

## Validity of Pathologic Comment with Macroscopic and Microscopic Findings of Infant Lung Regarding Live or Still Birth

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### Abstract

**Objective:** In the case of a newly born infant, either stillborn or found dead, the state of the lungs is of particular forensic interest. The aim of this study was to determine whether lungs are adequate for pathological comment about stillbirth or live birth of infant

**Material and Methods:** In order to evaluate the relevance of totally 171 autopsy reports of infants, macroscopic and microscopic findings, and body measures at autopsy, microscopic investigations on the degree of alveolar expansion performed on the lung specimens, were obtained.

**Results:** The lung filled the thoracic cavity and covered the anterior surface of the heart in 45 (26.37%) cases and didn't fill the thoracic cavity and presented at the back side of the thoracic cavity in 56 (32.7%) of the cases. In total 40 histological sections, 19 (47.5%) uniform, 10 (25%) semi-collapsed, 11 (27.5%) collapsed alveoli sections in shape, 11 (28.2%) amnion aspiration, 9 (23.1%) mild amnion aspiration, 9 (23.1%) moderate amnion aspiration, 10 (25.6%) evident amnion aspiration, 22 (57.9%) pulmonary emphysema were determined.

**Conclusion:** Macroscopical findings of infant lungs with combination of histological findings were more formative than their histological findings alone in the assesment of still or live birth of an infant.

**Keywords:** Infant; Stillbirth; Lung; Live; Birth; Autopsy

### Introduction

The body of a newborn is very often disposed of in drains, rivers, or rubbish dumps etc. [1-3]. Some births especially in rural area of Turkey occur at home without medical assistance. If any infant is found death in Turkey, the body of infant is sent to the autopsy center by public prosecutor. Most parents claim that their child was death before birth with suspect of infanticide. Some parents also claim about medical malpractice. Determining live birth in these instances may make a difference in subsequent criminal proceedings. Besides it is important to diagnose an infant as live or stillbirth in order to penalty code, civil law also in relation with this subject. Civil law in Turkey order that if any infant was live birth, infant would have all civil rights since the time of fetus fertilization [4]. The contract law also stipulates that healthy and executed birth is in advance of fetus rights [5].

The determination of live birth is one of the most important aspects of the autopsy of an infant who has been suspected death. A careful evaluation of clinical data and family diseases, investigation of death scene area, accurate postmortem examination is very important in differential diagnosis of live birth or stillbirth. Postmortem examination includes external examination, weight of organs, macroscopic and microscopic evaluation of lungs, hydrostatic tests of lungs, evaluation of umbilical cords, stomach contents and placenta. Natural diseases, congenital anomalies, trauma and birth injuries that could have caused or contributed to death has naturally to be included in medico-legal investigations of infant autopsies [6].

In the case of a newly born infant, either stillborn or found dead, the state of the lungs is of particular forensic interest [6,7]. The critical evaluation of the histological and macroscopic examinations may aid in solving the case [8]. Besides histopathological examination, macroscopic appearance, the texture, border features of lungs and their

filling of chest cavity are valuable parameters in diagnosis of live or stillbirth. Some authors state that pulmonary interstitial emphysema is also an important parameter in differentiation of live or stillbirth. Pulmonary interstitial emphysema is defined as interstitial dissociation of the lung with the air due to degradation of alveolar structure. Pulmonary interstitial emphysema is accepted as certain live birth criteria by some authors. There is also some discussion about that pulmonary interstitial emphysema may occur by artificial respiration or putrefaction [3,9,10].

The aim of this study was to determine whether lung samples together with other macroscopic and microscopic autopsy findings are adequate for pathological comment about stillbirth or live birth of infant.

We compared our findings which had an impact on the reports' conclusions about live or still birth of infants and reviewed difficulties and deficiencies encountered during the evaluation of these cases.

### Materials and Methods

In this study, retrospective data including the period between 1999

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and 2006 and investigating vitality of cases during birth by prosecutor was obtained from the infant autopsy database of the 1st Specialization Board of the Council of Forensic Medicine in Turkey.

