# Pathological Findings of the Lung at Neonatal Autopsy in Dr. Hasan Sadikin General Hospital Bandung Period 2016–2019

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## Abstract

**Background:** Infanticide is a criminal act when a mother kills her child at or soon after birth. Considering whether a case has been decided as infanticide, determination of the life of the neonate at birth is imperative. Breath signs from macroscopic and microscopic approacesh and hydrostatic test are useful indicators. This study aimed to explore the lungs pathological findings at autopsy of neonates.

**Methods:** This study was a retrospective descriptive observational study, using medical records of neonatal deaths in the Department of Forensics and Medicolegal Dr. Hasan Sadikin General Hospital, Bandung for the period 2016–2019. Total sampling method was used. Inclusion criteria were neonatal death with presumptive infanticide, had autopsied and microscopic examination as well as neonatal death without putrefaction. Data on macroscopic and microscopic findings as well as the hydrostatic test were presented.

**Results:** In total, 12 of the 42 medical records with data on presumptive infanticide met the inclusion criteria. For macroscopic findings, 7 of the 12 samples had positive results, meaning the lungs had sign of breath. Meanwhile, in microscopic findings 8 of the 12 samples had positive results. For the hydrostatic test, 8 out of 12 samples had positive results. Of the 12 samples, there were four samples that had different results, at least on one variable.

**Conclusions:** Most of the cases match the macroscopic, microscopic, and hydrostatic tests, but some unmatched data are also found. In order to improve reliability, especially for legal purposes in infanticide, it is necessary to conduct all the examinations.

**Keywords:** Hydrostatic test, infanticide, macroscopic finding, microscopic finding

## Introduction

The term infanticide has a specific meaning in each country based on the legislation. In general, infanticide is a criminal act when a mother kills her child soon after birth or until the baby is twelve months old.[1] In Indonesia, based on the Indonesian Penal Code Book II Chapter XIX article 341, infanticide is a crime committed by a mother who, driven by fear of the discovery of her confinement with deliberate intent takes the life of her child at or soon after its birth.[2] The mother shall be punished by a maximum imprisonment of seven years.[2] In addition, article 342 of the Penal Code states that the mother who, for the execution of a decision driven by fear of the discovery of her forthcoming confinement, with deliberate intent takes the life of her child at or soon after its birth, shall, being guilty of infanticide, be punished by a maximum imprisonment of nine years.[2]

To consider whether a case is decided as infanticide, it is necessary to determine whether a child was born alive or not.[3] To determine it, signs of breathing or other signs of life, such as the condition of umbilical cord, pulse and food in the stomach need to be shown from the infant. In this case, breath signs are the the most widely used indicators.[4] The hydrostatic test (floatation) became one of the examination approaches used for 300 hundred years by pathologists to find this sign. However, recently the reliability of the test has

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begun to be questioned by pathologists.[3] False-positive and false-negative are the reason why the hydrostatic test results are not completely reliable. There are well-known influences that may affect the results. One of the reasons for a false-positive result is gas due to putrefaction, and that will cause the lungs to float and give a different meaning to the test. While, the false-negative results can occur if a person can kill the newborn before the first birth or the fluid in the newborn's lungs. For that reason, if hydrostatic test results are submitted during a trial, then both false-positive and false-negative consequences could have far-reaching consequences.[5]

The hydrostatic test is not recommended as the only examination approach for finding breath signs in newborns, especially if the test results are used as evidence in court. Microscopic and macroscopic examination of the infant's lungs is another approache to examine the newborn's breath signs.[3] Based on these reasons, this study aimed to assess lung pathological findings in neonatal autopsy cases. This study is needed to help pathologists identify whether newborns are categorized as live or stillborn. Hopefully, this study can help the court to decide whether the alleged perpetrator, mostly mothers, are guilty.

## Methods

This study was a retrospective descriptive observational study, using medical records data retrieved from the Department of Forensics and Medicolegal of Dr. Hasan Sadikin General Hospital, Bandung. This study consisted of autopsy data on neonatal deaths during 2016–2019. A total sampling method was employed. The inclusion criteria for this study were neonatal deaths with presumptive of infanticide, had an autopsy and microscopic examination as well as neonatal deaths without putrefaction. Neonatal deaths that had been reported to had died due to medical conditions or other causes of death and decomposition found were excluded from this study. Of the 42 medical records of neonatal deaths with presumptive infanticide, 13 met the inclusion criteria.

