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Do the right children have necropsies?

Analysis of selected determinants

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Munan, L., Kelly, A., and Côté, R. (1975). *Archives of Disease in Childhood*, **50**, 620. **Do the right children have necropsies? Analysis of selected determinants.** An analysis of the frequency of post-mortem examinations was conducted in the paediatric age group. Among the factors found to influence necropsy rates were (i) age at death, the frequency of necropsy decreasing with age; (ii) cause of death, necropsy frequency varying with major diagnostic groups; (iii) investigation conducted before death, necropsy frequency decreasing when the clinical picture was ill-defined; and (iv) place of death, necropsy being less frequent when death occurred outside hospital. These findings imply (a) that necropsy practices may be governed by habit and convenience as well as by desire to complete the clinical picture, and (b) that more equitable balances in such practices should be sought if there is to be improvement in the quality of mortality data.

In epidemiological studies based upon a sizeable body of mortality data, the frequency with which necropsy examinations are carried out is known to influence the specificity and reliability of these data so that studies into the cause of death are hampered by the low necropsy rate and are only partially helped by interviews with parents and attending physicians.

During a multicentre study (PAHO/WHO, 1973) whose aim was to define underlying and associated causes of death in children under 5 years of age, it was decided to conduct a detailed analysis into factors influencing necropsy practices in the paediatric age group in the Sherbrooke area of Quebec.

Data collection, review, and analysis

All deaths under 5 years of age were included in the study, there being a total of 371 such deaths in a census population of just over half a million during a consecutive 24-month period beginning 1 January 1970. Data were collected from death certificates, hospital records, including necropsy reports whenever available, and family interviews using standardized questionnaires. A group consisting of a paediatrician, a pathologist, an obstetrician, and epidemiologists assigned the cause of death after re-examination of all available information (some of which may not have been available to the physician who signed the death certificate). For analysis deaths were classified into three age groups, into groups of those having necropsy and those with no necropsy, and into broad categories of causes of death using the WHO International Classification of Disease (WHO, 1967). Categories with low expected frequencies of deaths were eliminated so that diagnostic classifications with as similar aetiologies as possible were grouped to give in each class a minimum number of deaths suitable for statistical analysis.

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Results

Of the 371 infant and child deaths in the study population of the Sherbrooke area, 52% had a necropsy conducted during a 2-year period with hardly any variation between the first and second year of the investigation (Table I). Comparison of Sherbrooke with 14 other regions of the world participating in the study (Fig.) showed that San Francisco had a higher necropsy rate (82%), while Kingston, Jamaica, had the next lower rate (36%), and La Paz, Bolivia, the lowest (2%).

Necropsies by cause of death and by age. Cause of death was analysed for the neonatal and postneonatal periods and for ages 1–4 years (Table II).

In 132 (58%) of the 229 neonatal deaths a necropsy

TABLE I

371 deaths with and without necropsy by type of necropsy

Type of necropsy	Number (%)	
Hospital		
Complete	176	(47·4)
Incomplete	11	(3·0)
Medicolegal		
Complete	1	(0·3)
Incomplete	4	(1·1)
Type unknown	2	(0·5)
Total with necropsy	194	(52·3)
Total with no necropsy	177	(47·7)

was conducted. Death in 24% of those having a necropsy was due to maternal and obstetric conditions, in 19% to congenital anomalies, and in 7% to anoxia and prematurity. These same conditions were also the most frequent causes of death in neonates not having a necropsy, though the percentage distributions differ (Table II). After grouping certain categories of cause of death, χ^2 analysis of the frequency of cases with necropsy and without necropsy showed that the two distributions were significantly different ($\chi^2_4 = 9{\cdot}88$, $P < 0{\cdot}05$). It thus appears that the decision to conduct a necropsy and the cause of death were inter-related.

