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A new approach to the surgical treatment of hydatid cyst

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Summary

Hydatid cysts of soft-tissue organs occur in five forms: univesicular, multivesicular, calcified (aborted), ruptured (into adjacent body cavities or host organ ducts), and infected. Each of these distinct forms requires an appropriate surgical approach. For uni- or multivesicular cysts uncontrolled spillage of fertile elements of the parasite is a major hazard. A new method using local freezing of the cyst's outer layer and 0.5% silver nitrate as a scolicidal agent effectively overcomes this problem. Calcified cysts can be left alone. Suppuration or rupture into adjacent body cavities or internal organ channels must be handled according to basic surgical principles and all of the parasitic material removed.

Introduction

In 1773 John Hunter made the following observation on hydatid cysts: 'As to the structure of hydatids, it was the same in large and small; a transparent bag, uniformly round and smooth, filled with clear water. . . . The bag appeared to consist of two coats or layers; for, on handling them, the outer coat would get rumpled. . . . When they were opened their coats possessed a strong contractile force, so as to roll themselves up in part . . . and when opened their inner surface was found covered with small hydatids, which were not so large as the heads of pins . . .'. He further made the very astute suggestion that rupture of liver cysts would lead to intrapelvic cysts. The parasitological basis of echinococcosis had not yet been recognized in John Hunter's day. But his clinical and morphological description encompasses, from the surgeon's point of view, most of the pertinent features of this disease.

Hydatid cysts have been known since antiquity. They were seen not infrequently in England, on the European Continent, North America, and specially in Iceland until World War II. Thereafter sanitary measures taken decades earlier effectively controlled transmission of the disease from livestock to man. In many other parts of the world echinococcosis remains today a major clinical problem with a significant morbidity and mortality. With increasing ease and speed of international travel hydatid cysts are seen more and more often in surgical centres of Western countries. In these centres surgeons are called upon to deal with a condition outside their past clinical experience.

Parasitology and natural history

A proper surgical approach to hydatid cyst in any soft-tissue organ depends not only on an appreciation of the parasitological features and the natural history of the disease but also on a full understanding of the technical problems involved in the surgical removal of such cysts. A hydatid cyst is in actual fact a large colony of countless microscopic scolices which are the larvae of the parasite. These float freely in a watery medium or hydatid fluid, being all contained within an outer protective coating which gives the whole structure a spherical configuration.

The characteristic outer laminated membrane of the cyst is of chitinous nature and never exceeds one or two millimetres in thickness. It is acellular and totally non-reactive to host tissues, from which it can be readily separated. As John Hunter noted, this laminated membrane ruptures very easily, exposing an inner and much thinner transparent germinative membrane. This membrane, as the name implies, is the breeding ground of the innumerable scolices. A hydatid cyst must

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grow continuously in size in order to survive and propagate the species at the right time. This obligatory growth is a very slow process and is the result of the continuous production of hydatid fluid. This is a type of 'amniotic fluid' for the scolices and also serves as a medium for transport of their nutritive requirements. It is the cyst's persistent enlargement which is damaging to the host as it causes mechanical compression of involved organ parenchyma. This is also what makes a particular cyst become clinically obvious, prompting its surgical removal. If it is not removed but allowed to grow at will the parasite eventually brings about its host's demise. Not all cysts pursue the same end, however, but may take one of the following alternative courses of development:

A) *Univesicular hydatid cyst* This is the simplest form, containing usually no daughter cysts, with the laminated membrane remaining intact as the cyst grows larger and larger.

B) *Multivesicular cyst* The laminated membrane ruptures, but innumerable small replica daughter cysts develop and occupy the initial space. The overall growth pattern is retained.

C) *Rupture into adjacent body cavities or entry into normal host organ channels* In the first instance the parasite continues to grow in its new domicile. On entering a channel or ductal system the parasite seeks an egress and in the process creates a whole series of new clinicopathological conditions.

D) *Spontaneous abortion* The parasite, for some unknown reason, stops growing and slowly calcifies.

E) *Suppuration* Secondary bacterial infection rarely supervenes in the case of multivesicular cysts.

Treatment

For each situation an appropriate surgical approach must be selected. The criteria of success in the surgical treatment of all cases, however, are three in number: (1) minimal damage to host organs; (2) total removal of all grossly visible parasitic material; and (3) avoidance of spillage of fertile elements of the parasite (scolices).

Applying these criteria, a new approach to the surgical treatment of all hydatid cysts in soft tissues will be described.

