Original Article

Role of Medical Officer (Aviation Medicine Specialist) in Aircraft Accident Investigation : Present Policy and Practical Problems

Randhir Singh

Increase in the number of Human error (Pilot factor) accidents is alarming to Indian Air Force which accounts for an average of 20% of total and more than 50% of fatal/cat I accidents. Air Force can ill afford to lose trained aircrew and very costly combat potential. Hence the importance of a thorough, systematic and scientific analytical approach to the problem by the medical member in a multipronged in investigative group/team needs no overemphasis. Present policy on aircraft accident is laid down vide Air Force Order (AFO) 3/86 itself does not refer to certain aspects of reporting procedure and there is also no of the present policy, practical problems encountered in the conduct of Court of Inquiry are brought out. A protocol with special emphasis on role of medical member in the Court of Inquiry is discussed. Few recommendations are made to improve upon the performance of medical member of the investigative team.

Keywords : Aircraft accident investigation, court of inquiry, role of medical member, practical problems

The first documented inquiry dealing with medical and pathological investigation into fatal aircraft accident was recorded in 1926[1]. But importance of medical aspects was established after World War II when Gilson et al, Hass[2] and Teare[3] tried to tabulate and highlight the injuries sustained in aircraft accident. However, it was around 60's when not only the importance of medical member in a court of inquiry was established but was considered essential to help correlating, Human errors and inadequacies, failures machinery coupled with other facets of flying like the Mission and Media[4].

Increase in the number of Human error (Pilot factor) accidents is alarming to IAF which accounts for an average of 20% of total and more than 50% of fatal and catagory (cat)I accidents[5,6]. Air Force can ill afford to lose trained aircrew and very costly combat potential. Hence the importance of a through, systematic and scientific analytical approach to the problem by the medical member in a multi pronged investigative group needs no overemphasis. A protocol with special emphasis on role of medical member in court of inquiry in the light of present policy and practical problems is discussed.

Air Force Order (AFO) 3/86 lays down policy on aircraft accident investigations[7]. It deals right from categorization of aircraft damage, classification of injuries, constitution of the court to the detailed reporting procedures. This AFO came into force with effect from 1st April 86 and superseded all earlier AFOs and policy letters on the subject. AFOs in vogue dealing with aircraft damage/categorization and classification of injuries are given in Table - I.

Table-I Air Force Orders related to classification of aircraft accidents

AFO No	Type of accident	Accident category	Damage of aircraft	Injuries of pilot
2/80	Major	I	Missing/BER	Fatal or serious
		II	30-70% BER	
		III	10-30% BER	
3/80	Minor Incident	IV	10% BER	Nil
		V	No damage	

As per AFO 3/86 medical member may not be detailed, if there is no aeromedical aspect involved or when there are no injuries sustained by the aircrew/occupant. However, inclusion of medical member (Aviation Medicine Specialist) in Cat I accident is mandatory. As is evident from the table, there is no mentioned about injuries in Cat I and II accidents. AFO 3/86 gives detailed of constitution of the court and reporting procedures and administrative aspects of the court of inquiry, mode of travel for the members and members in attendance.

But AFO 3/86 does not mention about submission of form MS-1956. Where as Senior Medical Officer is required to submit this form in fatal/major aircraft accidents in consultation with medical members of the court of inquiry as per instruction vide AFO 666/76, 935/76 and IAP 4305. IAP 4305 guide to medical officers issued in October 1978 obviously refers AFO's of 1976 where in the aircraft damage/categorization and classification of injuries is also different. Hence

the updating of IAP 4305 and accordingly modification of AFO 3/86 may stream line the investigation procedures.

Aims of accident investigation

The concept of accident prevention is to identify the risk factors and eliminate them if possible or reduce them. The scope of inquiries is three folds.

(a) To establish a medical cause of accident :

(i) inadequate human responses to adversaries inside/outside the cockpit both on the ground or in the air,

(ii) sudden emergency prior to accident,

(iii) cause of injuries / fatalities and

(iv) sequence of injuries antemorten/ postmortem and reconstruct the sequence of events.

(b) Evaluate use/abuse of safety equipment/restraint system (life support system) and recommend modifications.

