

ACFAS Scientific Report

Questions to be addressed:

Does the evidence available on delayed drowning or secondary drowning support the clinical phenomenon of delayed onset of respiratory symptoms in a drowning survivor following a period of being asymptomatic?

Introduction/Overview:

Review Process and Literature Search Performed

A National Library of Medicine, Medline database search was conducted using OVID and PubMed for the period of 1965-2013 in June 2013. Medline was searched using the MeSH headings Drowning or Near Drowning including combinations of the terms: secondary drowning, delayed drowning. Drowning and Near Drowning with the classification subheading was also used. All retrieval was limited to humans and English language. This search strategy yielded a combined set of 97 citations. *An additional Medline search was done using “respiratory, pulmonary, lung, or ventilatory” text words combined with Drowning or Near Drowning Complications yielding 209 citations. Immersion and submersion were also used within these search strategies as MeSH terms or text words.*

Journal citations were screened, all available abstracts were reviewed and 20 papers obtained. Articles consistent with the research questions were reviewed and additional references of interest were identified by a hand search of references from these selected papers and review articles.

There were no relevant results from a search of the Cochrane Database of Systematic Reviews using keyword or text word combinations “secondary drowning” and “delayed drowning” .

Scientific Foundation

History of published research on Secondary/delayed drowning

The respiratory effects of drowning injury was poorly understood until 1980’s. Initially thought to be a problem of water in the airways, assessment and all treatment focused on initial removal of water thought to be in the airways. In the 1960’s case reports described the development of respiratory distress in survivors who were hospitalized. Early papers that promoted the concept of delayed onset of respiratory distress described several patients who were found dead in their hospital bed. It is important to note that at that time, there was no prehospital, emergency department care nor assessment of patients who might be hospitalized without a physician evaluation.

In 1980, Pearn, the father of drowning research and prevention, a pediatric neurologist, published a study “Secondary drowning in children” describing five paediatric patients who “seemed well”

after a drowning event in which they were apneic and unresponsive; following a “latent period” of between 1-48 hours, these five developed respiratory symptoms. Two of these had had a cardiac arrest, were noted to take their first spontaneous gasp greater than 30 minutes after being rescued; had latent periods of > 30 hours, and ultimately died, one having become cyanotic with distress, the other with gradual worsening distress but not intubated until 40 hours post incident. In other words, both these patients had severe respiratory distress and failure for a period of time prior to intubation, a very different standard of care than today’s. Another three patients had had submersion durations of 5 minutes, had their first spontaneous gasp within 3 minutes of rescue, did not have a cardiac arrest, and had shorter latent periods (up to 4 hours) prior to onset of becoming cyanotic or significantly hypoxic. These three survived. He warned that drowning survivors can develop post-immersion respiratory syndromes with rapid deterioration after drowning. Yet his brief descriptions, without any cardiopulmonary monitoring, describe patients who slowly deteriorated until a point of rapid decompensation. (Although this paper muddied the waters around the concept of delayed drowning, it was important in identifying the need to monitor these patients, that the respiratory symptoms due to surfactant washout take some time to develop and will worsen as they remain untreated. This paper foretold the association between a quick response to interventions at the scene as sign of a mild drowning injury and a good outcome)

Chin et al (1980) described 22 children hospitalized post drowning who developed respiratory symptoms, noting that tachypnea was the earliest presenting sign. He also noted that oxygen treatment helped and that all survived. (This paper supported Pearn’s finding that the patient who responded well to interventions at the scene would do well and developed the concept that scene oxygen therapy could result in good outcomes.

In the 1970’s case series identified the development of acute pulmonary edema/ARDS in some to many hospitalized patients after the patient was admitted. The incidence of ARDS varied from - %. Of note, during this time, a standardized definition of ARDS was not in place, but for the purposes of this review, significant respiratory symptomatology and complication. These small, purely retrospective descriptive studies included patients with all degrees of drowning: those who had had a cardiac arrest, or were unconsciousness with a respiratory arrest, as well as those with mild drowning injuries who remained alert and breathing immediately after retrieval.

The term secondary drowning was used in multiple ways, including to describe any patient who survived a drowning and during hospitalization developed worsening respiratory distress, who was diagnosed with respiratory distress during hospitalization, developed ARDS, or found dead of ARDS or respiratory failure.

Papa et al reviewed drowning studies from 1966 to 2002 and found the following definitions for “Secondary drowning”, most of which were linked to outcome:

- Delayed death from drowning, due to such complications as pulmonary alveolar inflammation.
- Death from complication of submersion at least 24 h after the episode.
- Death occurring in minutes to days after initial recovery.
- After aspiration of fluid pulmonary parenchymal damage leads to outpouring of fluid into the alveoli

- Death from complications (such as ARDS, pneumonia, neurogenic pulmonary edema) after submersion more than 24 h after the drowning that is directly attributable to submersion.

