One Stage Thoracoplasty Using an Adhesive Hemicast

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The day of routine single stage thoracoplasties has been brought nearer with the control of shock by using adequate blood replacement and with the control of respiration during operation by a tracheal intubation and the use of curare. Laird and Lindenfield presented a series of 72 single stage thoracoplasties in 1950 to the American Association for Thoracic Surgery. These operations were done on selected patients. Contrary to Laird's finding that the control of paradoxical respiration did not present a problem, we have found that even normal three rib operations are occasionally marked by noticeable respiratory embarrassment caused by paradoxical respiration. We have attempted to solve this problem by developing an adhesive hemicast for the thoracic cage, the use of which we have been investigating under varying circumstances. We are now convinced, so far as the immediate post-operative period is concerned, that if the patient is a good enough risk for any type of pulmonary resection he is also a satisfactory risk for almost any degree of one stage thoracoplasty. As a final estimate of the effectiveness of this procedure can only be made over a period of several months post-operative study, the present paper is presented as a preliminary report.

The requirements to be met by such an aid as a half cast to the chest wall are many.
1) It must be effective in preventing paradoxical respiration.
2) It must allow effective use of the contralateral side.
3) It must allow satisfactory clearing of the bronchial secretions on both sides.
4) It must be sufficiently flexible to allow enough movement of the shoulder to prevent fixation of the scapula to the chest wall.
5) It must be easy to apply, and it must be applicable to many different types of thoraces—fat, thin, full breasted, etc.

Finally, it must not interfere with the healing of the wound and must be easily removable.

During the period, February to June 1951, 17 patients undergoing thoracoplasty at Tranquille Sanatorium have been routinely subjected to the following procedure. The anaesthetic is administered via tracheal intubation which is performed using sodium pentothal and curare. An ordinary first stage thoracoplasty is then performed removing the third rib first, then the second and finally the first rib. The ribs are removed with their transverse processes and their cartilages in the case of the first three. Half the cartilage of the fourth rib is also removed with the fourth rib

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so that a normal anterior stage is done. From the third rib on down the ribs and transverse processes are removed seriatum so the operation can be discontinued at any point without changing the approach that would be necessary later if further operation were indicated. In only two cases, both Japanese females, one of 58 years, was it necessary to discontinue operation after complete removal of five ribs because of surgical shock. One of these women had a normal lower stage operation three weeks later without incident.

When the desired number of ribs have been removed the wound is closed in layers using interrupted cotton for the muscles and fascia and Dermol for the skin. Whitehead's varnish is applied to the incision which is then covered with a strip of gauze one inch wide. This is painted with Mastisol and covered with another strip two inches wide. With the patient still lying on the operating table and still intubated, the entire chest is painted with tincture of Benzoin which is allowed to become tacky. The chest is then wrapped around with Elastoplast bandage which is laid on without tension. The overlap on the bandage, because this is the weakest part of the dressing, is kept less than one quarter inch. Six inch plaster bandages are then applied to the chest over the operative side as shown in the photographs (Figures 1-10). Care is taken to keep the plaster low in the axilla so that the shoulder is not raised uncomfortably and plaster is kept high in the infraclavicular area to prevent the paradoxical respiratory movement that is usually most marked in this space. The plaster must be wet and well rubbed into the mesh of the adhesive for good anchorage. The bandage extends from the spine posteriorly to the opposite side of the sternum anteriorly because the relatively fixed skin over these structures assists greatly in stabelizing the cast. As a rule three six inch plaster bandages are used with the plaster thickest in the axillary and infraclavicular areas. The edges of the plaster are kept thin so they will be slightly springy and will not provide a fixed point from which the adhesive may begin to strip from the skin. Pressure is applied with the hands to keep the collapse maximal while the plaster is setting. The patient is brought out of the anaesthetic at this time. The shoulder and the clavicle are kept sufficiently free from the plaster to allow enough scapular movement to prevent adherence of the scapula to the chest wall.

We have found at the end of 10 days when the plaster is removed, that the bandage is usually well fixed to the chest wall. In case of premature separation the bandage is removed locally and the adhesive and plaster are reapplied. This has seldom been necessary. Skin sutures are removed in 10 days by which time the chest wall has stiffened enough so that an ordinary chest binder over the wound dressing is all that is necessary. At this time also evidence of wound exudate deep under the muscles is looked for and if present removed with a moderately large bore aspirating needle. This has been necessary in less than a fifth of cases.