This study analyzed macroscopic and microscopic findings as well as the results of the hydrostatic examination in accordance with the collected data. Macroscopic findings such as lungs' color, weight, structure, and border features of the lungs were assessed as characteristics to determine the live births. Positive results on macroscopic findings were characterized by the presence of signs of breath, the color of the lungs was pink or light red, and rounded lung edges. For microscopic findings, alveolar expansion was observed. If an alveolar expansion was found, it was categorized as positive findings on microscopic findings.

Meanwhile, the lungs sink or float after being placed on the water observed in the hydrostatic test. The result was positive when the lungs were respired, which gave a positive breath sign and indicated that the lungs floated after being placed on water; whereas a negative result was indicated when the lungs were unrespired, which gave a negative breath sign It was shown by the sinking of the lungs after being placed on the water.

The collected data were then presented in tables for each variable to represent the lung findings in neonatal deaths autopsies. The

**Table 1 Frequency of Lung Pathology Findings from Autopsy Data on Neonatal Deaths Registered at Dr. Hasan Sadikin General Hospital 2016–2019**

| Variable | n |
|---|---|
| Gender | |
| Female | 7 |
| Male | 5 |
| Macroscopic finding | |
| Positive | 7 |
| Negative | 5 |
| Microscopic finding | |
| Positive | 8 |
| Negative | 4 |
| Hydrostatic Test | |
| Positive | 8 |
| Negative | 4 |

**Table 2 Conformity of Lung Pathological Findings from Neonatal Death Autopsy Data Registered at Dr. Hasan Sadikin Hospital 2016–2019**

| Macroscopic Finding | Microscopic Findings | Hydrostatic Test | N |
|---|---|---|---|
| + | + | + | 5 |
| + | + | - | 1 |
| + | - | + | 1 |
| - | + | + | 2 |
| - | - | - | 3 |

study was approved by the Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital no. LB.02.01/X.2.2.1/19925/2020.

## Results

In total, only 12 of 42 retrieved medical records were included. Most of the cases excluded were due to decomposition in almost the entire body of the infant, thus making it difficult to analyze, and incomplete medical record data as other reasons.

Most of the samples included were female neonates. The macroscopic findings of the lungs at autopsy of the neonate cases were predominantly positive result (n=7), indicating that the lungs were brighter red than the negative results and the edges were rounder (Figure 1). Similar to the microscopic finding, a primarily positive result was found (n=8), as shown in Figure 2.

For the hydrostatic test, a positive result (n=8) was mainly found. As shown in Figure 3, the lungs floated on the water, indicating that the lungs had a positive result. For negative results, the lungs sank. In this study, 4 of the 12 samples had different results for each variable.

## Discussions

Newborn autopsies provide important information, such as the cause of death and the accuracy of pre-death clinical information.[6] Associated with infanticide, the forensic pathologist needs to determine stillbirth or live birth as well as to determine the cause and manner of death.[7] The breath sign is one of the indicators to prove that the newborn was born alive. The hydrostatic test or floatation test has used to be the definitive test to determine a newborn's breath sign.[1] In addition to hydrostatic test, macroscopic

