The introduction of external or closed type cardiac massage has provided the physician with a simple but highly effective technique for cardiac resuscitation. The survival rate reported by Kouwenhoven, Jude, and Knickerbocker, who described external massage, surpasses previously reported successes utilizing the open method of cardiac massage. The medical literature reports successful closed resuscitation even under such adverse circumstances as cardiac arrest occurring on the playing field.

Since the only large series of patients with cardiac arrest treated by external massage was reported by the originators of the method, it is of interest to ascertain successes with this technique in other hospitals. The present report reviews the results of cardiac resuscitation in a large general hospital and demonstrates the progressive improvement in survival from cardiac arrest during the brief period since the introduction of external cardiac massage.

CLINICAL STUDY

The data was obtained from the hospital records of 73 patients treated for cardiac arrest at Charity Hospital of New Orleans during the 22 month period from June, 1960 through March, 1962. The primary purpose of the study was to evaluate closed cardiac resuscitation. Therefore, patients who developed cardiac arrest while the chest was open and those who had recently undergone thoracotomy, were excluded from the series.

Treatment of the cardiac arrest was classified into three categories: (1) closed massage only, (2) open massage only, and (3) combined closed followed by open massage.

Closed massage is performed according to the method described by Kouwenhoven et al. Pressure is applied through the heel of the hand to a localized portion of the sternum just above the xiphoid. The sternum is compressed at a rate of at least 60 times per minute while oxygen is supplied to the lung. In the operating room and recovery room, positive pressure oxygen was supplied by means of a tight fitting mask or an endotracheal tube. In the emergency room, artificial respiration was...
INCREASED SURVIVAL FROM CARDIAC ARREST

FIGURE 2: Mira resuscitating tube. A plastic double-oropharyngeal airway which can be used in adults or children.

accomplished using either the Kreiselman resuscitator (Fig. 1), or the Mira resuscitating tube (Fig. 2), until an anesthetist arrived with more suitable equipment. Intracardiac administration of drugs was rarely used with closed massage. The chest was opened immediately when fibrillation was thought to be present since the external defibrillator was not available in this hospital until the latter months of the period covered by this study.

When external cardiac massage was attempted as the initial therapy, but it was necessary to open the chest prior to successful resuscitation, the patient was assigned to the combined massage group.

Open chest resuscitation is performed in a routine manner through an anterior incision in the fourth or fifth left intercostal space. A set of sterile instruments is available for such emergencies in various areas of the hospital including the emergency room, recovery room, delivery and minor procedure rooms. The house staff is familiarized with the resuscitative procedure including the use of the electrical defibrillator at the beginning of each training year. Drugs used during open resuscitative procedures include calcium chloride, adrenalin, isoproterenol (Isuprel), sodium bicarbonate or lactate, and anticholinergic drugs. Post-resuscitative therapy included digitalization when indicated, antibiotics, and suction drainage of the pleural space. Hypothermia has been reported to be of much value in the post-resuscitative period. No significant information could be obtained regarding the use of hypothermia in the present series, since it was employed in only six of the 73 patients. Hypothermia was considered to be of definite value in the patient referred to in Case Report 1.

There were 54 instances of cardiac arrest occurring in the operating room and 19 in other areas of the hospital. Sites outside the operating room included the emergency room, recovery room, and general wards.

The specific etiology of the arrest was often difficult to determine. In the 54 operating room cases, arrest was attributed to a combination of two or more of the following: anesthetic agent, vagal reflex, hypoxia, central nervous system damage, rapid blood loss, drug reactions, and myocardial infarction. Etiologic factors in arrests outside the operating room were similarly complex.

A patient was considered a survivor if he was subsequently discharged from the hospital or if he was successfully resuscitated, but expired later during his hospitalization period of causes unrelated to the cardiac arrest or resuscitative procedure.
FIGURE 3: Graph showing increase in survival rate and decrease in incidence of thoracotomy in the treatment of cardiac arrest.

Non-survivors included those patients in whom resuscitative measures failed to re-establish the heartbeat, and those who were resuscitated but died of brain damage, congestive heart failure, or other complications of the arrest or resuscitative therapy.

Figure 3 indicates the change in trend as to the type of resuscitation procedure used by the resident staff during the period of this study. Whereas the chest was opened in 31 of the initial 36 cases in this series, thoracotomy was performed in only 17 of the subsequent 37 cases. The significance of this change is indicated by the fact that 15 of the 31 survivors in the entire series of 73 patients were resuscitated by the closed method during the last nine month period of the study. An additional six survivors were treated by the combined closed-open technique during the latter months of the period.