Thus the term “secondary drowning” had no specific definition. The group consensus achieved at the Drowning Utstein conference (2003) elected to discard the term, secondary drowning, saying that it implied a second drowning had occurred, none of which happened to any of these patients. The European Council of Resuscitation, comprised of those who had participated in the Drowning Utstein Conference, agreed with this reason to exclude the term for the same reason. This group did not evaluate the concept of delayed, sudden onset of respiratory distress in a previously asymptomatic patient post drowning.

More recent studies have evaluated the clinical course of drowning victims in a more controlled environment. Noonan reported that 10% of pediatric victims admitted to the hospital were asymptomatic at admission and noted that 70% of these were asymptomatic at 8 hours. He noted factors associated with a benign course over the next 8 hours were: a normal initial exam (90% of those with normal initial exams became asymptomatic) and short submersion duration. Patients became asymptomatic with normal oxygen saturations they could be safely discharged home. He thus recommended an observation period of 6-8 hours. Causey (2000) evaluated retrospectively 61 patients admitted with a Glasgow Coma Scale (GCS) ≥ 13 who required no advanced life support prior to or ≤ 4 hours after ED presentation. He confirmed that by 4-6 hours no patient with a normal O₂Saturation deteriorated clinically. He recommended that patients who have O₂Sats $> 95\%$ and no respiratory distress could be discharged home safely after 5-6 hours of observation. He excluded from his study and therefore recommendation victims with other significant distracting or confounding injuries and significant past medical problems (cardiac, pulmonary, CNS). Milne specifically questioned whether secondary drowning was even a real problem and noted that in 22 patients seen in an emergency department, no one who had been truly asymptomatic subsequently worsened.

When reviewed for cases that seemed to meet the criteria for the concern, few cases were “surprises”, that is low risk cases for ARDS. Importantly, none of these case reports provided any clinical information on the patients’ initial status, vital signs, nor condition when assessed or admitted and course during hospitalization. Moreover, at that time, oxygen saturation assessment was not available, prehospital and emergency department care were not available, and admitted patients were not monitored in hospital. These studies too failed to evaluate these patients’ initial status implied that the development of these severe respiratory conditions was unpredictable and without warning.

Subsequent and more detailed clinical experience have not led to reports of cases of delayed onset of respiratory distress in victims who were initially fine. Most experts today consider secondary or delayed drowning syndrome a myth.

What the evidence tells us:

- Some patients develop worsening respiratory distress after drowning.

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- Patients who develop worsening respiratory distress after drowning do so very soon after drowning event/retrieval.
- Those who have had a drowning event leading to respiratory symptoms should be evaluated medically and be observed for 5-8 hours.
- Those who are asymptomatic at 5-8 hours after the drowning event will not develop further symptoms. (level of Evidence 4)
- The incidence of ARDS as presently defined is low and is usually seen in patients whose drowning led to or was associated with a cardiac arrest.

What the evidence fails to tell us:

- What is the real time line of developing respiratory distress? all studies have failed to track the time course from the drowning event. Instead, the studies tracked time in the hospital or emergency department.

Summary

Standards:

- **Guidelines:** Drowning, an event in which can result in injury to the lungs. Lung injury may progress after the event. However, there is no data to support that delayed drowning occurs in drowning victims who become asymptomatic after the event. The terms Secondary or delayed drowning should not be used.
- After the event, if the victim has no difficulty breathing, the victim should be advised to be with someone for 5-8 hours to watch for development of any breathing difficulty breathing. Any victim who a) is abnormal in any way post event, b) has a significant preexisting condition, especially cardiac, pulmonary, neurological, c) a complicated drowning event, such as with a seizure or d) has a distracting or significant other injury should have medical evaluation.