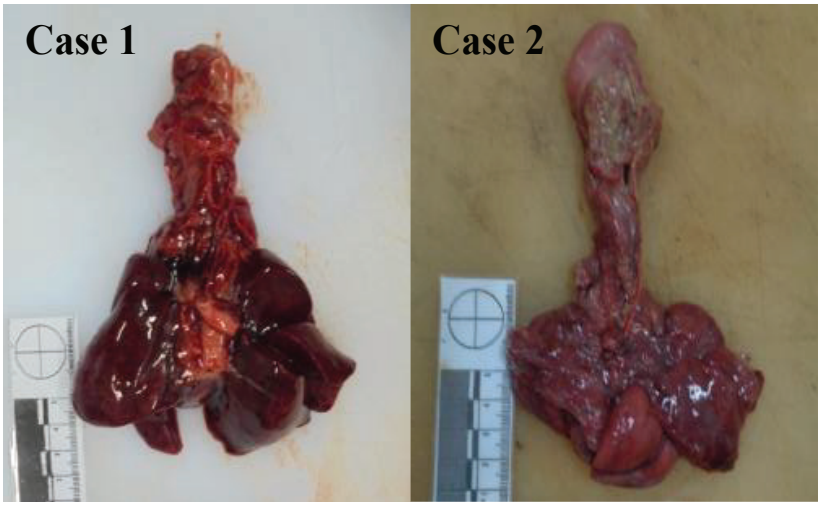


**Figure 1 Lung Macroscopic Findings in Neonatal Deaths as Shown during the Autopsy**
Note: Case 1 positive result; Case 2 negative result

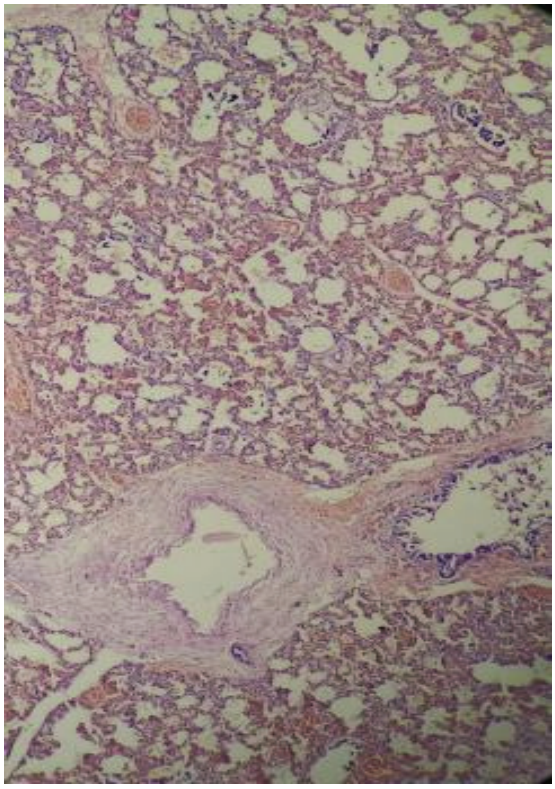

**Figure 2 Microscopic Finding of the Lung with Positive Results**

and microscopic evaluation of the lungs have been included as a post-mortem examination to determine whether the newborn was born alive or stillbirth.

This study shows a positive or negative signs of breath in macroscopic findings, especially by the lungs' color. The bright red color of the lungs is categorized as respired lungs or has a positive breath sign. The bright red color of the lungs occur due to increased blood flow to the pulmonary circulation after breathing and the low resistance placenta

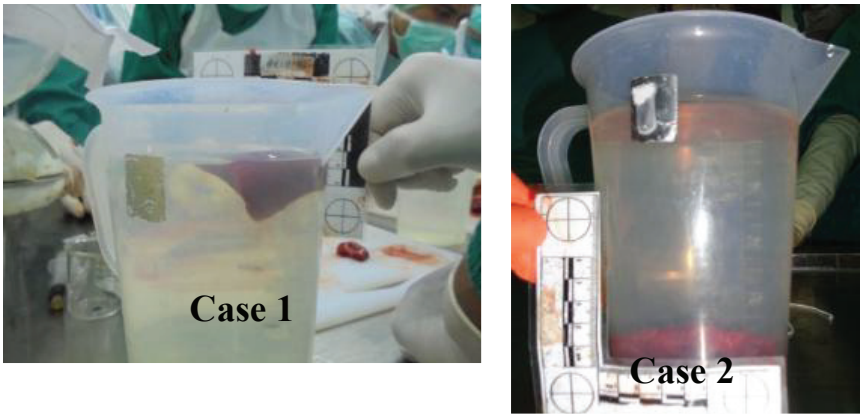


**Figure 3 Hydrostatic Test**

Note: Case 1 sample with a positive result; Case 2 sample with a negative result

removal.[8] Mechanical forces in the lungs can directly influence physiological functions such as during lung development, surfactant release by alveolar epithelial cells, contraction of airway smooth muscle, and tissue remodeling through cellular signaling. Subsequently, these physiological changes provide features of macroscopic findings.[9] Therefore, lung's weight, texture, and border features have been used in macroscopic findings for additional characteristics.

