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THE IMPORTANCE OF AUTOPSY IN MAJOR DISASTERS

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SUMMARY

It is appreciated that there are national and jurisdictional variations in regard to post-mortem dissections following accidental death. The purpose of this paper is to plead that, since there will be nationals of many states involved in an aircraft disaster, there should be a uniform system of forensic investigation on a world wide bases. The justification for this recommendation is illustrated through the investigation of accident causes and through the solution of the many problems relating to the settlement of probate which arise in accidental death.

The causes of accidents which may be discovered by autopsy include crew incapacitation and criminality of all types. The emergency status may also be revealed and the type of accident, particularly whether in a controlled or uncontrolled phase, may become clear.

The medico-legal problems to be resolved include those concerning payment of insurance policies, including the degree of life expectancy, and, especially the disposal of estates when members of a family apparently die together. The resulting payments to beneficiaries may be quite different depending on the quality of the autopsy.

These investigations are complementary to, and do not interfere with, the identification process but they are time consuming and expensive.

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It is only in those countries in which the Anglo-Saxon jurisdiction persists that autopsy is a commonplace following accidental death. Within those legislations based on Roman law, emphasis is upon the privacy of the individual and, by and large, post-mortem dissection is regarded as an infringement of that privacy (!). As a result, there are very large areas of the world in which internal dissections in the assumed conditions of accidental death would be positively disapproved; if we add to this a possible shortage of manpower and religious or other societal objections to autopsy in areas which are still dominated by Anglo-Saxon medico-legal thinking, it is apparent that the chances of a victim of an accident involving an airliner coming to post-mortem dissection are, on a world basis, very low.

Nevertheless, aircraft accidents are no respecters of nationality and it is justifiable to question whether it is right to impose one's own national traditions on those who have died in one's jurisdiction or should not one's thoughts be in terms of what is expected in the casualties' own countries. This question is raised because it is becoming increasingly apparent that many of the urgent family problems posed by sudden expected death depend for their solution on the findings at autopsy.

In the aircraft accident, however, there are problems additional to those related to private law. The major concern lies in the investigation of the accident particularly as to its cause and, again, experience is that this may ultimately rest on autopsy examination.

There is, therefore, a case for a uniform standard of investigations of sudden death throughout the world. But, since post-mortem dissection is extravagant in time, money and manpower, it follows that such a case may be justified by results. This paper attempts to do this using both accident investigation and medico-legal considerations in illustration.

For the purposes of the investigation of a fatal airliner accident, we can divide the casualties into three categories - the flight deck crew, the cabin crew and the passengers.

The importance of autopsy examination in the case of the flight deck crew is already widely accepted. Enough has been written in the past as to the significance of diagnosing incapacitation of the crew as an accident cause to convince even the most sceptical. Despite this, there have been disasters where the national authority has made no effort to identify the flight deck crew, let alone encourage a post-mortem dissection. In point of fact, accidents due to pilot incapacitation are surprisingly rare and this is due to two factors - aircrew medical surveillance and double crewing. This, apposite instances arise only in exceptional circumstances and this is well exemplified by one historic case (2) which illustrates certain important features - first, the adherence to a routine, even when, as was so in this instance, the possibility of pilot incapacitation seems remote; secondly, the need to back one's autopsy by histological examination (Fig. 1); and, thirdly, the importance of interpretation of the findings, particularly when the pre-cursor condition - in this context, simple atheromatous restriction of the coronary lumen - is widespread in the population.

This leads to a further very important medico-legal aspect of disease in professional aviators. The discovery of diagnosable disease in a pilot as a cause of the accident could lead to an action for negligence with all the financial implications which that entails; on the other hand, if the airline could not know of the existence of disease, there can be no negligence - at least not in British law. It is, therefore, vital to correlate the diagnostic findings in life with the conditions found at autopsy - essentially an application of hospital techniques to forensic pathology - and one has to have controls if these are to be correctly interpreted. There are, therefore, both powerful, practical and academic reasons for examining the hearts of all pilots killed in accidents irrespective of the immediate implications.

There are, of course, other organs to be considered in the examination - particularly, perhaps, the brain - but toxicological examinations are also important. This was shown in Stevens' brilliant investigation of an accident in which the finding of low carboxy-haemoglobin values in the crew led to a review of the flight deck heating system in one particular type of aircraft (3). The presence of alcohol should always be sought, although we have never found a killed commercial pilot to have been intoxicated at the time of his death; attention is drawn to the need for the parallel examination of control specimens in view of the possibility of post-mortem artefact (4).

As to the autopsy of the cabin crew, particular note should be made concerning the presence or absence of lap belt injuries or injuries consistent with being in a situation similar to that of the passengers. This indication of preparation for a crash landing, either in water or on land, may seem rare but there has been one accident in which that information was crucial (5).