RESULTS OF CARDIAC RESUSCITATION

Operating Room: Survival rates are indicated in Table 1. Twenty-eight of 54 patients (52 per cent) survived. Forty patients had closed chest massage as either definitive therapy or as preliminary treatment to thoracotomy; 25 of these (63 per cent) survived. This is in contrast to the 21 per cent survival among 14 patients treated with immediate thoracotomy.

The series included 32 males and 22 females ranging in age from seven days to 87 years. There was a 20 per cent higher rate of survival among the females. Approximately 40 per cent of the arrests occurred in patients below four years or above 70 years of age. However, there was no significant difference in survival rate among the various age groups.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Survival Rate Following Cardiac Arrest Occurring in the Operating Room in 54 Patients Treated at Charity Hospital from June, 1960 through March, 1962.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. Lived</td>
</tr>
<tr>
<td>Closed Massage Only</td>
<td>18</td>
</tr>
<tr>
<td>Combined Massage</td>
<td>7</td>
</tr>
<tr>
<td>Open Massage Only</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
</tr>
</tbody>
</table>
Eighteen patients responded to closed massage alone. Resuscitation for periods of four to ten minutes was required in only four cases, as the remaining 14 patients were successfully resuscitated in less than three minutes. The two non-survivors included an 82-year-old man operated upon for a fractured hip. The type of operating table made closed massage difficult and, because of his generally debilitated status, open thoracotomy was not thought indicated. The second non-survivor was a 76-year-old man whose heart stopped beating during the skin incision of an exploratory laparotomy for carcinoma of the colon. Although he responded to closed resuscitation and the operation was discontinued, he developed oliguria with congestive heart failure and died on the fourth postoperative day. Eleven of the 18 survivors from closed massage were over age 60. These results demonstrate that closed resuscitation is an effective method for treating cardiac arrest in aged, as well as in young patients.

There were 20 patients treated by combined closed-open resuscitation. The seven survivors underwent closed massage for periods usually less than one minute after which the chest was opened. The reason for thoracotomy following such brief attempts at closed massage is not evident in four of the records. In three cases, the absence of an effective pulse with external massage in one and the type of surgical procedure in the remaining two, necessitated thoracotomy. Open massage resulted in successful resuscitation within two minutes in six of the seven patients. Ten of the 13 non-survivors underwent closed massage for one minute or less. The records clearly indicate that in at least five of these an effective pulse was produced during external massage. Thus, the indication for abandoning external massage in most of the patients in the combined resuscitation group was apparently the physician's lack of familiarity with closed cardiac resuscitation. A more concentrated effort with the closed technique would have probably eliminated the necessity for thoracotomy in some patients.

No permanent residual brain damage occurred in any of the 28 patients successfully resuscitated in the operating room. These included 19 discharged from the hospital and nine who recovered from the arrest, but died later of other causes.

Seventeen of the 26 non-survivors died during the attempted resuscitation and the remaining nine died from six hours to four days later. Irreversible brain damage was apparent in five of the post-resuscitative deaths. Three of the remaining patients died of heart failure and one of pericarditis with empyema.

*Outside the operating room (Table 2):*

The difficulty in ascertaining in a large hospital the incidence of cardiac arrest outside the operating room invalidated any general conclusions derived from an analysis of this group. There were eight arrests in the recovery room, eight in the emergency room, and three on the hospital wards. Three patients were successfully resuscitated, one in each of the above locations, and all three were discharged from the hospital without residual central nervous system damage. The following are the case summaries of these three survivors:

<table>
<thead>
<tr>
<th>Closed Massage Only</th>
<th>Combined Massage</th>
<th>Open Massage Only</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lived</td>
<td>Died</td>
<td>% Survival</td>
<td>Lived</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>40</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3—Survival Rate Following Cardiac Arrest in Patients Treated at Charity Hospital from June, 1960 through March, 1962, Includes Arrests Occurring in the Operating Room and Other Areas of the Hospital.