During the period, February to June 1951, thoracoplasty patients in this institution were routinely subjected to this operative approach and the following observations have been made.
Figure 1: Preoperative x-ray film.
Figure 2: Two weeks postoperatively showing fairly heavy wound exudate shadow.
Figure 3: Showing absorption of exudate five weeks post operatively.
Figure 4: Mastisol dressing.  
Figure 5: Anterior aspect application of elastoplast.  
Figure 6: Posterior aspect application of elastoplast.
Figure 7: Posterior aspect of cast 48 hours postoperatively.

Figure 8: Anterior aspect of cast 48 hours postoperatively.

Figure 9: Prior to removal of sutures nine days postoperatively.
1) There has been no difficulty controlling post-operative paradoxical respiration. Post-operative respiration, because of the protective splinting action on the injured side has been effectively carried out—on some cases more comfortably after a seven rib removal with a cast, than with a conventional three rib removal. It has been found advantageous to keep the cast relatively thin so that movement of the opposite side may be facilitated by a slight springing of the cast with the normal forward movement of the sternum accompanying respiration.

2) In only one case was there any real difficulty in raising sputum post-operatively, and this disappeared in three days. Further support is given to the impression that sputum is cleared adequately by the fact that there were no post-operative spreads with the possible exception of one patient who had also formed a rather large amount of post-operative exudate. He had an elevated temperature for a longer period than we were accustomed to seeing so gave streptomycin. The exudate, or infiltrate, whichever it was, cleared very quickly. It was our impression that it cleared too quickly for it to have been tuberculous infiltration.

3) Shoulder function has not been interfered with in any case and all the patients have been able to touch their hands above their heads with their arms fully extended following removal of the cast.

4) There has been little difficulty adapting the cast to various types of physique; an emaciated male, age 27, a very muscular and obese male age 50 from whom 50 inches of rib were removed in one operation and a medium sized female with large breasts reacted well to this technique.

5) The aspiration of post-operative fluid in the pleural space has been easily managed by cutting a hole in the cast posteriorly and using a needle.

6) Removal of the cast after a 10 day period has not presented any difficulty. The skin is usually well stuck but is stripped fairly easily as the cast is sprung from the midline anteriorly and posteriorly.

7) One of the most remarkable and pleasing things about this procedure has been the excellent healing of the wound under the protection of the cast which reduces the tension in the skin to a minimum. This satisfactory healing is found even in cases where there is considerable wound exudate in the layer between the muscles of the shoulder girdle and the decostalized chest wall. In one instance only where 1,000 cc. sero-sanguinous wound exudate was aspirated (after the cast had been removed 10 days post-operatively) was there a slight separation of the lower wound edges. Satisfactory wound healing occurred within a few days of aspiration.

8) In one case with a completely fused pleural space the fluid collected over the left side of the heart with sufficient pressure in our opinion to effectively tamponade the cardiac action. In this instance, our only fatality, death occurred 52 hours post-operatively. Post-mortem examination, which was carried out immediately, was very interesting. This patient was a 42 year old female in excellent general condition. The previously described seven rib thoracoplasty was carried out in one stage and a plaster applied. The condition of the patient was quite satisfactory until 36 hours after
Figure 10: Removal of cast nine days postoperatively.

Figure 11: Preoperative x-ray film.

Figure 12: Plangram cavity left apex.
the operation, when the patient began to complain of slight breathlessness with tightness of the chest. As we suspected a pleural tear with some effusion we made an attempt to aspirate the pleural space which could not be found. The following day a hole was cut in the plaster posteriorly and an attempt was made to aspirate the wound. This was also unsuccessful. It was noted that when the patient was turned on her right side to facilitate aspiration of the fluid from a direct anterolateral approach to the wound she became quite cyanosed. There was relief of the cyanosis and also of a feeling of discomfort when the patient was turned back so that the operative side was dependent. This led us to suspect that there was a pressure effect from the weight of the fluid in the wound space. This was believed to be causing a cardiac compression which was relieved when the fluid was put in a dependent position. However, attempts to aspirate fluid directly over the space were ineffective at this time and it was decided to explore the possibility that the change in position either by a mechanical distortion of the air tubes or the extrusion of intra-bronchial exudate from the collapsed lung were causing the interference with oxygenation of the blood. It was noted that there were none of the usual signs of tracheal blocks such as marked inspiratory effort, cough, etc., except for the marked cyanosis and a sensation of pressure in the chest. Bronchoscopy was carried out immediately as the condition of the patient had deteriorated suddenly and she became unconscious. The bronchial tree was found to be clear of secretions—a further evidence that clearing of secretions from the respiratory tree is effective. The patient was then stripped of her plaster dressing to allow free and easy exposure to the anterolateral chest wall for a further attempt at aspirating the wound. At this point the heart stopped and all attempts at resuscitation were unsuccessful.

