Original Article

Toxicological Findings in Occupants of a Crashed Commercial Aircraft and the Legal Implications on Personal Injuries Claims

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Abstract

Background: A commercial aircraft operated by DANA Air crashed just outside the Lagos International Airport, Nigeria, killing a total of at least 150 people. The crash was accompanied by a fire outbreak. There were no survivors. There is a consideration that some victims might have survived for some time and consequently suffered agonal pain. **Materials and Methods:** Postmortem examination for the purpose of disaster victim identification, and determination of the cause of death was carried out for the first time in the country. Part of the mass disaster investigation entailed toxicological studies conducted on bodies that were fairly well preserved, and where body fluids were available. A total of 148 victims were positively identified and toxicological samples could only be obtained from 82 of them, comprising the blood, urine, vitreous, and marrow. One hundred and twenty-one samples were collected and of this, only 74 were sufficient for analysis. **Results:** Toxicology revealed postmortem endogenous alcohol production in 30 victims. Although 27 victims showed morphological features suggestive of carbon monoxide poisoning, only 4 revealed significantly elevated levels of carboxyhemoglobin saturation. **Discussion:** Some of the victims were apparently alive for some time in the fire that followed the crash, and probably suffered pain during this agonal period. This paper discusses the relevant aspects of personal injury claims and further damages under the Montreal Convention as it relates to possible pain and suffering. **Conclusion:** The authors opine that the next-of-kin of the victims might be entitled to some compensation based on agonal pain and other loses.

Keywords: Agonal period, commercial plane crash, damages, fire, pain and suffering

Introduction

The Nigerian airspace is not unfamiliar with fatal air accidents.[1] However, mass burial of the victims has always been the practice. This practice was discontinued in Lagos State, Nigeria when a forensic mass disaster investigation culminating in disaster victims identification (DVI) with the determination of the cause of death, was conducted.[2,3] The forensic investigation of bodies of the victims of the DANA Air Flight 992 that occurred within the jurisdiction of Lagos State abolished the crude practice of mass burials of such victims of mass disasters without any detailed medicolegal autopsies. The autopsies were made possible by the newly introduced Coroners Systems Law of 2007 in Lagos State.[4] Certainly, the rest of the country is yet to adopt and operate a similar practice because they have not modified their Coroner Laws to meet international best practice.[5,6]

Part of the medicolegal investigation was the toxicological analysis of the body fluid samples collected from the victims, where available at autopsy. Postmortem toxicological studies in victims of airplane disasters are important and necessary for the determination of the cause of death.[7] Toxicological tests help to determine possible contributions of drugs and alcohol to the performance of the pilot and other crew members. It helps to determine if any passenger might have been under the influence of drugs and alcohol and possibly further interfered with navigation activities. Toxicology will reveal the role, if any, of an accelerant or explosive device in the mishap; finally, it will detect if there was a secondary fire incident and if any of the victims was alive for some time in the fire. This latter observation might suggest the possibility of a period of agony, pain and suffering, and this might impact on compensatory claims by the next of kin.

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Investigations into airline crashes might reveal among others, structural or design defects, engine or fuel defects, failure to comply rigidly to the maintenance schedule, errors due to the pilot or air traffic controllers, and particularly at this time, terrorist activities. One or more of these could have caused the accident. Following an accident reconstruction, and where a toxicology report is available, such issue as a possible brief survival of the passengers might ultimately play a role in subsequent litigations. Legal claims are therefore generally based on factors such as defective products with accompanying doctrine of strict liability, negligence, and vicarious liability.[8-10] These claims can be pursued by family members of the decedent such as, spouse, lawful common-law partners, parents, children, or siblings. Other damages include family instability, loss of companion or parental care, loss of income including anticipated future earning capacities, emotional distress, pain and suffering.

This article is intended to present the toxicological findings in the course of the medicolegal investigation of the cause of death of the victims of DANA Air crash, Flight 992 that occurred in Lagos, Nigeria in 2012, and discuss the possible contribution of secondary fire incident to the terminal suffering experienced by the victims. It will also discuss the possible impact of the toxicological findings on any claims by the next of kin.

Case Report

DANA Air Flight 992 was on a scheduled domestic commercial flight from Abuja to Lagos in Nigeria, on Sunday, June 3, 2012. The aircraft was a twin-engine McDonnell Douglas MD-83 which was registered as 5N-RAM in Nigeria. The plane, which was built in 1990, had previously been on the fleet of Alaska Airlines until 2007 but was acquired by DANA Air in 2009.[11] The aircraft had undergone routine maintenance 2 days before the fatal crash. The event occurred in the densely populated Iju-Ishaga suburb of Lagos, located <2 km from the Muritala Mohammed Local Airport where it was scheduled to land. However, at about 3:43 pm local time, the pilot reported a dual engine failure. After crashing, a massive fire engulfed the plane and the surrounding houses; these resulted in the death of at least 150 victims, including three persons on the ground.