<table>
<thead>
<tr>
<th>Closed Massage Only</th>
<th>Combined Massage</th>
<th>Open Massage Only</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Lived</td>
<td>No. Died</td>
<td>% Survival</td>
<td>No. Lived</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>80</td>
<td>8</td>
</tr>
<tr>
<td>31</td>
<td>42</td>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>
Case Reports

Case 1

L. S., a 29-year-old colored man, was brought to the accident room on January 13, 1962 with a stab wound over the precordium inflicted 30 minutes prior to admission. Blood pressure was 110/70 and pulse 84. Heart sounds were normal and there was no venous distention. Breath sounds were diminished over the lower left lung field. Intravenous fluids, blood and nasal oxygen. The standstill and hemopericardium of the accident room and without aseptic administration of calcium chloride returned the heartbeat to a regular rhythm with a rate of 70-80 mm. Hg. He regained consciousness and femoral pulse was produced. An anesthesiologist was summoned and an endotracheal tube was inserted for oxygen administration.

After five minutes of external massage, left thoracotomy was performed. There were 2000 ml. of blood in the left pleural cavity. Cardiac standstill and hemopericardium were noted. The pericardium was opened and there was seen a 1.5 cm. laceration of the left ventricle through the left anterior descending coronary artery near the apex of the heart. The coronary artery was ligated and the lacerated ventricle repaired with difficulty. Cardiac massage was performed intermittently during this procedure. Intra-cardiac administration of calcium chloride returned the heartbeat to a regular rhythm with a rate of 120 per minute and systolic blood pressure of 70-80 mm. Hg. He regained consciousness and nitrous oxide anesthesia was then administered to permit closure of the chest. This procedure was performed entirely in the close quarters of the accident room and without aseptic technique. He received 4000 ml. of blood and 1000 ml. of dextran.

Postoperatively, he received antibiotics, intravenous fluids, blood and nasal oxygen. The temperature rose to 102° F. until the third postoperative day when hypothermia was used. A cortical type blindness persisted to the seventh day, after which vision returned to normal. Serial electrocardiograms revealed changes compatible with pericarditis without evidence of myocardial infarction. The thoracotomy incision healed per primum and chest x-ray film at the time of discharge on February 7, 1962 revealed a slight elevation of the left diaphragm with some pleural reaction. He was asymptomatic when last seen in the outpatient clinic on April 10, 1962.

Case 2

D. K., a 38-year-old colored woman, had a subtotal thyroidectomy for diffuse toxic goiter on June 5, 1961. Two hours following operation, while in the recovery room, she developed respiratory obstruction secondary to a large hematoma in the neck. During the tracheostomy, respiration and heart action ceased. External cardiac massage was begun and after 30 seconds, the heartbeat returned. She was then taken to the operating room where a bleeding vessel in a strap muscle was ligated. Following the resuscitation and control of the bleeding, her postoperative course was uneventful, and she was subsequently discharged without residual abnormality.

Case 3

T. C., a three-year-old white girl, was transferred to Charity Hospital on July 25, 1961 after treatment elsewhere for Hemophilus influenza meningitis. A ventriculostial shunt had been performed at an earlier age for hydrocephalus. She had been vomiting prior to admission, and was dehydrated and in electrolyte imbalance. On the fourth hospital day, after a severe bout of vomiting she became anoxic and developed a cardiac arrest on the ward. External massage and positive pressure oxygen were administered. Adrenalin was given intravenously, and after 10 minutes of massage, the heartbeat returned to normal. The child remained comatose for several hours then rapidly improved. The meningitis and electrolyte imbalance responded to therapy and she was restored to her previous central nervous system status when discharged on August 10, 1961. X-ray studies performed prior to discharge demonstrated that the ventriculo-atrial shunt was still patent.

Survivals from cardiac arrest outside of the operating room are uncommon, and the above cases demonstrate the value of closed cardiac massage under such circumstances. The immediate application of external cardiac massage in the patient with the stab wound of the heart (Case 1) allowed sufficient time to obtain personnel and equipment required for tracheal intubation and optimum oxygenation. An immediate thoracotomy would have resulted in further hypoxia and probable death. This case demonstrates the value of external massage as a preliminary measure to thoracotomy under certain conditions. Cases 2 and 3 indicate the successful use of closed cardiac resuscitation as a definitive treatment for cardiac arrest. The child in Case 3 would certainly not have survived during the era prior to the introduction of closed massage, when survivals from arrest on the general hospital ward were almost non-existent.
There was no survival from cardiac arrest outside the operating room when primary open massage was employed.

Ten of the 16 non-survivors of cardiac arrest outside the operating room died during the resuscitative procedure. Three others were resuscitated long enough to reach the operating room where they died during operation for trauma. The remainder expired from 12 to 36 hours after resuscitation, two from irreversible brain damage and one from bacterial endocarditis.