Options:

Level	Description	Implication
I	Convincingly justifiable on scientific evidence alone	Usually supports Standard
II	Reasonably justifiable by scientific evidence and strongly supported by expert opinion	Usually supports Guideline or Option but if volume of evidence is great enough and support from expert opinions is clear may support standard
III	Adequate scientific evidence is lacking but widely supported by available data and expert opinion	Usually supports Option.
IV	No convincing scientific evidence available but supported by rational conjecture, expert opinion and/or	May support option

	non peer-reviewed publications
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Summary of Key Articles

Author(s)	Full Citation	Summary of Article (provide a brief summary of what the article adds to	Level of Evidence (Using table below)
Chin KC. Galea P. Goel KM. (1980).	Secondary drowning in children. British Medical Journal. 281(6251):1351	Prompt resuscitation was provided at the scene of the incident for 17 patients, and 16 children who were initially comatose regained consciousness. Tachypnoea (81 0,) was the commonest presenting feature. None of the children required mechanical ventilation. One patient who was submerged for about 10 minutes but responded to resuscitation at the rescue site required high-concentration inspired oxygen because of hypoxaemia. All our children survived.	2c
<u>Gregorakos L, Markou N, Psalida V, Kanakaki M, Alexopoulou A, Sotiriou E, Damianos A, Myrianthefs P. (2009)</u>	Near-Drowning: Clinical Course of Lung Injury in Adults. <u>Lung</u> . 2009;187:93-97.	<p>Abstract:</p> <p>Background and Objectives: Although anoxic encephalopathy is the most dreaded consequence of submersion accidents, respiratory involvement is also very common in these patients. Nevertheless, few data are available about the clinical course and resolution of lung injury in adult victims of near-drowning. Our goal was to study the clinical manifestations of near-drowning and the course of respiratory involvement in a retrospective cohort of adult, mostly elderly patients.</p> <p>Patients: Our study included adult patients who were hospitalized after neardrowning in seawater over an 8-year period. Forty-three patients (26 female, 17 male), with an age range of 18–88 years old, were studied. Most (79%) of the patients were elderly ([60 years).</p> <p>Results: In the Emergency Department two patients were comatose and required</p>	2c

		<p>intubation. Another patient was intubated within the first 24 h because of ARDS. At presentation, all patients but two had a PaO₂/FiO₂>300, while ARDS was present in 17 and acute lung injury in 15 cases. The nine remaining hypoxemic patients had either focal infiltrates or a negative chest X-ray. Superimposed pneumonia was observed in four patients and resulted in a protracted hospital stay. Improvement of lung injury was rapid in most cases: by day 4 resolution of hypoxemia was observed in 33/43(76.7%) of the cases and resolution of radiographic findings in 66.6%. Duration of hospitalization varied from 2 to 14 days (mean = 5.2 ± 0.5 days). One patient with coma died due to ventilator-associated pneumonia (mortality= 2.3%). Conclusion: Respiratory manifestations of near-drowning in adult immersion victims are often severe. Nevertheless, in noncomatose patients at least, intubation can often be avoided and quick improvement is the rule while a good outcome is usually expected even in elderly patients.</p>	
<p>Idris AH. Berg RA. Bierens J. Bossaert L. Branche CM. Gabrielli A. Graves SA. Handley AJ. Hoelle R. Morley PT. Papa L. Pepe PE. Quan L. Szpilman D. Wigginton JG. Modell JH. (2003)</p>	<p>Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". Circulation. 108(20):2565-74.</p>	<p>An international resuscitation group addressed nomenclature and definitions for drowning injury and resuscitation. Group decided to discard the term "secondary drowning" saying that it implied a second drowning had occurred,</p>	<p>5</p>
<p>Lopez-Fernandez Y, Martinez-de Azagra A, de la Oliva P, Modesto V, Sanchez, JI, Parrilla J, Arroyo J, Reyes SB, Pons-odena M, Lopez-Herce J, Fernandez R</p>	<p>Pediatric Acute Lung Injury Epidemiology and Natural History Study: Incidence and outcome of the acute respiratory distress syndrome in</p>	<p>Prospective Multicenter study of pediatric ARDS dx in over xx years. Only 3 children in several years developed ARDS following drowning incident. Although this did not provide an incident rate of ARDS for drownings, suggests that ARDS incidence is low in hospitalized pediatric pts who drowned.</p>	<p>2a</p>

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L, Kacmarek RM, Villar J. (2012)	children*. Critical Care Medicine. 40(12):3238-3245.		
Milne S. Cohen A. (2006)	Secondary drowning in a patient with epilepsy. BMJ. 332(7544):775-6.	Single case report of a woman with multiple seizures while swimming; after drowning event “seemed fully recovered”, refused further medical attention, went home and developed resp distress and was unconscious; developed full blown ARDS. Not a “routine, mild drowning event- Seems like a patient at risk given her multiple sz.	