For the microscopic findings, the lungs as a respired and unrespired lungs were categorized based on the expansion of the alveolus. Initiation of breath during the delivery process increases the secretion of surfactant into the fetal lungs, allowing the alveolar to stretch. Surfactant has the function of lowering the surface tension in the lungs, thus allowing inflation at lower pressures.[10]

The hydrostatic test is a method for assessing lung aeration by the lung floatation technique. If an infant is breathing or born alive, the alveolus will be filled with air, and the lungs will float when placed into water.[11] This sign is categorized as a lung that has positive sign of breath. Meanwhile, if the lung sink when put in water, it is categorized as a negative breath sign.

Based on the medical record data in our study, some samples were found to have a bright red color, and some samples also had a soft texture, and features a rounded border. This finding has been categorized as respired lungs, which gives a positive breath sign.[12] Another finding is the appearance like marbles in some respired lung. This marble-like appearance or mottled also proves that the lungs have a positive sign of breath. Furthermore, a mosaic appearance has been found in some samples.[13–15]

Some samples have shown a dark red color, solid texture, and a sharp margins. Its appearance is similar to that of the liver, showing an unrespired lung as a negative sign of breath.[12,13] Moreover, lungs weighing >40g are designated as respired lung, and <40 g are considered unrespired lungs.[16]

In this study, the alveolus was mainly expanded in microscopic finding, indicating that the alveoli have been aerated and therefore, it had a positive sign of breath. On the other hand, the alveoli found to be uniformly unaerated had a negative sign of breath.[12,13]

As for the hydrostatic test, some samples showed positive result in the hydrostatic test. The lungs float when placed in water, indicating that the infant has been born alive with aerated and expanded alveoli. On the contrary, the lungs sink when placed in water, indicating a stillbirth infant with a negative sign of breath.[13]

Interestingly, some samples had different results in each test; macroscopic, microscopic, and hydrostatic tests. Positive and negative breath signs for macroscopic findings are showed mainly by their color. This can give a false-positive and false-negative result because there is no standard color and the result can be influenced by a personal judgment in determining the color of lung, whether it is dark red or bright red. Indeed, in some medical records, they just mentioned one primary color: "red", which could cause live births interpreted differently. A study of the inter-rater reliability of vehicle color perception for forensic intelligence has discussed similar problems regarding variations in color perception by individuals with normal vision, leading to incorrect determinations.[17] Macroscopic findings will be more reliable if supported by other characteristic, such as lung weight, texture, and topography. In the medical records used for this study, not every sample included all macroscopic characteristics other than color, which limits our study to interpreting macroscopic finding to decide whether the infant was born alive or stillbirth.

Although the microscopic approach has been considered the most reliable approach, false-negative results might occur due to possible atelectasis in the neonates' lungs indicating stillbirth. For example, the sample used for the microscopic test is from the part of the lung that has not been aerated, while the other part is aerated, as noted in study by Philip et al.[13] Microscopic assessment should not be used as the definitive test to determine the neonates' live birth,[13] contrary to the study of Milroy et al.[3] which stated that microscopic examination of the lungs has greater value in determining fetal age or maturity than in determining live birth.[3,13]

Interestingly, the value of the hydrostatic test and its reliability were questioned to determine whether the infant was born alive or stillbirth. Due to decomposition, the development of gases for ventilation of a lifeless neonate by the mother or a third person, or the possibility of the neonate breathing before delivery, will give a false-positive result on a hydrostatic test. Meanwhile, a false-negative result could happen if the newborn's lungs are filled with fluid after a water birth. Another possibility if someone could kill the neonate

before the newborn takes its first breath or the air is absorbed by the surrounding tissues from the post-mortem if breathing is insufficient.[3,5]

This study has several limitations. First, the low number of microscopic examinations performed on autopsy cases of neonates with presumptive infanticide. Second, not every sample includes all macroscopic characteristics other than color, especially the topographic characteristics. As mentioned earlier, the color red in the medical record can provide different interpretations and variations in color perception can lead to incorrect determinations.