SUMMARY AND CONCLUSIONS

1. Hospital records of 73 patients treated for cardiac arrest at Charity Hospital from June, 1960 through March, 1962 are reviewed. Patients who developed cardiac arrest during or after cardiac or pulmonary operations are not included. There were 54 arrests in the operating room and 19 in other areas of the hospital.

2. Patients were classified according to type of resuscitative procedure employed. These included (1) closed chest massage, (2) open thoracotomy with massage, and (3) combined closed-open massage.

3. The survival rate in the operating room with closed massage as definitive therapy was 90 per cent and when instituted as a preliminary measure to open-chest massage was 35 per cent. There was a 63 per cent survival among all patients in whom closed massage was attempted in the operating room. When immediate thoracotomy was employed for cardiac arrest in the operating room, the survival rate was 21 per cent.

The overall survival from cardiac arrests in the operating room was 52 per cent.

4. The number of patients resuscitated outside of the operating room is too small to allow any general conclusion. The three survivors reported demonstrate the value of closed chest massage as definitive therapy in cardiac arrest and as a preliminary measure to allow proper preparation for open cardiac resuscitation. There was no patient with cardiac arrest outside the operating room successfully resuscitated with primary open massage.

5. This study demonstrates that as the resident staff of the hospital became more familiar with the technique of external cardiac message, the incidence of open thoracotomy decreased and the survival rate from cardiac arrest increased.

6. External or closed cardiac massage has significantly improved survival from cardiac arrest in the operating room and has resulted in successful resuscitation in other areas of the hospital where cardiac arrest is almost always irreversible.

RESUMEN

1. Las historias de 73 enfermos tratados por paro cardiaco en el Hospital Charity desde junio de 1960 hasta marzo de 1962 son el objeto de esta revisión. No se incluyen los enfermos que presentaron el paro durante o después de operaciones en corazón o pulmón. Hubo 54 paros cardiacos en la sala de operaciones y 19 en otras partes del hospital.

2. Los enfermos fueron clasificados de acuerdo con el tipo de procedimiento de resucitación que se usó. Estos incluyeron: 1) masaje del pecho cerrado, 2) toracotomía con masaje y 3) masaje combinado abierto y cerrado.

3. Las sobrevividas en la sala de operaciones con masaje exterior como tratamiento definitivo fue de 90 por ciento y cuando se hizo preliminarmente masaje con tórax abierto fue de 35 por ciento. Hubo una sobrevivida de 63 por ciento entre todos los enfermos en los que se intentó el masaje exterior en la sala de operaciones. Cuando se llevó a cabo inmediatamente la toracotomía para el paro cardiaco la sobrevivida fue de 21 por ciento. El conjunto de las sobrevividas en la sala de operaciones fue de 52 por ciento.

4. El número de enfermos recuperados fuera de la sala de operaciones es demasiado pequeño para obtener una conclusión general. Los tres sobrevivientes relatados demuestran el valor del masaje en tórax cerrado como tratamiento definitivo en la detención cardiaca, así como que es una adecuada preparación para la resucitación a tórax abierto. No hubo enfermos con paro cardiaco fuera de la sala de operaciones que se haya resucitado con buen resultado con masaje abierto inicial.

5. Este estudio demuestra que mientras más se ha familiarizado el personal con la técnica del masaje externo la frecuencia de la toracotomía decreció y la sobrevida después del paro aumentó.
6. El masaje cardiaco externo o cerrado ha mejorado significativamente la sobrevida después del paro en la sala de operaciones y ha logrado satisfactoria resucitación en otros sectores del hospital en los que el paro cardiaco es casi siempre irreversible.