Papa L. Hoelle R. Idris A. (2005)	Systematic review of definitions for drowning incidents. Resuscitation. 65(3):255-64.	<p>Papa et al reviewed drowning studies from 1966 to 2002 and found the following definitions for “Secondary drowning” , most of which were linked to outcome:</p> <ul style="list-style-type: none"> • Delayed death from drowning, due to such complications as pulmonary alveolar inflammation. • Death from complication of submersion at least 24 h after the episode. • Death occurring in minutes to days after initial recovery. • After aspiration of fluid pulmonary parenchymal damage leads to outpouring of fluid into the alveoli • Death from complications (such as ARDS, pneumonia, neurogenic pulmonary edema) after submersion more than 24 h after the drowning that is directly attributable to submersion. <p>Level 5</p>
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<p>Pearn JH. (1980)</p>	<p>Secondary drowning in children. British Medical Journal. 281(6248):1103-5.</p>	<p>Case series of 5 pediatric patients who “seemed well” after a drowning event after which they were apneic and unresponsive; following a “latent period” of between 1-48 hours, they developed respiratory symptoms: Two had had a cardiac arrest, took their first spontaneous gasp > 30 minutes after being rescued; had latent periods of > 30 hours, and ultimately died, one having become cyanotic with distress, the other with gradual worsening distress but not intubated until 40 hours post incident. Another three patients had had submersion durations of 5 minutes, had their first spontaneous gasp within 3 minutes of rescue, did not have a cardiac arrest, and had shorter latent periods (up to 4 hours) prior to onset of becoming cyanotic or significantly hypoxic. These three survived. Author warned that drowning survivors can develop post-immersion respiratory syndromes with rapid deterioration after drowning. Yet his brief descriptions, without any cardiopulmonary monitoring, describe patients who slowly deteriorated until a point of rapid decompensation. The first 2 patients had severe respiratory distress for a long time prior to intubation, a very different standard of care than today’s. (Although this paper muddied the waters around the concept of delayed drowning, it was important in identifying the need to monitor these patients, that the respiratory symptoms take some time to develop and will worsen, probably due to increasing ventilation:perfusion mismatch with increasing atelectasis) as they remain untreated. This paper foretold the association between a quick response to interventions at the scene were the sign of a mild injury and a good outcome.</p>	<p>2c</p>
<p>Pratt FD. Haynes BE. (1986)</p>	<p>Incidence of "secondary drowning" after saltwater submersion. Annals of Emergency Medicine.</p>	<p>Abstract: We prospectively studied 52 swimmers with symptoms of respiratory distress after submersion. Thirty-one (60%) were released on the beach, and none of 26 followed up by telephone sought medical care or exhibited symptoms of respiratory distress as many as five days later. Twenty-one patients</p>	<p>2a</p>

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	15(9):1084-7.	(40%) were transported to a hospital for further evaluation. All who required admission displayed signs of respiratory distress within four hours. No patient developed "secondary drowning" after an asymptomatic interval, indicating that emergency department observation for four to six hours could effectively screen for those patients requiring inpatient therapy. We question the existence of "secondary drowning" as anything other than established, detectable respiratory insufficiency.	
Rivers JF, Lee G, Orr HA. (1970)	Drowning: Its clinical sequelae and management. BMJ. 2:157-161	Describes 3 cases. Onset of resp sx, PE, minutes to hours after incident. Uses term secondary drowning to describe any resp sx within minutes to hours and recommends 24 hr hospitalization	2c
Szpilman D. (1997)	Near-drowning and drowning classification: a proposal to stratify mortality based on the analysis of 1,831 cases. Chest. 112(3):660-5	Prospectively evaluated drowning victims to correlate their disposition and mortality at the end of evaluation by lifeguard rescuers with a clinically based categorization system at rescue grade 1--normal pulmonary auscultation with coughing; grade 2--abnormal pulmonary auscultation with rales in some pulmonary fields; grade 3--pulmonary auscultation of acute pulmonary edema without arterial hypotension; grade 4--pulmonary auscultation of acute pulmonary edema with arterial hypotension; grade 5--isolated respiratory arrest; and grade 6--cardiopulmonary arrest.) Discharged patients were told to call back if they developed any problems. Did not do follow up to determine if any discharged persons subsequently died or were hospitalized. RESULTS: From 2,304 cases in the database, 1,831 cases presented all clinical parameters recorded and were	2c