The Council of Forensic Medicine is the official organ of the Ministry of Justice and the only official expert in Turkey. The duties and responsibilities of the Council of Forensic Medicine are considered by the law. Each year approximately 85000 reports are written about scientific and technical subjects related to forensic sciences asked by the courts and the district attorneys. The Council of Forensic Medicine includes specialized departments such as the morgue and the toxicology department, branches such as the first branch which deals with autopsy, toxicological analysis and medical and legal records.

Details of autopsies that have been performed in the cities of Turkey since 2001, have been recorded in a database in the first branch which deals with the cause of death and medical malpractice. The first branch includes a general surgeon, cardiovascular surgeon, neurosurgeon, gynecologist, internist, cardiologist, hematologist, immunologist, pediatrician, pathologist and forensic medicine specialist.

Totally 171 autopsy reports of infant cases with a suspect of infanticide or malpractice during birth were included in the study comprising year of death, gender, any witness statements, any medical records, report conclusion about live or still birth, body measures and weight, any traumatic changes, any congenital anomaly and any disease, umbilical cord examination, macroscopic and microscopic findings of the lung (sharpness of edge and shape, texture of lungs, their expansion in the chest cavity, degree of alveolar expansion, pulmonary interstitial emphysema and amnion aspiration).

In order to evaluate the relevance of reports, the conclusion about live or still birth, macroscopic and microscopic findings, and body measures at autopsy, microscopic investigations on the degree of alveolar expansion, were obtained from autopsy reports of infant deaths. Which data affected on which extend to conclusion (live or still birth of cases) were compared with statistical analysis.

The findings of the study were evaluated by utilizing SPSS 13.0 (Statistical Package for Social Sciences 13.0) program. Descriptive analysis, chi square test between groups comparison of numerical data was used. P value of  $< 0, 05$  was accepted as statistically significant in all these comparisons.

## Results

Totally, 171 infant autopsy reports which had been asked for live or still birth by prosecutors, were concluded at the 1st Specialization Board of the Council of Forensic Medicine in Turkey between the years of 1999 and 2006 (Figure 1). 99 of these cases (57.9%) were female, and 70 (40.9%) were male. In 2 cases any information was not given about gender because of advanced putrefaction. Reports of infant autopsy cases were finalized as 47 stillbirths (27.5%) and 34 live births (19.9%). In 42 cases, conclusion about live or still birth couldn't be obtained due to putrefaction of body (24,5%) and insufficient autopsy information. Any comment was not provided in 48 (28.1%) cases.

According to the statement of witnesses in medical records, cases were 56 (32.7%) stillbirth, and 36 (21.1%) live birth. 79 (46.2%) cases had been found death at the death scene and/or didn't have any eye-witnesses. There was a statistically significant correlation between witness statement and conclusion about live or still birth at reports of cases ( $p < 0,000$ ).

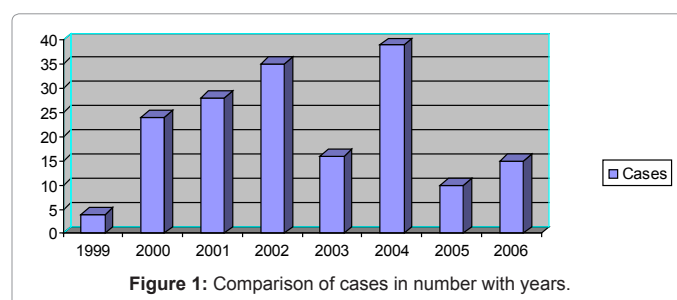


Figure 1: Comparison of cases in number with years.

As maturation of infant has been compared with height, weight, body measures (foot length, crown-heel, crown-rump length, head circumference), weight of organs, development of ossification centers in the lower end of the femur, calcaneus and talus, presence of hair, lanugo, ear arcade, breast nodule, morphological appearance of genital organs, 71(41.5%) cases were immature and 100 (58.5%) cases were mature. There wasn't any statistical correlation between maturation of the infant and the conclusion about live or still birth at reports.

The weight of a term infant has been estimated normal as equal as or heavier than 2500 gr., small for the gestational age as lighter than 2500 gr., very small for gestational age as lighter than 1500 gr., incompatible with life as lighter than 800 gr. compared with newborn standard charts. Infants which are 112 (65.5%) normal, 26 (15.2%) small for gestational age, 21(12.3%) very small for gestational age and 2 (1.2%) incompatible with life were established. There wasn't any statistical correlation between birth weight of infants and the conclusion about live or still birth.

