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# To Strip or Not to Strip? Physiological Effects of Chest Tube Manipulation

By Margo A. Halm, RN, PhD, APRN-BC, CCRN

Chest tube manipulation strategies to ensure the patency of chest tubes and mediastinal tubes in patients after cardiac surgery have been common practice among both nurses and surgeons in a variety of healthcare settings. The purpose of this clinical review is to summarize the current scientific evidence in relation to the following clinical question: Does the practice of milking or stripping chest tubes increase patency and thereby prevent cardiac tamponade in postoperative cardiac surgery patients? A secondary question is this: Is milking or stripping associated with negative clinical consequences?

## Methods

The search strategy for this clinical review included searching MEDLINE and CINAHL databases as well as hand searching bibliographies of clinical and research articles related to the care and manipulation of chest tubes. Key words included *chest tubes, mediastinal tubes, chest tube manipulation, milking,* and *stripping*. All types of evidence (eg, nonexperimental and experimental studies, systematic reviews) were included. Criteria for inclusion were (1) care and manipulation of chest tubes and (2) studies focused on the adult cardiac surgical population.

## Results

Spanning from 1982 to 2005, a total of 5 original research studies and 1 systematic review met the criteria for inclusion. In addition, 2 descriptive studies exploring nurses' knowledge of chest tube care, including manipulation techniques, were found.

### Patency of Chest Tubes

Four of the 5 studies[1-4] evaluated impact of chest tube manipulation techniques on mediastinal output. Sample sizes ranged from 30 to 204 patients. Chest tube sizes varied from 28F (most common) to 40F. Chest tubes were placed only in the mediastinal space in 2 studies,[1,2] whereas patients in 2 other studies[3,5] had both pleural and mediastinal tubes. The same chest drain device was used in each study and was attached to -20 to -25 cm suction in all studies (Isaacson et al[2] also evaluated -5 cm). One study did not report the type or size of chest tubes or type of drain device used.[4]

No universal protocol for chest tube manipulation was used. Protocols involved routine or sporadic manipulation, including (1) every 15 minutes 4 times (for a total of 1 hour), 30 minutes 2 times (a total of 1 hour), 1 hour 8 times (a total of 8 hours), then 2 hours as needed[2]; (2) every 2 hours[3]; (3) every 15 minutes the first 2 hours, hourly for the next 2 hours, then as needed[1]; or (4) only if a clot was evident.[4] Two studies used manual manipulation,[2,3] whereas the others used handheld rollers.[1,4] Definitions of milking and stripping were not uniform across studies. (In practice, *stripping* usually refers to compressing the chest tube with the thumb or forefinger and, with the other hand, using a pulling motion down the remainder of tubing away from the chest wall; *milking* involves manipulations such

as squeezing, twisting, or kneading to create bursts of suction to move clots.)

Comparisons were predominantly made between milking or stripping,[2,4] or between milking, stripping, or no stripping.[3] However, Duncan et al[1] compared a stripping protocol to stripping with venting of pressures exceeding -20 cm from the chest tube to no stripping of a chest tube with a smaller air intake channel acting as a sump. Although total length of tubing manipulated ranged from 12 cm to 135 cm, studies varied in lengths of tubing evaluated at a time (range 15- to 45-cm segments milked or stripped).[1-3] Pierce et al[4] reported an inability to control the length of tubing manipulated as a limitation. The effect of position changes or the amount of pressure and tension applied to the chest tubes (either manually or mechanically) also was not controlled for in the studies.

Postoperative measurements began immediately to 2 hours after admission and were continued from 8.5 to 40 hours (or until chest tubes were discontinued). In all 4 studies, no significant differences were found in *total mediastinal drainage* between the previously mentioned group comparisons or *chest tube occlusion rates.*[3] Although no difference between techniques was found in hourly drainage in 1 study,[3] the stripping group had a significantly higher drainage amount in both the 4- to 8-hour as well as the 8- to 16-hour intervals. Similarly, Isaacson et al[2] found no significant difference in drainage totals at either 8 or 12 hours. Furthermore, no difference in the incidence of tamponade between milking, stripping, or no stripping was documented by Pierce and colleagues.[4] In a regression analysis, Duncan et al[1] found that the manipulation method had little effect on the cumulative drainage volume. Instead, time after surgery accounted for a highly significant percentage (94.5%, $P<.001$) of variation in cumulative drainage volume, indicating that there was a predictable increase in cumulative volume over time.

In another study,[4] chest tubes were manipulated only if a clot was present. In this study, only one-third of patients required manipulation. In comparing mediastinal drainage between manipulated and nonmanipulated groups in this same study,[4] researchers found that patients whose chest tubes were milked or stripped had significantly higher drainage. However, no differences were found in either the number of manipulation episodes between the milked or stripped groups or the total drainage per number of manipulation episodes following these 2 established protocols.

In a systematic Cochrane review, Wallen et al[6] summarized the limitations of the experimental studies[2-4] that met criteria for review. Because there were no common interventions or outcomes and no significant differences were reported for any of the outcomes across any of the interventions, these authors concluded that there was no evidence to make any conclusion regarding the efficacy or benefit of one type of chest tube manipulation strategy over another. Furthermore, because no chest tube manipulation strategy was associated with higher mediastinal drainage or occlusion rates, it was suggested that there is no evidence at all about the need to manipulate chest tubes.[6]

> "A systematic Cochrane review yielded no evidence at all about the need to manipulate chest tubes."