In conclusion, most of the cases have matched macroscopic, microscopic, and hydrostatic tests. However, some unmatched results have been found, so a comprehensive examination is necessary to decide whether an infant was born alive or stillbirth to avoid mistakes. This approach could also provide more practical results, primarily if these results are used for jurisprudential interest in infanticide cases.

## References


1. Payne-James J, Jones R, Karch SB, Manlove J. Deaths and injury in infancy. In: Payne-James J, Jones R, Karch SB, Manlove J. Simpson's Forensic Medicine. 13th ed. London: Hodder Education Publisher; 2011. p.65–75
2. Directorat General of Law and Legislation Ministry of Justice Republic of Indonesia. Penal code of Indonesia Book II Chapter XIX: crimes against life-Article No. 341 and 342. Jakarta: Republic of Indonesia; 1982. p. 81
3. Milroy C. Neonatal deaths, infanticide, and the hydrostatic (floatation) test: historical perspectives. Acad Forensic Pathol. 2012;3(4):338–45.
4. Amelinda A, Hoediyanto H, Kalanjati VP. Profil kasus pembunuhan anak di Departemen Ilmu Kedokteran Forensik dan Medikolegal RSUD Dr. Soetomo. eJKI. 2018;6(1):50–2.
5. Große Ostendorf AL, Rothschild MA, Müller AM, Banaschak S. Is the lung floating test a valuable tool or obsolete? a prospective autopsy study. Int J Legal Med. 2013;127(2):447–51.
6. de Sévaux JLH, Nikkels PGJ, Lequin MH, Groenendaal F. The value of autopsy in neonates in the 21st century. Neonatology. 2019;115(1):89–93.
7. Haridas S V, Patekar MB, Ninal NS, Zine KU. Newborn infanticide within hospital premise an unusual case report. Journal of Indian Academy of Forensic Medicine. 2014;36(2):220–2.
8. Hillman NH, Kallapur SG, Jobe AH. Physiology of transition from intrauterine to extrauterine life. Clin Perinatol. 2012;39(4):769–83.
9. Suki B, Stamenović D, Hubmayr R. Lung parenchymal mechanics. Compr Physiol. 2011;1(3):1317–51.
10. Morton SU, Brodsky D. Fetal physiology and the transition to extrauterine life. Clin Perinatol. 2016;43(3):395–407.
11. Barber JL, Sebire NJ, Chitty LS, Taylor AM, Arthurs OJ. Lung aeration on post-mortem magnetic resonance imaging is a useful marker of live birth versus stillbirth. Int J Legal Med. 2015;129(3):531–6.
12. Turan N, Pakis I, Yilmaz R, Gunce E. Macroscopic and microscopic findings of infant lung in case of live or still birth. Sci Res Essays. 2013;8(21):867–74.
13. Phillips B, Ong BB. "Was the infant born alive?" a review of postmortem techniques used to determine live birth in cases of suspected neonaticide. Acad Forensic Pathol. 2018;8(4):874–93.
14. Karmakar RN, editor. J.B. Mukherjee's forensic medicine and toxicology. 5th ed.. Kolkata, West Bengal, India: Academic Publisher; 2018. p.1068
15. Aldila BA, Alit IBP. Studi deskriptif terhadap ciri-ciri korban infantisida di Bali, tahun 2012 sampai 2014. Medika Udayana. 2015;4(6):13834.
16. D'Angelis CA, Coalson JJ, Ryan RM. Structure of the respiratory system: lower respiratory tract. In: Fuhrman BP, Zimmerman JJ, editors. Pediatric critical care. 4th ed. Philadelphia: Elsevier Saunders; 2011. p. 490–8.
17. Lee K, Abdul Fatah AA, Norizan NM, Jefrey Z, Md Nawi FH, Wan Nor WFK, et al. Inter-rater reliability of vehicle color perception for forensic intelligence. PLoS One. 2019;14(6):e0218428.