(c) Help in establishing a non-medical cause of accident (Bomb explosion/sabotage)

Role of medical officer : A protocol for investigation

Since the human factors constitute the largest single cause of aircraft accidents, their identification risk factors tend to remain obscure. To bring out the physiological and psychological aspects as cause factors, medical member can contribute maximum through his professional/ technical competence, and impartial approach.

(a) Initial action at the scene of accident :

The medical member should followed the set procedures so as no to miss any aspect of investigation. He should try to get maximum information regarding the accident. Investigation by operation group and engineering group are not included for discussion. But it is pertinent to note that there is lot of overlapping areas of investigations which could be avoided if all members collectively gather information from various sources like station medical setup, squadron medical officer, aircrew, ground crew, mess staff and family members. This information should include the precrash events related to aircrew's personnel, medical, flying aspects.

(b) Interaction with station medical setup and squadron medical officer :

On receipt of emergency call of an aircraft accident, the crash rescue team initiates action. Not going into details, a word of caution at this stage whether we are fully prepared and what is our capability to tackle the situation, particularly in multiple casualties in transport aircraft disaster[8]. There is a need to review our medical/ordnance scales for such a task. Before the medical member arrives on the station, the relevant information regarding the aircraft accident involving pilot/passengers, rescue procedures, collection of the body remains and aeromedical equipments pertaining to life support system have already been taken care of by the medical staff at stations. Hence the medical member of court of inquiry will have to initiate action methodically and sytematically before the wreckage is disturbed i.e.

(i) take down photographic evidence of wreckage,

(ii) make a sketch of crash site/wreckage,

(iii) Retrieval of body parts and record details of injuries and

(iv) assist autopsy with collection of samples for histopathological and biochemical investigation.

Medical Officer in rescue mission at station level plays an important role for furtherance and helps the court of inquiry to come to a positive conclusion. Professional honesty if maintained the scope of investigation is achieved well.

(c) Role of squadron medical officer :

Aircrew are subjected to a lot of psychophysiological stressess in military strategical and operational flying. Medical member has to seek confide their problems. But the a fresh medical graduate as a squadron medical officer who has learnt the art of classic medicine dealing with patients having abnormal physiology or illness, is required to deal with aircrew and his normal adaptation physiology in

abnormal environment. He will take time to make a rapport and be knowledge himself of the operational activities he intends to support. To accomplish this tasks effectively he will have to involve himself in periodic physical examination supporting flight safety, medical indoctrination and act as family physician[9].

(d) Perusal of following documents gives valuable information regarding medical/ psychological factors :

(i) medical documents and sick book,

(ii) pre flight medical check register,

(iii) academy record will show any adverse attitude to flying and deficiencies of aircrew,

(iv) log book/blue books for flying experience total and on on the type,

(v) flying clothing card which reflects the type of flying clothing and maintenance standards and

(vi) personnel habits like drinking, late night or any recent changes in his mood, and behaviour (psychological stress, financial, domestic service/social problems).

As per AFO 3/86 'Inexperience, faulty judgement and flying technique and negligence' are traceable as obvious factors by which the aircrew fail directly. However medical member should help the court in analysing the information available so as to find out the reasons for these pilot factors. Find out if at pupil stage any traits or accident proneness indicated which are know to have higher probability of committing the three associated errors like over-confidence violation of flying discipline and overmotivation[10].

(e) Examination of the wreckage :

In case these have been join already by the medical officer of the station then detail study is required by medical member.

(i) *General Survey* : Assess an overall view and extent of damage.

(ii) *Accident Locations* : Precise location of accident be determined and plotted on the map. Profile of the terrain and elevation may be marked.

(iii) *Photographic evidence* : The wreckages to be photographed before it is disturbed. General view of wreckage from all possible angles especially along the wreckage trail should be done. Following areas may need special coverage :

— aircraft cockpit/instruments,

— ejection seat/safety equipment,

— hand grip controls,

— body parts/remains in relation to wreckage and life support system,

— fire damage and

— gouse marks/damage to building/obstructions/trees.

(iv) Wreckage distribution may be of help in correlation of injuries. A scaled sketch should be made.

(v) Flight data Recorder/Voice Recorder provides informations regardubg parameters like altitude, air speed, vertical accelerations and indicate flight paths and deviation of aircraft heading prior to accident.

