summary

We have studied the problems related to development of a comfortable and surgically satisfactory position for patients who must be operated upon while lying prone. A questionnaire inquiring of practices of placing patients in the prone position was sent to 214 anesthesia teaching centers. Upon study of the 165 replies, all the positions advocated, except those requiring special frames, were tried in four normal awake volunteers. Adequacy of ventilation, blood pressure and venous pressure were measured in five anesthetized patients placed in the various positions. From these subjective and objective data, none of the recommended positions appeared satisfactory. However, we were able to determine certain fundamental requirements which led to the development of a position that was comfortable to awake subjects and did not adversely affect ventilatory requirements and arterial or venous blood pressures. This position is described. We have utilized this position to advantage in clinical practice.

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REFERENCES

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