Air Medical Helicopter Accidents in the United States:

A Five-year Review

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Abstract

Objective. To determine the number of air medical helicopter accidents in the United States during a five-year period beginning January 1, 1997, and ending December 31, 2001. **Methods**. The National Transportation Safety Board's (NTSB's) Accident Synopses database was accessed to determine the number of accidents involving air medical helicopters during the five-year study period. The NTSB reports for each accident were downloaded. **Results**. The NTSB records revealed 47 accident files pertaining to air medical helicopters during the five-year study period. These were analyzed for: date of accident, time of accident, air ambulance operator, location of accident, type of aircraft, number of persons, number of fatalities, number of injuries, cause of accident, and other factors the NTSB investigators deemed appropriate. Of the 47 accidents, there were 40 fatalities and 36 injuries. Overall, there were 13 helicopter types involved. The majority of accidents (70%) were attributed to pilot error. The number of accidents increased from a low of 4 in 1997 to a maximum of 12 in both 2000 and 2001. **Conclusions**. This study has examined 47 U.S. air medical helicopter accidents for a five-year period (1997–2001). There was an increase in the number of accidents during the study period. However, this study is limited by the fact that it presents only raw data and does not reflect the actual incidence of accidents per hours flown. Various factors related to these accidents have been described. These factors should be considered when strategies to improve air medical helicopter safety are developed. **Key words**: emergency medical services; ambulances; air ambulances; accidents, aviation.

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Air medical helicopters are now widely used in emergency medical services (EMS) in the United States. There has been a proliferation in both helicopter ambulances and helicopter ambulance operations over the last decade.[1] With this proliferation of helicopter ambulances, there has been a seeming increase in the number of air medical helicopter accidents. The goal of this investigation was to determine whether any gross trends in air medical helicopter accidents were available from assessment of raw data with univariate, descriptive analysis.

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Methods

All significant aircraft accidents in the United States and several other countries are investigated by the National Transportation Safety Board (NTSB). The NTSB is an independent federal agency that investigates every civil aviation accident in the United States and significant accidents in the other modes of transportation, conducts special investigations and safety studies, and issues safety recommendations to prevent future accidents. Following these investigations, the NTSB issues a preliminary report within a few days of the accident. When all factual information has been gathered, the preliminary report is replaced with a final description of the accident and its probable cause.

Using the database query function, we downloaded every NTSB accident report for a five-year period beginning January 1, 1997, and ending December 31, 2001, involving air medical helicopter accidents. Data from fixed-wing ambulances and military aircraft ambulances were excluded.[2]

Results

Search of the NTSB database revealed files on 47 accidents involving air medical helicopters in the United States from January 1, 1997, to December 31, 2001. Of these, 39 (83%) were final reports. Data extracted from these files included: date of accident, time of accident, air ambulance operator, location of accident, type of aircraft involved, total number of persons involved

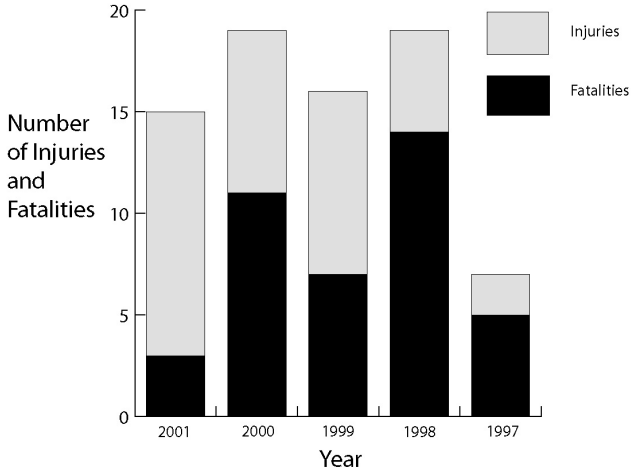

Figure 1. Numbers of injuries and fatalities by year.

TABLE 1. Summary of Air Medical Helicopter Accidents (1997–2001)