At immediate post-mortem were found: a) 450 cc. sero-sanguineous fluid between the shoulder girdle muscles and the chest wall; b) fused pleural space; c) fixed mediastinum. The negative bronchoscopic findings were confirmed and our impression that coughing is effective even with a fixed hemithorax was reinforced. Unhappily, however, from a statistical point, this death in such a small series was disastrous. Because of its obviously preventable nature and the information gained by the post-mortem examination, the accident was not felt to preclude further use of this method.

9) As in staged thoracoplasties, streptomycin has not been routinely used, but I am inclining to the view that in this procedure it would be of value.

10) There is also a saving in blood. An average of 1,500 cc. per large single stage is used instead of 1,000 cc. for a first stage and 500 cc. for each additional stage, or about 2,000 to 2,500 cc. total.

As the months of post-operative observation increase we are becoming impressed with other less obvious things:

11) In the case of one patient with an apical cavity and a very fibrotic lesion a seven rib single stage thoracoplasty was done. We now think that
It would have been reasonable to expect a cavity closure by the single stage technique removing only five ribs (Mr. J.).

12) Another patient with a cavity and parahilar infiltration got an effectual collapse from a seven rib one stage operation which we do not think would have been the case if the staged procedure had been used (Mr. H.).

Patients are extremely grateful to escape the long wearing-down process of repeated major operations. In this institution 3.04 operations per patient have been used over the past three years so that the adoption of the present procedure saves more than two operations per patient.

The ordinary three stage procedure takes about six weeks so that the adoption of the single stage technique means a saving in hospitalization during the operative period of six weeks, not to mention the fact that final convalescence is greatly shortened, at least by an additional month.

Acknowledgments: Any major change in a surgical programme is brought about by the efforts of many people who must be nameless if only for lack of space. The re-arrangement occasioned by the adoption of the present technique has required a good deal of cooperation from the staff of Tranquille Sanatorium. I am very grateful to the medical superintendent, Dr. H. S. Stalker, and to the members of his staff for the spirit in which this cooperation has been given. I am also grateful to Dr. I. G. Smillie of the Burris Clinic, Kamloops, without whose excellent anaesthesia this project would never have been undertaken.

SUMMARY
1) Paradoxic post-operative respiration has been controlled using an adhesive hemicast.
2) Sputum has been adequately cleared.
3) The technique has been successfully applied under varied circumstances.
4) There has been good wound healing under the cast.
5) The collapse obtained appears to be more complete than when an equal number of ribs are removed by the staged procedure.
6) Patients are enthusiastic about the prospect of a one stage alternative.
7) Two operations and two and one-half months hospitalization are saved.

RESUMEN
1) La respiración paradojica post-operatoria ha sido controlada usando un molde adhesivo.
2) El esputo ha sido adecuadamente negativizado.
3) La técnica ha sido satisfactoriamente aplicada bajo variadas circunstancias.
4) Ha habido buena cicatrización debajo del corsé adhesivo.
5) El colapso obtenido parece ser más completo que cuando se quitan igual número de costillas, mediante el procedimiento escalonado.
6) Los pacientes se entusiasman con la perspectiva de una intervención en un tiempo.
7) Se ahorran dos operaciones y dos y medio meses de hospitalización.
RESUME

1) L'auteur a lutté contre la respiration paradoxale post-opératoire par
l'utilisation d'un plâtre et par la thoracoplastie en un temps.
2) L'expectoration s'est trouvée éclaircie.
3) La technique a été utilisée avec succès dans différentes circonstances.
4) De nombreuses lésions se sont trouvées guéries sous le plâtre.
5) Le collapsus obtenu apparaît plus complet que lorsqu'on enlève un
   nombre équivalent de côtes en plusieurs temps.
6) Les malades sont très satisfaits à l'idée d'une intervention en un temps.
7) Ainsi se trouvent économisés deux temps opératoires et deux mois et
demi d'hospitalisation.