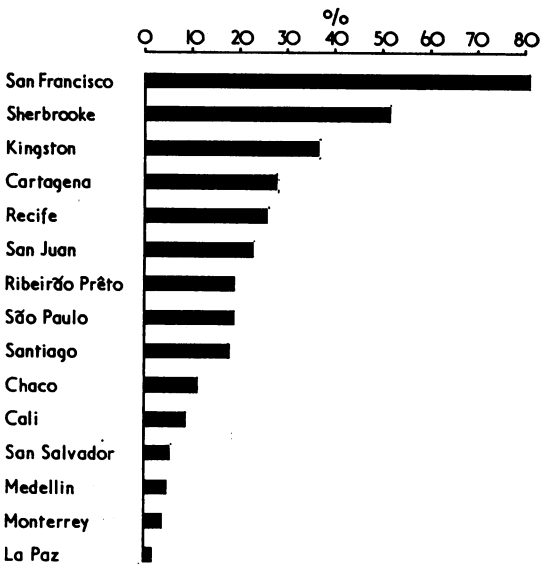

FIG.—*Percentage of deaths with necropsies in children under 5 years in 15 study areas of the Americas.*

In the postneonatal period the necropsy rate was

TABLE II

Deaths with and without necropsy in neonatal, postneonatal, and early childhood periods

Cause of death*	Deaths		With necropsy		Without necropsy	
	No.	%	No.	%	Nc.	%
(1) Neonatal						
Total deaths (<28 d)	229	100	132	58	97	42
Perinatal						
Maternal & obstetrical 760–773	101	44	54	24	47	21
Anoxia & prematurity 776–777	36	16	15	7	21	9
Haemolytic & haemorrhagic 744–775, 778	15	7	12	5	3	1
Congenital anomalies 740–759	65	28	43	19	22	10
Other 000–136; 140–577; 800–999	12	5	8	3	4	2
(2) Postneonatal						
Total deaths (28 d–1 yr)	81	100	40	49	41	51
Congenital anomalies 740–759	33	41	15	19	18	22
Infections 000–136	3	4	2	3	1	1
Neoplasms140–239	1	1	1	1	0	-
Metabolic & nervous system 240–389	5	6	4	5	1	1
Circulatory & respiratory 390–519	22	27	13	16	9	11
Other than above 520–739	3	4	2	3	1	1
Ill-defined conditions 780–799	6	7	1	1	5	6
External causes 800–999	8	10	2	3	6	7
(3) Early childhood						
Total deaths (1–4 yr)	61	100	22	36	39	64
Congenital anomalies 740–759	7	12	2	3	5	8
Infections 000–136	3	5	2	3	1	2
Neoplasms 140–239	10	16	8	13	2	3
Metabolic & nervous system 240–389	6	10	4	7	2	3
Circulatory & respiratory 390–519	6	10	3	5	3	5
Digestive system 520–577	1	2	1	2	0	-
External causes 800–999	28	46	2	3	26	43

*Numbers refer to disease categories of the International Classification of Diseases (WHO, 1967).

49% and lower than in neonates. Among the 40% having a necropsy about 19% of deaths were due to congenital anomalies and 16% were attributed to disease of the circulatory and respiratory systems. Again, these types of deaths are among the highest not having a necropsy, but the difference in frequencies of deaths with and without necropsy proved not to be significant when cause of death was divided into four major diagnostic groups ($\chi^2_3 = 2{\cdot}05$). The unspecified category (ill-defined conditions, Table II) includes sudden unexpected deaths as well as causes assigned on symptomatology alone. The low percentage (1%) of deaths with necropsy in the unspecified category as compared to 6% without necropsy in the same category suggests that postneonatal deaths are often assigned to this cause because of lack of precise post-mortem evidence.

The necropsy rate in children of 1–4 years was 36%, the lowest in the three age groups analysed (Table II). When subdivided into those with and without a necropsy the frequencies produced a significant difference ($\chi^2_3 = 23{\cdot}55$, $P < 0{\cdot}001$), which again supports an association between cause of death and necropsy patterns.

It should be noted that the χ^2 test has been used for interpreting the pattern of differences in necropsy percentages rather than for statistical hypothesis testing. For the latter, the requirement of independence of observation in diagnosis and in necropsy has not been met because the final diagnosis was often made only after the necropsy findings became known.

In summary, it appears that there is an inverse relation between necropsy frequency and age of death in the three age groups, in that the older the child the lower the necropsy rate. This varies from 58% in neonatal and 49% in postneonatal infants to 36% in children between 1 and 4 years of age. It also appears that the decision to conduct a necropsy is related to the cause of death.