Date	Time	Operator	Location	Aircraft	Persons*	Fatalities	Injuries†	Cause	Comments
11/14/01	0030	Bannock Medical Center	Lone Pine, ID	Eurocopter BO-105LS	1		1	Pilot error	Spatial disorientation
11/09/01	1445	Life Flight	Ogden UT	Agusta A119	3		3	Undetermined	Maintenance discrepancies
10/22/01	2006	Enloe Medical Center	Chico, CA	Eurocopter 350BA	3	1	1	Pilot error	Vision loss due to dust
10/07/01	2250	Scott & White Hospital	Rosebud, TX	Eurocopter 355F1	3		2	Pilot error	Couldn't locate accident and ran out of fuel
08/18/01	1432	Rocky Mountain Helicopters	Reno, NV	Eurocopter 355F1	4			Pilot error	Visual loss due to dust
07/20/01	1603	North Texas Lifestar	Decatur, TX	Eurocopter BK-117C1	3		3	Pilot error	Pilot failed to turn on fuel transfer pumps
06/03/01	1620	Smokey Mountain Helicopters	Hanapepe, HI	MD 369D	4			Undetermined	Lost engine power
05/05/01	1700	Mercy Flights	Medford, OR	Eurocopter BO-105C	4			Undetermined	Lost engine, caught fire
04/06/01	1715	Corporate Jets	Alcova, WY	Bell 222-UT	3			Pilot error	Tail rotor struck barrel during take-off
03/23/01	1520	EMS Air Service	Seneca Falls, NY	Bell 206-L1	2		2	Mechanical failure	Lost tail rotor thrust
02/28/01	1024	Care Flight	Grand Junction, CO	Bell 412-SP	1	1		Pilot error	Post-maintenance check flight
01/22/01	0005	Air Evac EMS	Quincy, IL	Bell 206-L1	2	1		Security guard	Security guard walked into tail rotor
12/22/00	0331	Critical Air Medical	Wilcox, AZ	Bell 206-L3	3		3	Pilot iIncapacitation	Pilot drank "bad tea" and collapsed onto cyclic
11/13/00	2048	Flight for Life	Parumph, NV	Eurocopter BO-105S	3			Undetermined	Skids struck at accident site and rolled over
10/16/00	2355	Duke University	Burlington, NC	Eurocopter 355F2	1	1		Mechanical failure	Lost gearbox oil pressure
10/14/00	1227	Classic Aeromedical	Grand Canyon, AZ	Bell 206-L1	4		4	Pilot error	Forced landing impacting trees
07/28/00	1140	Air Methods Corp.	St. Paul, MN	Bell 222-U	1			Pilot error	Struck light fixture on take-off
07/24/00	0230	Critical Care Medflight	Sumner, GA	Eurocopter350B	3	3		Pilot error	Pilot experienced spatial disorientation
07/16/00	0140	Omniflight Helicopters	Allen, TX	Eurocopter BK-117A3	3			Pilot error	Pilot failed to maintain obstacle clearence
05/06/00	2335	University Hospital	Cincinnati, OH	Eurocopter BK-117-A4	1		1	Pilot error	Crashed on hospital roof top heliport
04/25/00	1216	BayFlite	St. Petersburg, FL	Eurocopter BK-117-A3	3	3		Pilot error	Struck radio tower
04/14/00	1612	Life Link III	St. Paul, MN	Bell 222-U	2			Mechanical failure	Loss of flight control systems; struck warehouse
03/10/00	0605	Northwest Texas Hospital	Dalhart, TX	Eurocopter MB105S	4	4		Pilot error	Flew into bad weather
02/26/00	0216	University Health System	Karns, TN	Bell 412	3			Pilot error	Tail rotor struck tree
11/17/99	1350	Mercy Flight/MedFlight	Neihart, MT	Bell 206L1	4			Pilot error	Struck tower during takeoff
09/10/99	0314	First Flight	Kehansville, FL	Eurocopter BO105-CBS	3		3	Pilot error	Struck trees landing at car accident scene
08/10/99	1138	Life Beat Air Medical	Cape Girardeau, MO	Bell 206-L	1			Pilot error	Crashed due to failure to disconnected power cord
07/17/99	1231	LifeFlight	Fresno, TX	Eurocopter BK-117-B2	3	3		Mechanical failure	Main rotor blades separated
06/14/99	2208	University of Kentucky	Jackson, KY	Sikorsky S-76A	4	4		Pilot error	Night with poor visibility
05/15/99	2122	Lifeline	Rockton, IL	Bell 222-UT	3			Pilot error	Hard night landing with substantial damage
04/11/99	1645	BayFlite	Sarasota, FL	Eurocopter BK-117 A-3	3			Pilot error	Tail rotor struck building
04/03/99	2350	Metro Aviation Inc.	Indian Springs, NV	Eurocopter BO105-CBS	3		3	Pilot error	Crashed in bad weather
02/13/99	1645	LifeFlight	Hockley, TX	Eurocopter BK-117-B1	5			Pilot error	Struck power lines leaving accident scene
02/12/99	1720	St. Vincent's Hospital	Toledo, OH	Eurocopter 355	3		3	Pilot error	Crashed during aborted interhospital transfer
12/13/98	1745	Shannon Medical Center	San Angelo, TX	Eurocopter 350-BA	2			Undetermined	Crashed during new pilot instruction
11/29/98	1456	LifeFlight	Idaho City, ID	MD-900	4			Pilot error	Struck power lines on ascent from scene