No obvious congenital abnormality and/or traumatic change was detected at autopsy reports.

Umbilical cord of 71(41.5%) cases was examined during autopsy and sampled for histopathological examination. Any inflammation was not detected in the samples.

The lung filled the thoracic cavity and covered the anterior surface of the heart in 45 (26.37%) cases (Figure 2), whereas in 10 (5.8%) cases the lung partially filled the thoracic cavity and partially covered the anterior surface of the heart. In 56 (32.7%) of the cases, the lung didn't fill the thoracic cavity and presented at the back side of the thoracic cavity. In 60 (35.1%) of the cases any information about macroscopical appearance of lungs in the thoracic cavity was not given at the reports. There was a statistically significant correlation between medical record data about live or still birth and macroscopical appearance of infant lungs at the autopsy ( $p \leq 0,000$ ) (Figure 3).

Hydrostatic test of lungs showed 25.7% sinking, 29.2% flotation, and 0.6% partially flotation. In 44.4% of the cases, any hydrostatic test was not performed. Hydrostatic test of lungs significantly correlated with the conclusion about live or still birth at reports ( $p \leq 0,000$ ) (Figure 3). Live birth infants according to the medical record were found to have a high percentage of sinking in water. Correlation of cases with medical data was insignificant with the hydrostatic test ( $p: 0.008$ ).

Un-aerated lungs, because of intrauterine death, were shown before autopsy with radiological examination in one case (Figure 4).

The histological sections of 40 cases were obtained. These 40 preparats were re-evaluated microscopically by an experienced pathologist. 19 (47.5%) uniform, 10 (25%) semi-collapsed, 11

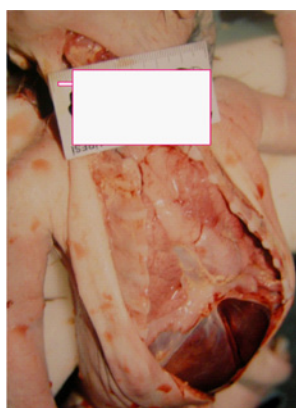
(27.5%) collapsed alveoli sections in shape were determined. When the existence and the diffuseness of amnion aspiration in alveoli was searched, 11 (28.2 %) amnion aspiration, 9 (23.1%) mild amnion aspiration, 9 (23.1%) moderate amnion aspiration, 10 (25.6%) evident amnion aspiration was determined in 39 sections. 22 (57.9%) cases had pulmonary emphysema in lung sections. 16 cases didn't expressed any pulmonary emphysema while we couldn't evaluate pulmonary emphysema in 2 cases because of technical causes.

There wasn't any statistical correlation between medical record data about live or still birth and microscopical findings (alveolar shape, amnion aspiration and pulmonary interstitial emphysema).

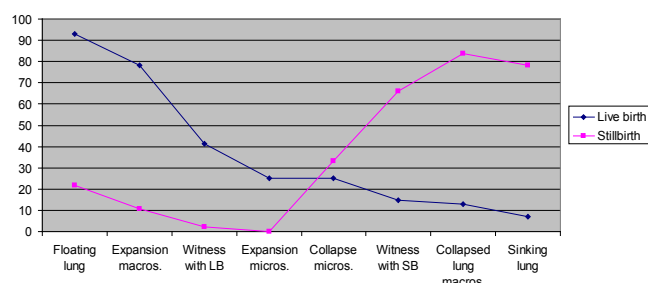
Prosecutions were initiated in 34 live birth cases (19.9%) of alleged abandonment.

## Discussion

The number of suspected infant death cases reported by the 1st Specialization Board of the Council of Forensic Sciences decreased between the years 2005 and 2006, although there was an increase in the number of these cases from 1999 to 2004. Among factors which may have influenced the change are improved birth control, adaptation facilities and welfare payments [2].



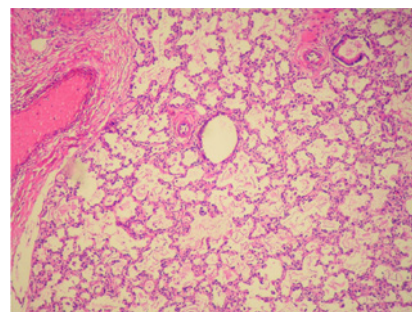
**Figure 2:** Macroscopical assessment of respired lungs during autopsy (The lung filled the thoracic cavity and covered the anterior surface of the heart in the shown case which also had an anamnesis of live birth by medical staff).