(f) Crash dynamics :

Fatal aircraft accident is a manifestation of acceleration forces beyond the human tolerance limit & design strength of the aircraft. The interaction of aircraft and occupant during dynamic phase of crash is a prerequisite in understanding the injuries and mode of death. For this the parameters like impact angle, speed, glide path and forces involved will help in calculating the crash forces.

(g) Assessment of acceleration forces and survivability :

This is an important task for the medical member of the court. In case the forces were within the human tolerance limits in survivable accident but there have been fatalities/injuries

then reason for the same should be found out. The forces encountered in aircraft accident are generally abrupt accelerations of short duration usually less than 1 sec. The mechanical damage during crash, result in death or injuries which are classified as contact, crushing, and decelerative type. In addition there could be injuries due to post crash complication like entrapment in aircraft, fire and drowning. Record of all the injuries in relation to pilot's immediate environment during precrash, dynamic phase of crash in important to reconstruct the sequence of events.

(h) Reconstruction of the sequence of events :

It means rearranging sequence of events from the time of aircraft emergency to its ultimate culmination into accident by integrating all the information gathered from various sources including autopsy/histopathological and biochemical analysis of body remains. At times the histopathological and biochemical analysis of body remains At times, the histopathological evidence may be the only positive clue to the cause of accident.

Problems encountered during investigation

Medical member arrives usually late on the station/scene of accident when the court of inquiry is already in progress, the wreckage has been disturbed, body remains have been retrieved and autopsy has also been conducted. In such a situation medical member needs to be stream lined.

(a) The medical member particularly who attends such an inquiry first time fails to appriciate the limit of text of Aeromedical aspects of the accident to be covered. Perusal of court of inquiry reveals ambiguous or total absence of the vital information in certain aspects.

(b) There is no monitoring or supervision of medical members' performance in the court of inquiries. In experienced medical member without a proper guidance/monitoring is often sidelined in the court of inquiry and his actions are limited to collection of autopsy report, death certificate or statement of medical officer doing preflight medical examination.

(c) There have been cases in the past where information had been superceded adversely. This is inherent limitation of present system of court of inquiry whereas in the true information may not be forth-coming.

(d) MS 1956s is required to submitted by Senior Medical Officers of station but he has not access to the relevant details of court of inquiry proceedings. Hence in majority of cases the information fed is incorrect, incomplete and it is at variance with court of inquiry proceedings. There is also no section in this form for correlation of injuries with aircraft environment.

(e) IAP 4305 gives suggested design and material for collection of body/body parts, collection of samples for biochemical/histopathological examination. These are neither scaled so for, nor any funds have been earmarked. With the results modes of collection/dispatch vary from one station to another. Further, there is also no clear cut authority for medical assistant to take the samples by air to Institute of Aerospace Medicine IAF, if an urgency is felt.

(g) Crash rescue setup at station level needs a review.

Recommendations

(a) Squadron Medical Officer should be aviation medicine specialist or at least should have undergone Primary Aviation Medicine Course before being posted to fighter squadron[11].

(b) The medical setup at flying station should be geared up to date :

(i) Crash rescue procedures - Medical scales for mass casualties.

(ii) Training Medical Assistant not only in first aid measures but also crash

Fig 1. Supplement Form* suggested to be incorporated in Form MS 1956

INJURY CAUSATION ANALYSIS AND CORRELATION CHART

STATE OF BODY AND INJURIES	INTACT	DISINTE GRATED	BURNS	CONTACT INJURY	CRUSHING INJURY	FRACT URES	DISLO CATION	AMPUTA TION	CYTOPATHOLOGICAL INJURIES	SHOCK	DROWNED	ANY OTHER
BODY PARTS												
HEAD												
NECK												
BRAIN												
UPPER LIMBS												
VERTIBRAL COLUMN												
SPINAL CORD												
THORACIC CAGE												
LUNGS												
HEART, AORTA												
DIAPHRAGM												
LIVER												
STOMACH												
SPLEEN												
KIDNEYS												
URINARY BLADDER												
LOWER LIMBS												
ANY OTHER												