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TABLE 1. (*continued*)

Date	Time	Operator	Location	Aircraft	Persons*	Fatalities	Injuries†	Cause	Comments
08/28/98	1053	Topeka Lifestar	Topeka, KS	Eurocopter BK-117	3			Pilot error	Pilot failed to secure cowling, resulting in crash
08/20/98	2114	Intensive Air	Spencer, IA	Bell 222	3	3		Mechanical failure	Aircraft broke up in flight
07/29/98	2248	SkyLife	Tranquility, CA	Bell 222B	3			Pilot error	Flew into dust; landed hard, destroying aircraft
06/05/98	0549	Valley Air Care	La Gloria, TX	Eurocopter 350-BA	3	3		Pilot error	Spatial disorientation
05/24/98	1235	Air Evac EMS	Springdale, AR	Bell 206-L3	3		3	Mechanical failure	Crashed on ascent from hospital
03/23/98	0740	Los Angeles Fire Department	Los Angeles, CA	Bell 205 A-1	6	4	2	Mechanical failure	Tail rotor seperated
01/11/98	2250	University Hospital	Sandy, UT	Bell 222-UT	4	4		Pilot error	Flew into blizzard
12/14/97	2200	Columbia AirLife	Littleton, CO	Bell 407	4	4		Pilot error	Struck power lines leaving accident scene
04/30/97	1810	Geisinger Medical Center	Kane, PA	Eurocopter BK-117-A1	4			Pilot error	Crashed on descent to helipad
03/14/97	0145	Acadian Ambulance	Lena, LA	Eurocopter BO-105S	2	1	1	Pilot error	Spatial disorientation
03/05/97	1215	Washington County Hospital	Washington, PA	Eurocopter 355F	1		1	Mechanical failure	Crashed during repositioning

*All persons involved, including pilots, crew, patients, and passengers.
†All injuries requiring medical evaluation.

(including pilots, crew, and passengers), total number of fatalities, total number of injuries (any injuries requiring medical evaluation or care), cause of accident (if determined), and other factors the NTSB investigators deemed appropriate (Table 1). Of these 47 accidents, there were 138 persons (pilots/crew/patients) involved. Over the five-year study period, there were 40 fatalities and 36 injuries reported (Fig. 1). A total of 16 (34%) accidents resulted in non-fatal injuries and 15 (32%) accidents resulted in fatalities. Only 3 (6%) accidents resulted in a combination of fatalities and non-fatal injuries. The incidence of fatalities was 0.85 fatalities per accident, while the incidence of non-fatal injuries was 0.77 non-fatal injuries per accident. There were 13 types of helicopters involved in the reported accidents (Table 2). Of these, 32 (68%) accidents involved twin-engine helicopters, while 15 (32%) involved single-engine helicopters. The number of accidents per helicopter type was also analyzed. The most accidents (19%) were reported in the Eurocopter BK-117 model (Fig. 2). In analysis of accident causes, the majority of accidents in the study group were attributed to pilot error (70%) (Fig. 3). When analyzed by year, there has been an increase in the number of accidents with a maximum total of 12 accidents each in 2000 and in 2001 (Fig. 4). There were 25 accidents (53%) during daytime hours (0700–1800 hours) and 22 accidents (47%) during nighttime hours (1900–0600 hours) (Fig. 5).

DISCUSSION

Helicopter ambulance safety has always been a concern of the EMS and medical community. In 1986, 14 major EMS helicopter accidents occurred, destroying or substantially damaging 9% of the air medical helicopter fleet.[3] Because of this, the NTSB undertook a safety study of helicopter air operations and found that helicopter ambulances had an accident rate almost twice that of non-scheduled air taxi helicopters and a fatal accident rate 3.5 times greater. They concluded that unexpected encountering of poor weather conditions posed the greatest single hazard to EMS helicopter operations.[4,5] After publication of the NTSB study, an improvement in the helicopter ambulance accident rates occurred.[6] In our five-year study period, we found a steady increase in the number of accidents involving helicopter ambulances. These numbers would be more meaningful if we were able to determine the total numbers of helicopter operations, helicopters in service, helicopter transports, and flight hours during the study period, thus providing an incidence of accidents per hour of flight and similar data. However, a national database of air medical helicopter operations is not available. In addition, this project is limited by the inability to control for Instrument Flight Rules (IFR) versus Visual Flight

Table 2. Helicopter Specifications by Model

Type	Model	Engine(s)	Pilot(s)
Agusta	119	1	1
Bell	205	1	1
Bell	206	1	1
Bell	222	2	1
Bell	407	1	1
Bell	412	2	1
Eurocopter	105	2	1
Eurocopter	117	2	1
Eurocopter	350	1	1
Eurocopter	355	2	1
McDonnell	369	1	1
McDonnell	900	2	1
Sikorsky	76	2	1

Rules (VFR) operational capability, single-engine versus multi-engine airframe, and overall air medical flight volume.