**Figure 3:** Significant correlation of live birth (in blue line) and stillbirth (in red line) conclusion of cases with autopsy findings (Floating lung; Floating lung at the hydrostatic test, Expansion macros; The lung covered the thoracic cavity and anterior surface of the heart, Witness with LB; Witness with live birth comment, Expansion micros; Uniform expansion in alveoli microscopically, Collapse micros; Collapse in alveoli microscopically, Witness with SB; Witness with still birth comment, Collapsed lung macros; The lung uncovered the thoracic cavity and anterior surface of the heart, Sinking lung; Sinking lung at the hydrostatic test).



**Figure 4:** The radiology of unaerated lungs because of intrauterine death.



**Figure 5:** Insufficient alveolar expansion in histopathological section of a case.

One of the most important medico-legal questions is whether an infant found abandoned had been born alive or not. The mothers in abandoned cases often claim that their infants were stillborn [3,9,11]. In this study, statements about live or still birth from witnesses before the autopsy significantly correlated with the conclusion about live or still birth at reports. Registered medical data was found to be more valuable than any oral data. The mother's statement especially with the claim of stillbirth was found to be less valuable than other witness (medical staff, or eye-witness of scene not related with the case) statements with respect to the conclusion about live or still birth at reports [11].

As the maturation of the infant has been compared with height, weight, body measures, weight of organs, the development of ossification centers in the lower end of the femur, calcaneus and talus, morphometric measurements were normal in relation with the gestational age and consistent with standard infant development charts. But there was not any statistical correlation between maturation, birth weight of the infant and conclusion about live or still birth at reports. Since not every mature infant is assumed to be born alive, clinical information, macroscopic and microscopic lung findings were found to be more valuable information to estimate of newborn as having been live or still birth.

Live birth can be established with certainty if there is an inflammatory reaction at the site of umbilical cord division area [2,3,11]. Histopathological inspection should be made in relation with umbilical cord including umbilical skin and intra-abdominal vessels parallel to vertical axis [6, 10]. But the absence of this finding does not indicate stillbirth. Histologically, inflammation around umbilical cord can be observed as early as 2-3 hours after birth [6,10,12]. However, in most

cases, infanticide usually occurs just after birth [2,11]. In our study, 71 umbilical cords were sampled during autopsies and any inflammation was not detected in these samples. As inflammation at a site of division of the cord may be more helpful, the identification of the cord alone is not sufficient. Umbilical inflammation in itself cannot be taken as the only certain evidence of stillborn or live born in the absence of other macroscopic and microscopic findings, and information regarding the duration of delivery and other circumstances. We didn't have any record from where the umbilical cord had been sampled during autopsy. In the absence of the knowledge of birth circumstances, any inflammation of umbilical cord samples would be a more valuable finding than the lack of inflammation would be.

The death of the infant may be a result of natural causes which are incompatible with life (e.g. congenital abnormalities) [13]. Maceration is a definite proof of stillbirth [11]. Curiously, there wasn't any evidence of intrauterine maceration, congenital anomaly or traumatic findings in 171 cases. Nor was injury on the skin around the nose and mouth and froth in the respiratory tract indicating the possibility of smothering [11,14].

The presence of food in the stomach would have been a reliable indicator of live birth if we had found any in our cases. Some traces of air in the gastrointestinal tract or the middle ear were mentioned in reports with suspicion of decomposition occurred before the autopsy [3,9,11].

At birth, reflex inspiration will aerate the lung, and depending on the period of survival, the lungs will gradually become aerated [15]. Un-aerated lungs, because of intrauterine death, were successfully shown with radiology before the autopsy in one case. But the aerated lungs do not mean in every case that the infant was alive during birth. Just as it is stated by numerous literature, under various conditions the aerated lungs may turn into un-aerated ones and, on the other hand, a stillborn's lungs may seem to be aerated (e.g. mouth-to-mouth revival, external cardiac massage, the administration of oxygen). Unfortunately, there is no consensus as to the use of the hydrostatic test for diagnosis of live birth at textbooks. Gross examination of the lungs was considered to be more valuable than the hydrostatic test [2,11]. Macroscopic evaluation of the lung can contribute to a differentiation between stillborn infants and infants born alive but dying shortly after birth in the absence of resuscitative efforts and putrefaction [1,13]. Both the histological and macroscopic examination of lungs is needed to solve the problem [8].