Analysis of the need for necropsy. The data support the following relation between the need for necropsy data and necropsy practices, namely, that the greater the amount of diagnostic investigation done before death the greater is the likelihood that a necropsy will be conducted. In Table III the basis for assigning the cause of death and the need for necropsy (judged after the event) is given for all deaths.

Necropsies were conducted in 61% of cases where, in the opinion of the group who assigned the final diagnosis, the clinical record alone would have been adequate for assigning a principal cause of death. These include (i) 161 necropsied cases where necropsy confirmed the clinical diagnosis or where necropsy findings were less specific than the clinical ones, and (ii) 103 cases without necropsy but with a well-defined clinical picture. On the other hand, where necropsy would have been essential for assigning cause of death with reasonable precision, the necropsy rate was only 29%. These include (i) 31 deaths where post-mortem diagnosis was more specific than the clinical one or where the only information available was the necropsy with or

TABLE III

Need for necropsy and basis for diagnosis

	Total deaths	With necropsy		Without necropsy
		No.	%	No.
Total	371	192*	52	179
Necropsy unnecessary (after the fact)	264	161	61	103
Necropsy				
Confirms clinical diagnosis		146		
Less specific than clinical diagnosis		15		
No necropsy				
Well-defined clinical diagnosis				103
Necropsy necessary (after the fact)	107	31	29	76
Necropsy				
More specific than clinical diagnosis		20		
Plus home interview only		8		
Only		3		
No necropsy				
Ill-defined clinical diagnosis				59
Home interview only				15
Death certificate only				2

*Two deaths with necropsy transferred to no necropsy category because necropsy record was not available.

without a home interview, and (ii) 76 deaths without necropsy where the clinical picture was ill-defined or where no clinical information was available at all. The association between need for necropsy data and necropsy practices was tested by the χ^2 test ($\chi^2_1 = 30{\cdot}0$; $P < 0{\cdot}001$), indicating a significant inverse relation.

This inverse relation between need for necropsy data and necropsy practice is further shown in Table IV. The lowest necropsy percentages are for deaths occurring either at home, where more data are needed to determine underlying and associated causes of death, or in public places (mostly road deaths). Necropsy rates, on the other hand, are highest in children who have been 48 hours or more in hospital where data recording is extensive, again supporting the view that deaths in children who are well investigated clinically are more likely to have a necropsy. The data in Table IV show that the association between place of death and decision to conduct a necropsy is significant $\chi^2_3 = 21{\cdot}7$, $P < 0{\cdot}001$).

TABLE IV

Deaths with necropsy, by place of death

Place of death	Deaths	With necropsy	
		No.	%
Total	371	194	52·3
Public place	15	2	13·3
Home	48	15	31·3
Hospital			
<48 h	200	111	55·5
>48 h	108	66	61·1

Discussion

One of the main findings of the present study is the relatively high necropsy frequency for certain causes of death, indicating that it would be desirable to conduct fewer necropsies when cause of death is already known and more when the clinical picture is incomplete or absent. Though based upon necropsy practices in the paediatric age group, this view can be more generally applied because of the current practice of conducting large-scale aetiologically-directed and computer-based epidemiological studies which frequently rely on mortality data for their conclusions. Recommending readjustment of this imbalance may be in conflict with the precept in pathology that states that one aim of the necropsy is to trace the development of morbid processes. Therefore, although cause of death is sufficiently clear clinically, it is of pathogenetic intestest. There are, then, at least two recognizable aims for conducting a necropsy, and they are not mutually exclusive. We claim that for the purposes of population studies based upon the death record the present practice appears to be unfavourable and requires that more necropsies be conducted on deaths where the medical record is incomplete. The debate on the usefulness of routine necropsy has had many exponents over the years (McManus, 1965; Angrist, 1966; Prutting, 1972), and good reasons have been advanced for and against (Starr, 1956; King, 1965; Powell, 1972; Robertson, 1972). Rational objections are usually based upon the best use of medical manpower. There is still no argument against, or substition for, high necropsy rates of good quality to produce valid mortality data for statistical processing.

In some large-scale descriptive studies, attempts have been made to improve the quality of data by including only those cases having a necropsy. While this might have merit in some instances (Naeye, 1972), the data presented here indicate that a serious source of bias might thereby be introduced into studies of multiple causes of death involving populations at different times and places.