Based on the Lagos State Coroners Systems Law of 2007,[4] the local Coroner took over the legal custody of the bodies and authorized the Chief Medical Examiner to conduct medicolegal autopsies directed at identifying the victims and determining the cause of death. The process involved cataloging the bodies/body parts and bone fragments, radiological and odontological examinations, autopsy studies, and photographic/video recordings of the entire process. The autopsy studies included detailed external and internal examinations with appropriate documentations, collection of histological and toxicological samples, as well as sampling of bones and muscle for DNA analysis. To complete the process of identification, buccal smears (reference samples) were collected from supposed parents, children, and siblings of the victims. The genetic profiling and matching was done through Orchid Cellmark Laboratories, United Kingdom. The dental charts were matched with antemortem records where available.

There were 152 body bags comprising 49 fairly well-preserved bodies and 103 moderately to severely charred bodies with some having missing parts apart from autolytic changes. Of the group of 103 bags, four bags were subsequently discovered to actually represent two bodies; in other words, the investigators ended up with 150 body bags. There were also two other bags containing 16 recognizable body parts and another bag with seven bone fragments. Of the 150 bags, 147 victims were identified while another one was identified from among the 16 recognizable body parts; therefore in total, 148 victims were identified which include three people on the ground and living in that suburb where the plane crashed. One significant finding in this investigation is that none of identified victims matched positively for the pilot and co-pilot despite repeated tests. Their bodies were believed to have been completely incinerated; other crew members were positively identified.

Considering that many of the victims had suffered multiple traumatic injuries, severe exsanguination, and autoamputations in the case of charred bodies, samples of body fluids were not readily available for toxicological studies in all cases.

Results

Tables 1 and 2 show the details of the samples submitted to the Forensic Toxicology Laboratory, Office of the Chief Medical Examiner, St. Louis, Missouri, USA.

Of the 121 samples (derived from 82 victims), only 74 were found to be of sufficient quantity or suitable enough for analysis. The 47 samples that were not analyzed (which include the 38 samples of bone marrow) were considered by the laboratory to be either unsuitable or insufficient. Of the

Table 1: Spectrum of toxicological samples and number victims sampled

Toxicological sample(s)	Number of victims
Urine	23
Marrow	20
Urine and marrow	9
Vitreous	7
Vitreous + urine + blood	4
Vitreous + blood	4
Vitreous + marrow	4
Urine + blood	3
Blood	2
Blood + marrow	2
Vitreous + urine + blood + marrow	1
Vitreous + urine + marrow	1
Urine + blood + marrow	1
Vitreous + urine	1
Total number of victims sampled	82

Table 2: Number of each toxicological samples collected

Sample type	Number of samples
Urine	43
Marrow	38
Blood	20
Vitreous	20
Total number of samples	121

74 samples analyzed, 34 were negative for alcohol, common drugs of abuse, and carboxyhemoglobin (COHb).

Of the 40 samples that showed positivity, seven of them contained more than one substance. Thirty-four samples were positive for alcohol with values ranging from 11.0 to 157 mg/dL among the fairly well-preserved bodies (16 cases) while those exhibiting moderate-to-severe decomposition had values ranging from 13.0 to 62.0 mg/dL (18 cases). Considering the marked variability in the postmortem ethyl alcohol level, the investigators could not associate the detected levels to antemortem or postmortem production.[12-14]

There were morphological features of carbon monoxide poisoning in 27 victims examined at autopsy. They exhibited features such as the cherry red appearance of muscle, blood, and some mucosal surfaces. Twelve samples were positive for COHb, the samples were unsuitable in six victims, while samples were not available in nine cases. Significantly elevated COHb % saturation levels could only be toxicologically demonstrated in four victims; the values were 29%, 51%, 59%, and 70%. Eight victims had <10% saturation levels.

One of the victims was positive for the presence of cannabinoids; 11-hydroxy-Tetrahydrocannabinol (THC) = 22 ng/mL and 11-nor-delta-9-THC-carboxylic (THC-COOH) = 41 ng/mL.

No accelerant or explosive chemical was detected.

The absence of the remains of the pilot and co-pilot meant that there were no available samples from them to assess the presence or absence of alcohol and drugs in their system.

Discussion

For the first time in Nigeria, victims of a mass disaster were not disposed of through mass burial. These victims of DANA crash underwent the rigorous process of DVI with determination of the cause of death and subsequent handing over of the bodies of the victims to their families. Where the toxicological samples were available, blood, urine, vitreous, and marrow were collected. The forensic toxicology laboratory took the final decision of determining what was suitable or sufficient enough for analysis.

It is noteworthy that toxicology did not reveal the presence of organic compounds such as toluene, benzene, or the hexanes as to suggest the presence of accelerants. There was also no identified explosive chemical. In other words, the absence of these chemicals would suggest that they cannot be implicated in the causation of the crash.

The identification of 11-hydroxy-THC (22 ng/mL) and 11-nor-delta-9-THC-COOH (41 ng/mL) in one of the victims would at the most suggest a recent use with no physiological effect.