1. Helmet
2. Visor
3. Oxygen Mask
4. Harness
5. QRB
6. Self Inflicted
7. Arm Guards
8. Leg Guards
9. Head Restraint
10. Seat Pan
11. Leg Restraint
12. Seat Back
13. Seat Pack
14. Parachute
15. Anti 'G' Suit Connector
16. Throttle Quadrant (Item carried loose)
17. Canopy Handle
18. Oxygen Regulator
19. L.H. and R.H. Consoles
20. Front Panel
21. Rudder Pedals
22. Rudder Pedestal
23. Cockpit Floor
24. Under Structure of Instrument Panel
25. Bulk Head
26. Engine
27. Control Column
28. Canopy Jettisoning Handle
29. Canopy Structure
30. Wind Shield
31. Cabin Window
32. Cabin Locking System
33. Side/Front/Rear Seat
34. Other Pilot/Passenger
35. Cabin Content/Baggage
36. Door Structure
37. Cabin Fuselage
38. Overhead Structure
39. Diagonal Brace Tubing
40. Fire Extinguisher
41. Map Case/ Writing Material
42. Any Test Equipment
43. Survival Equipment
44. Outside Object
45. Special Clothing
46. Aircraft Engine Propeller
47. Aircraft Wing
48. Tail Section
49. Nose Wheel
50. Stretchers
51. First Aid Box
52. Fire in Air
53. Fire After Crash
54. Water (Sea/Pond/River)
55. Jungle (Bushes or Tree)
56. CO Poisoning
57. Toxic Agent
58. Sabotage
59. Any Other

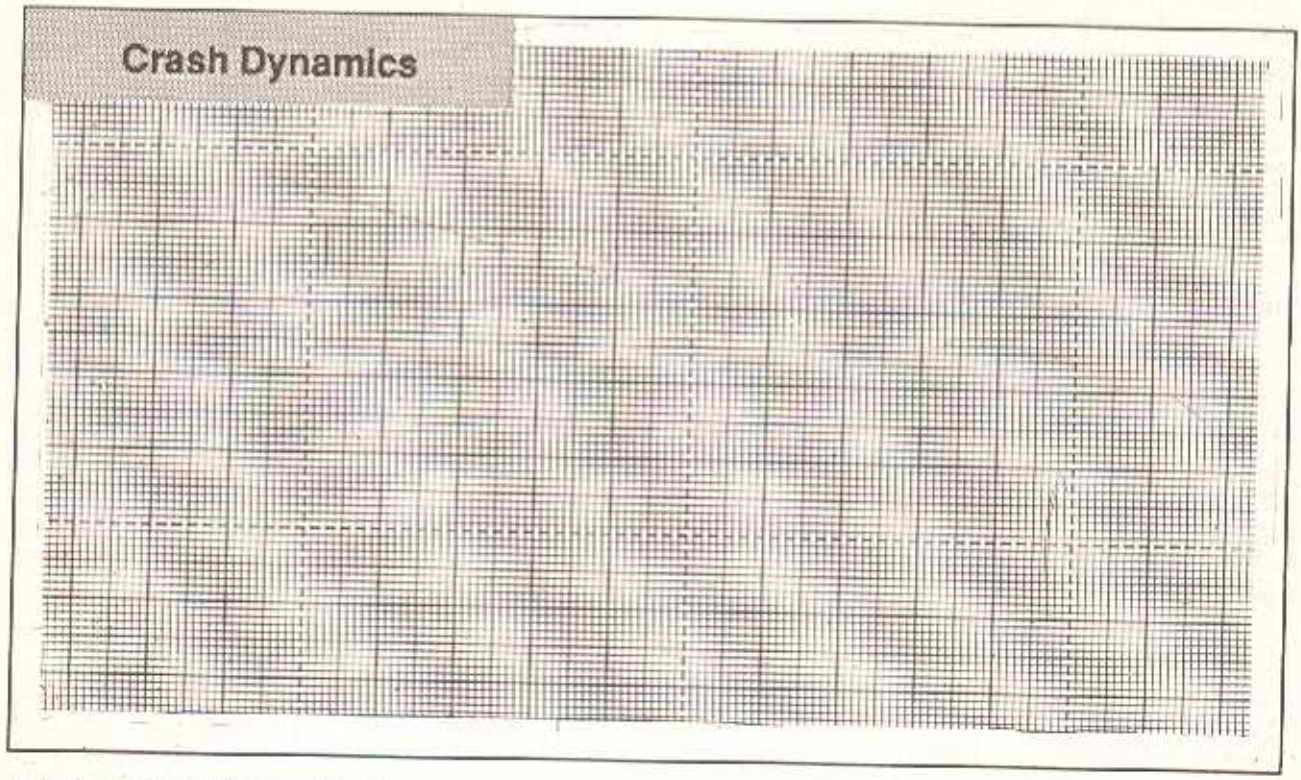
Indicate factors/cause of injury (numbers only) from the list given and mark in the appropriate boxes according to the type of injury on the body.