Univesicular and multivesicular cysts

Removal of whole or part of an organ harbouring the cyst—for example, a pulmonary or hepatic lobectomy—is a needlessly radical procedure since too much normal host tissue is sacrificed. Intact delivery of the cyst, meaning its enucleation without rupture of the laminated membrane, is tempting but can rarely be successful for larger cysts. The tensile strength of the laminated membrane is too low to withstand the full weight of the large volume of contained hydatid fluid. The cyst ruptures explosively half way through delivery. Any released and systemically absorbed hydatid fluid antigen may cause an acute anaphylactic reaction. But the more serious and delayed problem is the recurrence of hydatid cysts from the liberated scolices. This is called secondary echinococcosis, a grave clinical situation carrying a poor prognosis.

A number of techniques have been proposed to avoid uncontrolled rupture of cysts during their removal with attending loss of their contents. One of these techniques, adopted by many surgeons the world over, consists of a preliminary needle withdrawal of some of the hydatid fluid and replacement of this with an equal amount of a scolicidal solution. The aim is to have all scolices sterilized beforehand so as to eliminate the delayed danger of recurrence should rupture and spillage take place. Formalin in various concentrations has been the most commonly used agent for many decades, with others gaining and losing in popularity. No scolicidal agent can be truly effective in vivo in the concentration it is used, since it is invariably diluted within the mass of hydatid fluid. No proper mixing can take place either, once the agent is injected. The scolices are sturdy organisms and, unlike unicellular bacteria, cannot be readily exterminated chemically. This technique is, for obvious reasons, totally useless for multivesicular hydatid cysts which contain hundreds of small univesicular daughter cysts.

The drawbacks of preliminary aspiration and injection of scolicidal agents has led many surgeons to abandon this technique altogether. They rely more on protective walling-off gauzes and pads placed all around the surgical field. Such protective measures

may or may not work but are useful if not indispensable adjunctive measures.

The critical issue in the whole undertaking, leading at times to the surgeon's defeat during extraction of a hydatid cyst, is the extreme fragility of the laminated membrane. This one major limitation has to be overcome somehow before the removal of the cyst can be accomplished safely. In seeking various solutions to the problem it seemed quite logical that if the plastic consistency of the laminated membrane could be changed into a solid state its fragility and hence its tendency to rupture might be overcome. Freezing appeared to be the simplest way of accomplishing this and it was shown in the laboratory that the tensile strength of the laminated membrane would actually increase tenfold when frozen stiff. The clinical application of this finding called for a freezing device that could be readily used for all soft-tissue hydatid cysts. A simple apparatus was designed in the form of a stainless steel cone, using carbon dioxide gas as the refrigerant. The cone or frustum, open at both ends, is placed upon the surgically exposed surface of the cyst and within seconds of starting the refrigerant flow a frozen ring is created at the lower open end of the cone, sealing it firmly to the laminated membrane (Fig. 1). From within the cone the membrane is incised with impunity, there being no risk of a total rupture of the membrane nor of escape of the cyst contents into the operative field.

Initially it seemed an attractive idea to freeze the entire cyst into a large, solid ice ball. This idea was abandoned when it was found that complete freezing of a univesicular cyst about 10 cm in diameter would take a full hour of continuous freezing. Accordingly only that portion of the cyst's covering is frozen which will permit safe and controlled evacuation.

Further trials showed that it is not even necessary to dissect the involved organ so as to expose the laminated membrane. The cone can be placed on the surface of the organ directly over the most superficial portion of the underlying hydatid cyst. This area can be readily recognized by inspection or palpation of the involved organ surface. This technique has now been used in over 70 consecutive cases of liver, lung, and abdominal hydatid cyst of the univesicular and multivesicular varieties with great ease and success.

While the first problem of hydatid cyst surgery appeared to have been solved with the freezing technique, it seemed possible that during extraction of the torn and collapsed laminated membrane a few drops of hydatid fluid might still escape into the residual space within the host organ. These could potentially lead to the local formation of new cysts at a later date. It seemed reasonable that instillation of a suitable scolicidal agent into the evacuated pericyst space would eliminate this potential danger. A systematic search for a scolicidal agent other than formalin led to the discovery that a 0.5% solution of silver nitrate, while completely non-toxic to tissues, is extremely effective in sterilizing scolices within 2 min. The efficacy of this solution was proved in the laboratory by standardized mouse intraperitoneal inoculation techniques.