The study of Valdes-Dapena and Arey (1970) illustrates the pitfalls of relying solely on necropsies when generalizing on total mortality. The authors compared cause of neonatal death in nearly 500 consecutive necropsies over a 7-year period in a university hospital centre in Philadelphia with an equal number of death certificates issued during the last year of the study in that city. In deaths derived from certificates the necropsy rate was 47%, while in 29% of them there was no notation of a post-mortem examination. The wide discrepancy in distribution of cause of death was not surprising, since they were comparing hospital cases having a necropsy with cases from the city with and without necropsy and unknown cases. Immaturity as a cause of death, for example, appeared on 62% of death certificates (with and without necropsy) as compared with 9% in the consecutive necropsy series, whereas hyaline membrane disease appeared on 17% and 35%, respectively. These differences are due to bias in selection as well as to the almost universal practice of analysing cause of death without considering associated causes.

Other descriptive studies support the view that post-mortem examinations can correct and corroborate clinical diagnoses, and that population mortality patterns, based only on available post-mortems, are biased (Wilson, 1966; Willis, 1967). In contrast to descriptive studies, aetiological in-

vestigations on necropsy samples are safeguarded against such bias through case-control (Leviton and Gilles, 1973) and other study designs.

When examining such necropsy-related factors as whether the death occurred in hospital or outside and whether cause of death is among the major contributors to mortality, it appears that necropsies are requested more for convenience, or from habit, or because of a clinician's interest in a particular clinical syndrome than in an effort to define cause of death. This view is partly supported by examination of the data on paediatric necropsy practices in other areas participating in this study (PAHO/WHO), 1973), where necropsy frequency is usually higher in the city than in contiguous areas and is assumed to be related to urban/rural differences in the distribution of health resources. In some areas of the world there seems to be no valid reason for not achieving a 100% necropsy rate, especially in the paediatric age group, though obtaining consent might be an obstacle. The law, however, already provides for the possibility of necropsy without consent when necropsy seems mandatory: in deaths taking place outside hospital (or soon after admission), which often fall between medicolegal and clinical interests with the result that no one exercises the right to conduct a necropsy. Perhaps in some situations conducting competent necropsies in a systematic sample of deaths would permit a more reliable assessment of cause of death and allow for international comparisons under standard conditions, without, of course, precluding conducting necropsies for other reasons.

This study suggests the following recommendations for those regions of the world in which similar mortality patterns are encountered. (i) To encourage the clinican who is aware of current epidemiological research to request necropsy for those causes of death for which the aetiology is still vague. (ii) To invite clinicians to contribute to epidemiological studies on pathogenesis by requesting necropsies for all deaths where the clinical picture is either incomplete or absent. (iii) To give clinicians the right to conduct a necropsy on paediatric deaths without the consent of the nearest relative. With respect to the latter, it seems if there were such a law it would be far less traumatic to inform the parents that a necropsy is necessary than to ask them to give their consent. Where the coroner already has this right it appears most appropriate for him to request complete necropsy data on all cases under his juridiction in this age group. In many instances the coroner is restricted by budget rather than by lack of interest. The situation might be remedied by having the cost of paediatric necropsies conducted by the coroner covered by the health rather than by the judiciary sector.

Among the many omissions in necropsy practice, two appear to be most glaring. The first is the low frequency of post-mortem examinations for those unexpected deaths at home. Studies have shown that with high necropsy rates approximately 20% of these deaths can be adequately classified or explained and the remainder can then be categorized as sudden unexplained deaths (Fitzgibbons *et al.*, 1969). This syndrome is becoming increasingly important in some areas as a cause of death in the postneonatal age group and requires a substantial number of detailed observations to clarify the many aetiologies proposed.

The second omission refers to the quality of necropsy data in the paediatric age group and especially in neonates. Our study focuses on necropsy frequency without reference to quality or completeness of necropsy. It is believed, however, that few are the nonspecialized pathologists who fully recognize even common disorders underlying perinatal causes of death, and that in at least a substantial proportion of neonatal necropsies there is some question as to whether the cause reported truly reflects the underlying cause of death. With respect to completeness of necropsy examinations, there are no universal definitions as to what might constitute minimum requirements for a complete necropsy in the face of an expanding spectrum of diagnostic tools.

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