The degree of restraint in the passengers is also of paramount importance. The differences between the accident mentioned above and another, in which the aircraft was also lost at sea (6), are very marked (Table 1). If Case 1 indicates preparedness for a crash, Case 2 certainly does not and is, in fact, an example of criminality in the form of the detonation of a bomb in the aircraft passenger compartment.

The primary indication of sabotage in this case resulted from a combination of identification - by which means it was possible to know where some of the casualties were seated - and post mortem dissection - by which it was possible to identify a proportion of cases subjected to hypoxia. Even in the absence of supporting evidence, which was in fact available, the combination of the two lines of investigation left little room for doubt that a catastrophe had occurred at altitude in the rear passenger compartment. It will be interesting to know if a similar pattern of injuries resulted from the loss in 1983 of the Korean Airlines Boeing 747 off Hokkaido Island.

An alternative form of criminality - hijacking - is almost completely dependent upon autopsy for its detection. It might be possible to identify a bullet in a member of the flight deck crew but that would be extremely unlikely. It might also be possible to show that the Captain had been displaced but, again, this must be very rare. It is far more likely that a significant autopsy pattern will be discovered in the passengers; in particular, killing the pilot would be expected to result in a high-force impact crash rather than a premature or forced landing.

As an example, it has been possible to compare the results of a known undershoot with a supposed hijacking (Table 2). The similarity of the patterns of injury in the two accidents under consideration was such as to make it quite clear that both were of undershoot type - this similarity extended even to the toxicological pattern (7). The correspondence of these two accidents was, in fact, estimated to some extent by the diagnosis of burning as a cause of death and it cannot be over-emphasised that the differentiation between burning as a cause of death and post-mortem incineration can only be made by internal autopsy examination.

The person who dies from burning is more likely to have survived one who has been decapitated or whose major cardiovascular system has been disrupted, and this leads to a consideration of the most important feature of civil law in respect of aircraft accidents - that is, the disposal of estates in the event that two persons have apparently been killed together. The answers to the questions posed in this context lie almost entirely in medical - that is pathological - hands and may differ depending upon the extent of the medico-legal investigation (Table 3). The only way in which all the evidence can be provided is through full post-mortem dissection backed, is necessary, by toxicological and histological examinations. Since large amounts of money may depend on the analysis, it would seem that it is only right that the maximum evidence should be available irrespective of the place in which the 'commorientes' died.

The mention of money inevitably leads to a consideration of the problems raised by aircraft accidents as to life insurance. The insurers are entitled to information - for example, whether death was wholly attributable to accident, what was the life expectancy of the deceased and, indeed, whether the deceased was intoxicated at the time of death because alcohol exclusion clauses in a personal accidental death insurance policies operate on a temporal, not a not a causative basis (8). It is clear that there is no way in which these questions can be adequately answered save through autopsy - and, it is submitted, through the retention of permanent histological preparations which can be available to the experts of all parties interested in subsequent litigation.

There are two essential applications of pathological expertise following an aircraft accident - these are, on the one hand, the purely medico-legal concerns of which the main one from which all others spring - is identification of the dead and, secondly, those relating to the investigation of the accident as to cause and effect. The important feature is that these objectives are not antagonistic but are, on the contrary, complementary. Many interests may be represented in a major accident. The objective must be to establish the scientific truth and the autopsy provides a major tool in the achievement of that end. The conclusion is that it should be applied on an international basis.

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Figure 1



The appearances of calcifying atheroma, sub-intimal haemorrhage and intimal dissection were interpreted as being most probably attributable to an incipient coronary attack. The acute appearances were not evident in the gross specimen.

Table 1

Patterns of passenger injury in
two aircraft lost over the sea.

	<u>Case 1</u> (10 autopsies)	<u>Case 2</u> (47 autopsies)
Very severe injury	100%	45%
Minimal external injury	nil	26%
Evidence of oxygen lack	nil	30%
Severe facial injury	100%	13%
Leg injury due to seat	100%	nil
Lap belt injuries	60%	nil
<u>Conclusion</u>	crash into water	catastrophe at altitude

One of the 6 casualties showing lap belt injuries
in Case 1 was identified as a stewardess.

Table 2

Patterns of passenger injury in two accidents occurring
short of the runway

	<u>Case 3</u> (48 autopsies)	<u>Case 4</u> (63 autopsies)
Type of accident	Known undershoot	Possible-jacking
Asphyxial death	69%	68%
Lap belt injuries	20%	13%
Femoral fracture	43%	62%
<u>Conclusion</u>	Undershoot	Undershoot

Table 3

Depth of post-mortem examination
and conclusions available

External examination	-	the fact of death
Internal autopsy	-	the cause of death
Microscopic and toxicological examination	-	the mode of death

Very different results may
be reached according to the
range of the examination.

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