The combined approach to univesicular and multivesicular hydatid cysts of soft tissues, consisting of the extraction of the deliberately ruptured laminated membrane or daughter cysts with the cryogenic cone followed by irrigation of the residual space with 0.5% silver nitrate for about 2 min (Fig. 2), has now been tried in a total of 55 cases of liver and lung

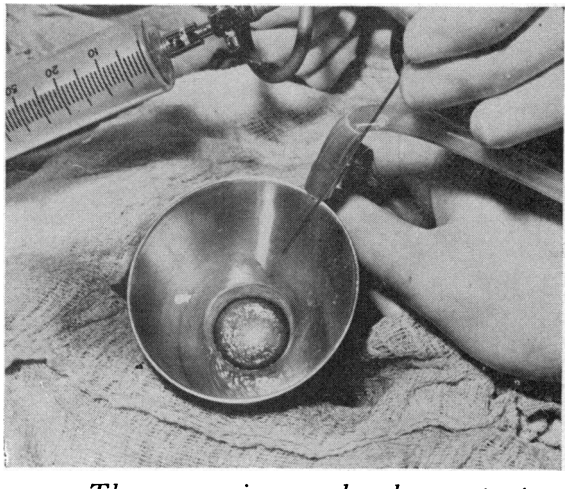

FIG. 1 *The cryogenic cone has been set upon and frozen to the surface of the involved organ. A preliminary needle evacuation of hydatid fluid releases much of the internal fluid pressure while establishing an accurate diagnosis.*

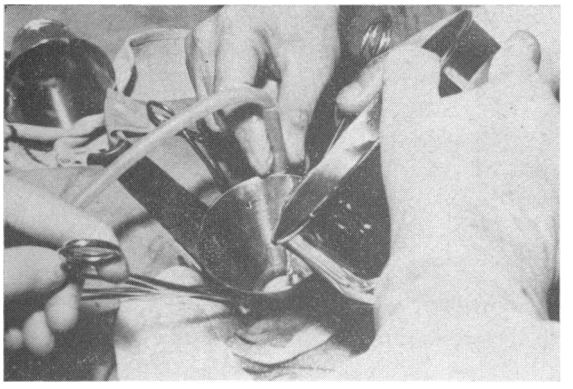

FIG. 2 *The parasite has been removed through the cryogenic cone. The residual space is filled with a freshly prepared solution of* 0.5% *silver nitrate to sterilise any spilled scolices. The silver nitrate is then washed out with saline and the cavity managed appropriately.*

cyst. No untoward local or systemic effect as a result of the silver nitrate washout of the residual space has been noted. Since the growth rate of hydatid cysts—primary as well as secondary ones—is very slow, extending over many months to years, it is too early to arrive at a final conclusion. But follow-up of 39 of these patients for over 3 years has shown no evidence of recurrence.

What one does to the evacuated and scolex-sterilized residual cavity is important but not crucial. The surgeon can elect to leave the cavity wide open after running a haemostatic suture over the edges of the opening; he can close the opening tight; or he can insert a small tube drain leading to the outside. Drainage is unnecessary in clean cases and adds to morbidity since obliteration of some of the large residual spaces takes a long time and drainage can lead to secondary bacterial invasion. Marsupialization to the outside is not recommended under any circumstances. It has been abandoned as very unsatisfactory by all surgeons with experience in the treatment of hydatid cysts of the liver.

Rupture into host organ ducts or adjacent body cavities Lung and liver hydatids quite often establish some type of communication with the bronchial or the biliary ductal system. The result, so far as the parasite is concerned, depends on the size of the communication. Lung cysts rupture with entry into the bronchial system and the collapsed laminated membrane is retained as a foreign body. In the liver univesicular cysts are transformed into multivesicular ones if small bile ducts are opened up. With larger bile duct communication portions of the hydatid cyst can actually enter the biliary tree. Depending on the size of the fragments and the site of arrest in the biliary system a predictable clinical picture of biliary obstruction ensues. Surgical treatment cannot be successful unless both the obstruction is relieved and all of the parasitic material within the substance of the liver is evacuated. Ruptured lung cysts demand surgical removal.

Rupture into adjacent body cavities with resulting secondary echinococcosis will have to be handled as dictated by the course of development of the individual secondary cysts.

Spontaneous abortion For unknown reasons some hydatid cysts undergo spontaneous degeneration. They stop growing, the scolices die off slowly, and the lesion, beginning with the surrounding host pericyst layer, starts to calcify. Unless the particular cyst is so large as to be clinically bothersome or diagnostic problems have arisen there is no reason to attack these aborting or aborted hydatids in any surgical manner. They do not grow any further and hence pose no danger to the host and can be ignored.

Suppuration Secondary bacterial infection, even if the cyst has ruptured into the host organ ductal system, is relatively rare. Bacteria have no deleterious effect on the parasite and the two can readily coexist. If infected the residual space must be managed like any other abscess cavity, with adequate drainage to the outside once the parasitic material has been fully extracted. There is no reason to establish drainage, however, if there is no concomitant bacterial infection. Quite often it is difficult to convince oneself that a multivesicular liver cyst with fragmented pieces of laminated membrane and small daughter cysts floating amidst turbid bile is *not* an abscess cavity. The question can be resolved by Gram-staining the 'infected'-appearing material and instituting appropriate drainage only if bacteria are seen on the smear. Otherwise the residual cavity can be handled without drainage and with a much shorter period of convalescence.