Resumé
1. Revue des dossiers de 73 malades traités pour arrêt cardiaque au Charity Hospital de juin 1960 à mars 1962. Ont été exclus les malades qui ont fait un arrêt cardiaque avant ou après inter-ventions cardiaques ou pulmonaires. Il y a eu 54 arrêts dans la Salle d’Opération et 19 en d’autres points de l’hôpital.
2. Les malades ont été classés suivant le type de réanimation utilisée. Ceux-ci comprennent: 1° le massage à thorax fermé, 2° la thoracotomie avec massage, 3° le massage combiné à thorax fermé et ouvert.
3. Le taux de survie dans la Salle d’Opération avec massage à thorax fermé comme traitement unique a été de 90 p 100. Lorsque ce massage a été utilisé comme mesure préliminaire à un massage à thorax ouvert, le taux a été de 35 p 100. Il y a eu 63 p 100 de survie sur tous les patients chez lesquels le massage à thorax fermé a été essayé dans la Salle d’Opération. Quand la thoracotomie immédiate a été utilisée pour l’arrêt cardiaque en Salle d’Opération, le taux de survie a été de 21 p 100. L’ensemble de survie après l’arrêt cardiaque dans la Salle d’Opération a été de 52 p 100.
4. Le nombre des malades réanimés en dehors de la Salle d’Opération est trop faible pour permettre une conclusion générale. Les trois survivants ont montré la valeur du massage à thorax fermé comme traitement isolé au cours de l’arrêt cardiaque, et comme mesure préliminaire permettant une bonne préparation à la réanima-tion à thorax ouvert. Aucun malade ayant eu un arrêt cardiaque en dehors de la Salle d’Opération, n’a été réanimé avec succès avec un massage immédiatement à thorax ouvert.
5. Cette étude démontre qu’à mesure que l’équipe de résidents de l’hôpital est devenue plus familiarisée avec la technique du massage cardiaque externe, le nombre des thoracotomies a diminué et le pourcentage des survies par arrêt cardiaque a augmenté.
6. Le massage externe (ou à thorax fermé) a augmenté de façon significative, la survie par arrêt cardiaque dans la Salle d’Opération, et entraine des succès dans la réanimation en d’autres points de l’hôpital où l’arrêt cardiaque est habituellement irréversible.

Zusammenfassung
2. Die Patienten wurden gegliedert entsprechend der Art der zur Anwendung gebrachten Wiederbelebungsmaßnahmen. Diese umfaßten: 1) geschlossene Thoraxmassage, 2) offene Thorakotomie mit Massage und 3) kombinierte geschlossene und offene Massage.
3. Die Überlebensrate im Operationssaal mit geschlossener Massage als refinitiver Therapie lag bei 90%, und wurde sie als eine vorläufige Maßnahme für die offene Thoraxmassage eingesetzt, bei 35%. Die Überlebenszahl lag bei 63% aller Patienten, bei denen eine geschlossene Massage im Operationssaal zur Anwendung gelangt war. Wurde eine unmittelbare Thorakotomie benutzt wegen Herzstillstand im Operationssaal, lag die Überlebensrate bei 21%. Die Gesamtüberlebensrate wegen Herzstillstand im Operationssaal betrug 52%.
4. Die Anzahl von Patienten, bei denen außerhalb des Operationssaales eine Wiederbelebung vorgenommen war, ist zu gering, um irgendwelche allgemeinen Schlüsse zu erlauben. Die drei, die überlebten, demonstrieren den Wert der geschlossenen Thoraxmassage als definitive Therapie beim Herzstillstand und als eine vorläufige Maßnahme, die eine entsprechende Vorbereitung für die offene, kardiale Wiederbelebung erlaubt. Es war kein Fall vorhanden mit Herzstillstand außerhalb des Operationssaales, der erfolgreich mit primärer, offener Massage angegangen worden war.
5. Diese Untersuchung demonstriert, daß, wenn die damit betreuten Ärzte des Krankenhauses vertrauter mit der Technik der externen Herzmassage werden, die Häufigkeit einer offenen Thorakotomie abnimmt und die Überlebensrate bei Herzstillstand zunimmt.
6. Externe oder geschlossene Herzmassage hat die Überlebensrate durch Herzstillstand im Operationssaal beträchtlich verbessert und hat zur Folge eine erfolgreiche Wiederbelebung in anderen Krankenhaus-Abteilungen, wo Herzstillstand sonst fast immer irreversibel ist.

References
EXPERIENCES WITH OPERATIVE TREATMENT FOR RARE MEDIASTINAL TUMORS

Two cases reported illustrate the operative treatment for lymphangioma and hemangioma within the mediastinum; only one case of lymphangioma and 11 cases of hemangioma have been reported in Japan. Case I: A 59-year-old man complained of severe cough for three years. Roentgenograms of the chest showed an oval mediastinal mass in the right hilum. A cystic mass about 7 x 5 x 4.5 cm. In the right anterior superior portion of the mediastinum was removed completely. Histologic examination showed benign lymphangioma. Case II: A 67-year-old woman complained of cough and dyspnea. X-ray examination showed a dense shadow in the left hilum. The operation disclosed a cystic mass in the left posterior portion of the mediastinum, and it was removed completely. Histologic examination revealed benign hemangioma.

Mediastinal tumors of vascular origin are asymptomatic and usually are discovered by roentgenography. Exploratory thoracotomy is often necessary to establish diagnosis and treat it.