### Adverse Clinical Consequences

In 1982, Duncan and Erickson[5] conducted the first study investigating the effects of manual or mechanical stripping on intrathoracic pressure changes in adult cardiac surgery patients. Stripping trials alternated the 2 methods between subjects using predetermined random lengths of tubing (ranging from 15 to 135 cm). When the full length of chest tubes was stripped (135 cm), intrathoracic pressure increased to -400 cm $H_2O$ (whereas 5 cm of tubing resulted in a mean pressure of -87 cm $H_2O$). This excessive pressure may be detrimental, damaging tissue entrapped in chest tube eyelets and potentially increasing bleeding. Other researchers have demonstrated that increased negative intrathoracic pressures also *impair left ventricular function.*[7]

Pierce and colleagues[4] evaluated the impact of 2 chest tube manipulation strategies on other negative clinical outcomes. In their study, no significant differences were found between no manipulations

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**Table**
**Levels of evidence**

| Class | Criteria | Definition |
|---|---|---|
| **Class I**<br>Definitely recommended | Supported by excellent evidence, with at least 1 prospective randomized controlled trial | Interventions always acceptable, safe, effective; considered *definitive standard of care* |
| **Class IIa**<br>Acceptable and useful | Supported by good to very good evidence; weight of evidence and expert opinion strongly in favor | Interventions acceptable, safe, and useful; considered *intervention of choice* by most experts |
| **Class IIb**<br>Acceptable and useful | Supported by fair to good evidence; weight of evidence and expert opinion not strongly in favor | Interventions also acceptable, safe, and useful; considered *optional or alternative* by most experts |
| **Indeterminate**<br>Promising, evidence lacking, premature | Preliminary research stage; evidence shows no harm, but no benefit; evidence insufficient to support final class decision | *Treatment of promise,* but limited evidence |
| **Class III**<br>May be harmful; no benefit documented | Not acceptable or useful; may be harmful | Interventions with *no evidence of any benefit*; often *some evidence of harm* |

or milking versus stripping and the *incidence of surgical reentry* or *hemodynamic values* before and after manipulation episodes.

### Nurses' Knowledge of Chest Tube Care

In recent exploratory-descriptive studies, researchers in the United Kingdom investigated nurses' knowledge of chest tube care. In a sample of 189 nurses from 2 large teaching hospitals, 58% responded that the claim that "milking chest tubes keeps them patent" was false. Less than one-third of nurses (29.6%) indicated that this statement was true, and the remaining 12% remained uncertain. In addition, no significant differences in knowledge of chest tube manipulation strategies were found between age groups.[8] In a second survey of 266 nurses, Parkin[9] found that whereas the vast majority of nurses (97%) knew drainage would be impaired with kinked tubing or when the drainage device was full, fewer nurses reported drainage would be impaired when tubing was coiled on the floor (21%) or the bed (23%) or was looped (20%).

### Recommendations Based on Current Evidence

This small collection of studies is associated with a number of limitations when the results are compared across studies. Although more methodologically sound studies are needed to better inform clinical practice, the body of current knowledge may be summarized as representing "Class III" evidence (see Table). Chest tube manipulation did not show any clear benefit in enhancing chest tube patency. As a result, strong evidence was not found for the need to routinely manipulate chest tubes to aid mediastinal drainage after cardiac surgery. On the contrary, stripping chest tubes may significantly increase negative intrathoracic pressures that could cause harm (eg, tissue entrapment, increased bleeding, left ventricular dysfunction), thereby further impairing patients' postoperative recovery.

> "Stripping chest tubes may significantly increase negative intrathoracic pressures that could cause harm."

Drainage from the mediastinal space is aided by suction and proper positioning of tubes, including the avoidance of dependent loops. Laboratory evidence from 2 studies[10,11] has shown that drainage from the pleural space is impeded when tubing is in a dependent loop. In both of these studies, straight and coiled tube positions were optimal for draining fluid. And whereas lifting the drainage tubing every 15 minutes will maintain adequate drainage if a dependent loop cannot be avoided, clinicians are advised to consider the clinical consequences of higher pressures at the chest tube and drainage tube connection when dependent loops are present.

The ideal practice is to lay the tubing horizontally across the bed or chair before dropping vertically into the chest drain device. If careful assessment suggests that some manipulation of the

tube is necessary, contemporary expert opinion strongly recommends gentle manual squeezing and releasing of small segments of chest tubing between the fingers (milking) instead of stripping.[12]

FINANCIAL DISCLOSURES
None reported.

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## Correction

The table "Levels of Evidence" was inadvertently printed in the first 3 articles in the Clinical Evidence Review department of *AJCC* (November 2007;16[6]:609-612, January 2008;17[1]:73-76, and March 2008;17[2]:160-163) without acknowledgment of its original source. The table is adapted from: Part 1: Introduction to the International Guidelines 2000 for CPR and ECC: a consensus on science. *Circulation.* 2000;102(8 suppl):I1-11.

We regret the error.