Of great significance in this case is the identification at autopsy, morphological findings compatible with carbon monoxide poisoning in 27 of the victims. While toxicology screening tests were positive in 12 victims, eight had COHb levels of <10%. The remaining four had values ranging from 29% to 70%; these levels are generally considered to produce symptoms in victims and would not normally be found in individuals who have not been acutely exposed.[15] It is the view of the authors that the number significant positivity could have been more if the bodies had been better preserved and samples were sufficient where available; it should be recalled that only 49 of the bodies were fairly well intact. The implication of elevated COHb% will suggest that some of these victims were alive in the fire and had sufficient time to inhale carbon monoxide fumes.[7,15]

The COHb% saturation levels observed in these victims could only have arisen from the fire that engulfed the plane after the crash. This then raises the question about whether or not some passengers "survived" the initial crash or probably only sustained injuries that incapacitated them such that they could not escape from the wrecked aircraft. Did they then succumb to the effects of the fire? Consequently, the next concern would be to attempt to determine how long these victims survived in the fire before death? This brings to the fore the issue of agonal period, pain and suffering, that might have preceded death. The concept of agony, agonal period, and possible pain and suffering preceding death can be subjective to some extent and continues to remain challenging to forensic pathologists while testifying in Court.[16] This is because of the rather complex nature of pain due to the interplay of pain perception, tolerance, prior ingestion of painkiller drugs, coexisting multiple injuries (especially those involving the nervous system such as cord transection), and possible comatose status even while maintaining ventilation. The forensic pathologist can only opine that an injury could have possibly caused pain or suffering under normal circumstances. However, deciding on a length of time (agonal period) could be more problematic for the forensic pathologist; he can at best only suggest that the nature of a particular injury could have terminated in death within hours, minutes, seconds, or instantly. The court would have to take into consideration other circumstantial evidence from the rescuers and even the hospital notes. Observations such as elevated COHb% saturation levels or hydrogen cyanide, "shock kidneys," presence of urine in the bladder, soot with mucus deposition in the tracheobronchial tree and probably extending into the alveoli, microscopic evidence of vascular and cellular inflammatory changes, and possibly enzyme histochemical staining, can all assist the forensic pathologist to attempt to predict the agonal period.

This prediction of the survival period could correspond with the duration of suffering and consequently impact on the legal damages. Issues of claims following aviation accidents are widely covered under a number of legal proclamations.[8-10] The Warsaw Convention of October 12, 1929 to which Nigeria is a signatory was domesticated locally on January 1, 1953. This was followed by the Carriage by Air Act of 1932 which was also domesticated and became applicable in Nigeria in 1953. Next is the Montreal Convention of 1999 which became domesticated in Nigeria on November 4, 2003. Finally in Nigeria, there is the Civil Aviation Act of 2006 which crystallizes all the above Conventions and Acts, as well as, making provisions for domestic flights.[8] All these Conventions and Laws guide the procedure and general magnitude of claims open to the next of kin of deceased victims of aircraft accidents.

The Accident Investigation Bureau (Nigeria) recently ruled that pilot error caused the DANA Air crash of 2012. The report on the crash stated that there was loss of power on the first engine 17 min after taking off while the second engine lost power on final approach of the plane's destination.[17] The agency concluded that the pilot failed to seek emergency landing permission after having problem with the first engine shortly after "take off." This event would probably fall into the category of product liability. The flight data recorder was said to be severely damaged sequel to the crash and subsequent fire, such that no information could be retrieved; there was also only 31 min of recording retrievable from the cockpit voice recorder, revealing that the pilot had reported failure of both engines.[11]

Ordinarily, the next of kin will be initially entitled to US$ 30,000.00 under Article 28 of the Montreal Convention and S48[3] of the 2006 Civil Aviation Act (Nigeria) to cover immediate and burial expenses.[8,10] This is followed by a maximum of US$ 100,000.00 (less any previous payouts). However, there are exceptions whereby additional claims can be made to the beneficiary through Article 21 of the 1999 convention.[8] All the claimant needs to do is to prove that the airline failed to adhere to industrial standards as it relates to safety. It is arguable that engine failure is probably due to a defective product and as such the doctrine of product liability should apply. In view of the fact that some of the victims (at least 27) died in the fire and most likely suffered pain during the agonal period, this should attract additional personal injury claims. The next of kin would have had to also suffer more pain due to emotional distress realizing that their loved ones suffered terminally. This aspect of the law has to the authors' best knowledge, not been tested in the Nigerian Courts.

Conclusion

The medicolegal investigation of the deaths of the victims of DANA Air Flight 992 crash resulted in the identification of almost all the victims. They suffered multiple injuries, but a number of them died in the fire that engulfed the crash site; they were obviously alive for some time in the fire as revealed by morphological findings at autopsy and the toxicological analysis. This means that they most likely suffered before death and as such the lawyers of the next of kin might be able to argue for additional compensation.

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Conflicts of interest

There are no conflicts of interest.

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