* Use one form for each occupant. Crash Dynamics should be entered on the reverse of this form with brief narrative of the accident.

Fig 1 (Contd)

Reverse of Supplement Form* suggested to be incorporated in Form MS 1956

INJURY CAUSATION ANALYSIS AND CORRELATION CHART



Brief narrative of the accident :

rescue procedures and casualty evacuation.

(iii) Improve serviceability state of ambulance.

(c) Scale the items for collection of body remains/ collection of samples. Issue authority for expenditure under specific code head rather than leaving to adhoc basis. Authorise move of medical assistant as per other members.

(d) Medical officer must be detailed as a member of the team enquiring the causes of all categories of aircraft accidents. For fatal aircraft accidents, Aviation Medicine Specialist should be detailed. However, for major accidents (non-fatal) and ejections Trainee Medical Officer in Aviation Medicine or Medical Officer undergone Primary Aviation Medicine course can also be detailed.

(e) On job training for aviation medicine specialists :

(i) Authorise the Trainee Medical Officer (Final phase of Aviation Medicine) to be co-opted member, among with senior medical member.

(ii) Perusal of court of inquiry proceedings by guide/senior Advisor in the zone monitor/guide the medical officer for his conduct in court of inquiry and improvement of his performance.

(iii) Familiarise the trainee medical officers with recent policies and various documents/forms to be submitted.

(iv) Circulation of relevant information of aeromedical interest to all medical officers by senior Advisor or publish in flight safety journal.

(f) AFO 3/86 may be amended to incorporate the relevant sections, and accordingly IAP 4305 may also be updated.

(g) MS 1956 should be submitted by medical member rather than senior medical officer and injury causation, analysis and correlation chart may be introduced (refer figure).

(h) Two types of court of inquiry are suggested as is in vogue in USAF i.e. one set of proceedings are meant for write off/strike off action for the Govrnment Certain information regarding modifications are not part of this proceedings. Second set should not have any legal binding on the witness and hence a true information should be forth-coming. The proceedings should suggest the modifications/remedial measures based on actual findings.

REFERENCES

1. Steven PJ : Fatal civil aircraft accident investigation. Their medical and pathological investigation 1925.

2. HASS GM : Relations between force, major injuries and aircraft. Suggestions for safety in design of aircraft. J Aviat Med 1945;15;395-400

3. Teare AF : Postmortem Examination on aircraft victims. Brit Med J 1951;230:551-560

4. Zeller AF : "Human aspects of midair collision prevention. J Aviat Med 1951;230:551-560

5. Deshmukh WN : Survey of Mig series aircraft accident (1970-72). 1983; Flight Safety Directorate, New Delhi.

6. Flight Safety Problems Mig 21 Variants (1987). A report 1987 New Delhi, Inst Flt Safety (IFS/5259/3/R & A)

7. AFO 100/72, 44/74, 666/76, 935/76, 266/77, 2/80 and 3/86.

8. Kart-Wilhelm Weden : Basics of Surgical handling in a disaster and mass casualties situation. Medical Corps International 1986;1:5-11

9. John W Ord : Aerospace Medicine In United States AF. In:Fundamentals of Aerospace Medicines. Edited by RL De Hart. Philadelphia Lea & Fabiger 1985.

10. Sanders MG, Huffman MA : Personality aspects of Involvement in Pilot Error accidents. Aviat Space Environ Med 1975; 46 : 186-190

11. Royce Moser Jn, Jeffersons C Davis, Richard D Hansan : Unique facets of the Speciality of Aerospace Medicine Aerospace Med 1974;45:1281-1285

12. Aircraft Accident Investigation and Prevention. A guide to the Medical Officers (IAP 4305). New Delhi, Dte of Medical Services, Air Headquarters, 1987.