The helicopter type involved in the most accidents during the study period was the Eurocopter BK-117 (formerly MBB-BK-117). However, because of its cost and utility, the Eurocopter BK-117 is among the most frequently used aircraft types in U.S. air medical operations. Thus, the high number of accidents involving this helicopter type may be simply related to increased usage compared with other helicopter types. Regardless, the Federal Aviation Administration (FAA) issued an Emergency Airworthiness Directive for the Eurocopter BK-117 on August 6, 1999, related to main rotor blade separation that had resulted in three fatalities.[7] The majority of accidents (70%) in the study group were attributed to pilot error, with mechanical failure accounting for only 17% of the accidents. Eleven percent of the reported accidents remain undetermined or remain under investigation. One accident (2%) was due to a hospital security guard's walking into a tail rotor while the helicopter was operating.

Additional prospective studies are warranted to further determine the safety of air medical helicopter operations. Ideally, these would be multicenter, industry-based studies with operational and accident data reported to a centralized clearinghouse or database.

Conclusion

The number of air medical helicopter accidents has increased from 4 in 1997 to 12 each in 2000 and 2001. The number of accidents occurred similarly during daylight and night hours in the study group. The majority of air medical helicopter accidents during the study period were attributable to pilot error. The helicopter type most involved in air medical helicopter accidents was the Eurocopter BK-117, followed by the Bell 206, Bell 222, and Eurocopter 105 models. Various factors related to these accidents have been described. Additional safety measures, such as on-board weather radar, mandatory IFR avionics, and exclusive use of

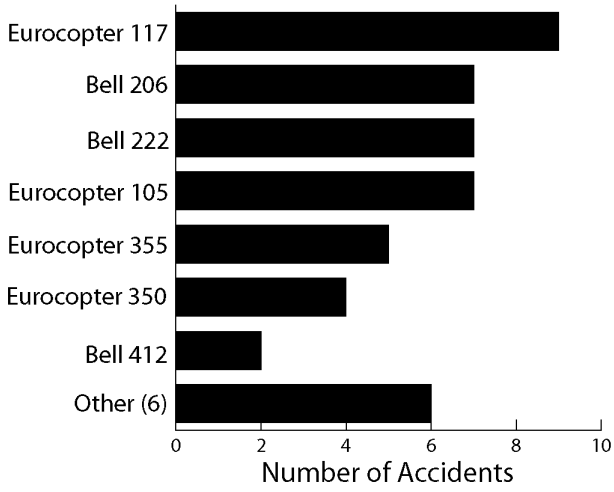

Figure 2. Number of accidents by helicopter type.

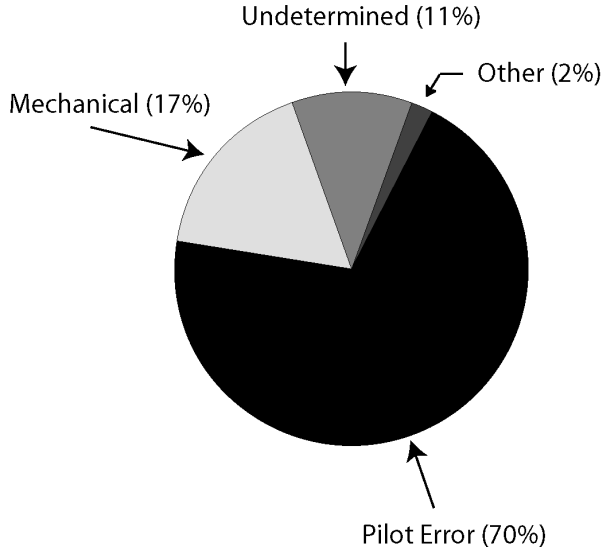

Figure 3. Causes of aeromedical helicopter accidents.