We classified lungs with their macroscopic findings (dark red color, solid texture, sharp edges without filling chest cavity and without covering front surface of the heart) as unrespired lung and (pink or light red color, soft texture, round edges with filled chest cavity and covered front surface of the heart) as respired lung. In unrespired infants, lung resembles to the liver and they don't have any crepitation with squeezing if artificial respiration has not been applied or any putrefaction hasn't occurred. Partial aeration may occur during intravaginal parturition and resuscitation. So we especially state that radiological examination of lungs and gastrointestinal system should be performed before the autopsy in the absence of putrefication and artificial respiration [16].

In our study, we didn't find any significant correlation related with live or stillbirth between the hydrostatic test and macroscopic findings of the lung in cases with clinical data. The hydrostatic test of live birth infants with premature, hyalen membrane disease, exposed to dense stress or 100% O<sub>2</sub> respired may turn to be false negative [10]. As it has been known that infection or edema in lung of live birth infants may

result in false negative finding, the hydrostatic test isn't a diagnostic test to differentiate live or stillbirth [17].

In many perinatal infant autopsies, a frequent microscopic finding was advanced autolysis of many internal organs limitating a pathologic comment. In antepartum fetal death, histological abnormalities are most commonly found in the liver or lungs, for example, if showing evidence of fetal bacterial or viral infection [18]. In our cases, amnion aspiration was microscopically considered as similar to a lung of stillbirth which also expressed the collapse in alveoli. Also, microscopically alveolar aeration of lungs was related with live birth conclusion at reports in deficiency of putrefication and artificial respiration.

A frequent cause of infant death at birth is the aspiration of amniotic fluid. The assessment of a fluid infiltration in the alveoli can pose forensic-medical problems in newborns if there is not any detailed knowledge of the circumstances of birth [6]. At least two samples should be taken from each lobe of the lungs in order to determine the diffusion of amniotic fluid.

The findings of uneven aeration and PIE (pulmonary interstitial emphysema) are supportive of live birth [2,3,8,9,14]. In the vast majority of cases, PIE affects premature, often low birth weight infants, who have primary surfactant deficiency and who are receiving mechanical ventilation [12,18,19]. In our study, cases with PIE were less in number to evaluate statistically. Studies including both PIE and birth medical data have been only case presentation until now,

Hyaline membranes in the lungs of infants who lived without resuscitative efforts is an important clue to predict live or still birth although our cases were not explored for hyaline membrane in the lungs [6,14,21,22]. Moreover, stereology of lung morphometry for these cases would have a great potential in the evaluation of respiratory physiology and pathology [7,23].

From the histological consideration alone, the manner of death cannot be proven. In such cases, a critical and reserved macroscopic and microscopic assessment of lung samples in conjunction with a careful ascertainment of case' history is advisable. When we evaluate cases to reach a conclusion of stillbirth or live birth, more than one finding had been in a scale of assessment.

Our study showed that there are still conflicts about evaluation of infant deaths. Further investigations are needed to take measures in conclusion of infant' live or stillbirth. Pathologists, pediatricians and forensic medicine specialists whole have vast information in newborn, must re-asses macroscopic and microscopic findings of infant autopsy to establish minor and major criteria about live or still birth. Definition and classification of infant autopsy findings as major and minor criteria will facilitate the standardization of infant autopsies as well as their results to estimate live or still birth.

## Limitations

We could re-evaluate microscopically histological sections of only 40 in total 171 cases because some autopsies were performed in different cities of Turkey and histological sections of autopsies in different cities couldn't be obtained.

There is not any clinical research paper investigating live or still birth of infants in Turkey. So we couldn't compare our findings with any Turkish literature data ([www.ncbi.nlm.nih.gov/pubmed/](http://www.ncbi.nlm.nih.gov/pubmed/)).

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