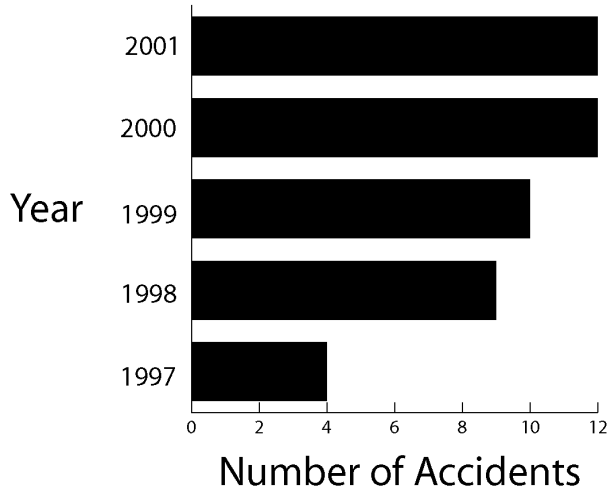

Figure 4. Number of aeromedical helicopter accidents by year.

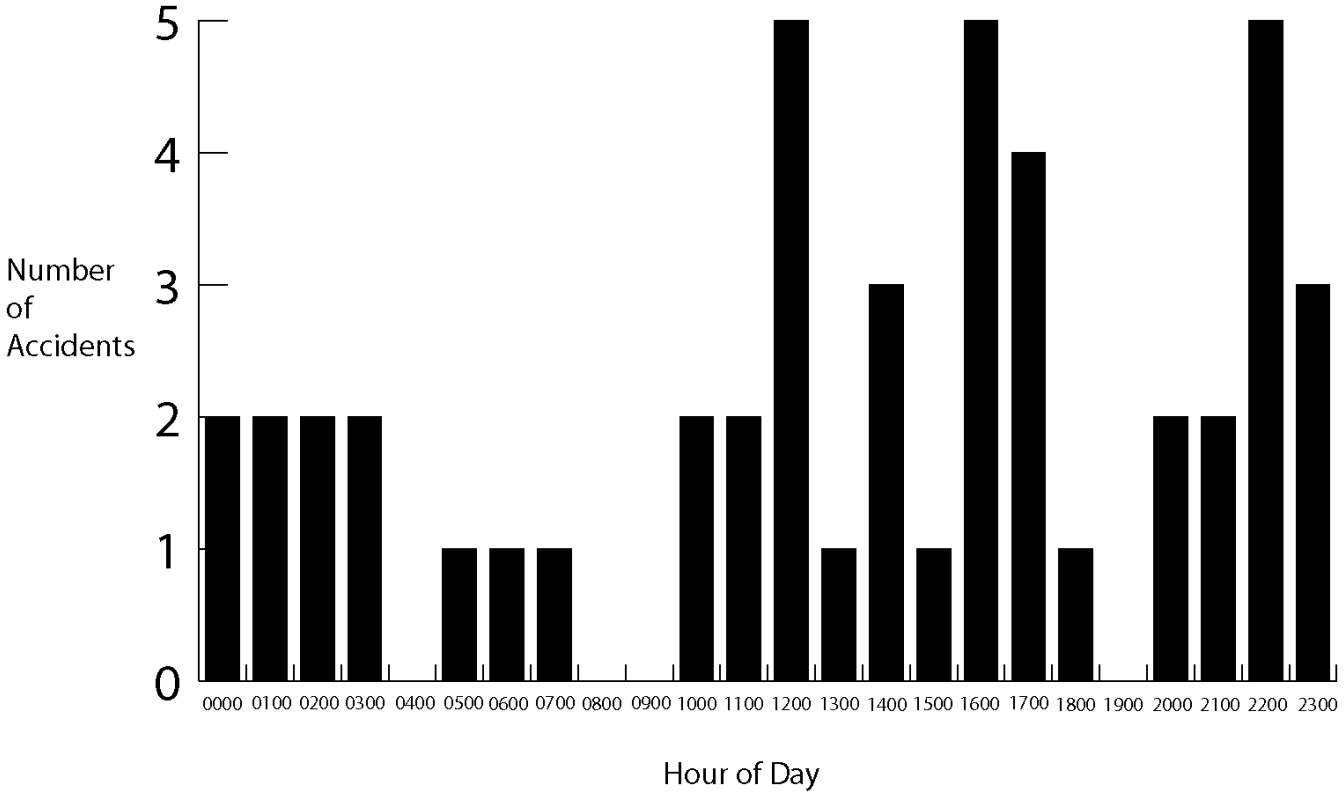

FIGURE 5. Helicopter accidents by hour of day.

IFR-proficient pilots, may decrease the number of accidents attributable to pilot error.[8] These factors should be considered when strategies to improve air medical helicopter safety are developed.

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