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		<p>selected for classification. From these 1,831 cases, 1,189 (65%) were classified as grade 1 (mortality=0%); 338 (18.4%) as grade 2 (mortality=0.6%). The one death was cardiac related. This study reports the largest number (2,369) of well appearing, asymptomatic drowning patients who did well and did not relapse.</p>	
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<p>Noonan L, Howrey R, Ginsburg CM (1996)</p>	<p>Freshwater submersion injuries in children: a retrospective review of Seventy-five hospitalized patients. <i>Pediatrics</i> 98:368-371</p>	<p>Abstract <i>Objective.</i> To determine whether or not selected victims of submersion accidents can be safely managed as outpatients. <i>Design.</i> Retrospective chart review. <i>Setting.</i> Children's Medical Center of Dallas. <i>Patients.</i> One hundred forty-eight charts reviewed, comprising all hospital admissions after submersion accidents from April 1987 to April 1994. <i>Results.</i> Of the 148 patient charts that were reviewed, 73 patients were excluded from the study for the following criteria: endotracheal intubation before initial medical evaluation; transfer from an inpatient unit of another medical facility; history of preexisting neurologic, neurodevelopmental, and/or pulmonary disease. Of the 75 evaluable patients, 3 were directly admitted to the inpatient service with no documented initial medical evaluation reported in the medical record. Of the remaining 72 patients, 62 (86%) were symptomatic at the time of the initial medical evaluation in the emergency department; 10 patients (14%) were asymptomatic. Seventy percent of the initially asymptomatic patients and 57% of patients who were symptomatic at the time of initial medical evaluation were asymptomatic by 8 hours after the submersion event. By 18 hours postsubmersion, all patients who were</p>	
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		<p>initially asymptomatic and 72% of initially symptomatic patients were normal. Thirty-five percent and 80% of patients who had abnormal initial physical examinations and abnormal chest x-rays had a normal physical examination by 8 hours and 18 hours, respectively, and all remained normal.</p> <p><i>Conclusions.</i> Routine hospital admission of all children who have had immersion accidents is unnecessary.</p>	
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Saule H. (1975)	Sekundares Ertrinken. Klin. Padiat. 187:346-349. (in German)	<p>The patients in this article all had drowning and immediate symptoms after accident; some died a few days after drowning. They call it secondary drowning, occurring 15 min to 4 hours after the incident, but symptoms were there immediately after drowning. Symptoms and medical findings are: asphyxia, lung edema, pneumonia, respiratory problems, heart problems. Then paper talks about treatments right after drowning.</p>	
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Level of Evidence	Definitions (See manuscript for full details)
Level 1a	Population based studies, randomized prospective studies or meta-analyses of multiple studies with substantial effects
Level 1b	Large non-population based epidemiological studies or randomized prospective studies with smaller or less significant effects
Level 2a	<u>Prospective</u> , controlled, non-randomized, cohort or case-control studies
Level 2b	<u>Historic</u> , non-randomized, cohort or case-control studies
Level 2c	<u>Case series</u> ; convenience sample epidemiological studies
Level 3a	Large observational studies
Level 3b	Smaller observational studies
Level 4	Animal studies or mechanical model studies

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Level 5	Peer-reviewed, state of the art articles, review articles, organizational statements or guidelines, editorials, or consensus statements
Level 6	Non-peer reviewed published opinions, such as textbook statements, official organizational publications, guidelines and policy statements which are not peer reviewed and consensus statements
Level 7	Rational conjecture (common sense); common practices accepted before evidence-based guidelines
Level 1-6E	Extrapolations from existing data collected for other purposes, theoretical analyses which is on-point with question being asked. Modifier E applied because extrapolated but ranked based on type of study.

References

Chin KC. Galea P. Goel KM. (1980) Secondary drowning in children. *British Medical Journal*. 281(6251):1351.

Dick AE. Potgieter PD. (1982) Secondary drowning in the Cape Peninsula. *South African Medical Journal*. Suid-Afrikaanse Tydskrif Vir Geneeskunde. 62(22):803-6.

Forler J, Carsin A, Arlaud K, Bosdure E, Viard L, Paut O, Camboulives J, Dubus JC. Respiratory complications of accidental drownings in children. (2010)[Article in French] *Arch Pediatr*. 17(1):14-8.

Gregorakos L, Markou N, Psalida V, Kanakaki M, Alexopoulou A, Sotiriou E, Damianos A, Myrianthefs P. (2009) Near-Drowning: Clinical Course of Lung Injury in Adults. *Lung*. 2009;187:93-97.

Idris AH. Berg RA. Bierens J. Bossaert L. Branche CM. Gabrielli A. Graves SA. Handley AJ. Hoelle R. Morley PT. Papa L. Pepe PE. Quan L. Szpilman D. Wigginton JG. Modell JH. Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". *Circulation*. 108(20):2565-74.

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Milne S. Cohen A. (2006) Secondary drowning in a patient with epilepsy. *BMJ*. 332(7544):775-6.

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Szpilman D. (1997) Near-drowning and drowning classification: a proposal to stratify mortality based on the analysis of 1,831 cases. Chest. 112(3):660-5

van Beeck EF. Branche CM. Szpilman D. Modell JH. Bierens JJ. (2005) A new definition of drowning: towards documentation and prevention of a global public health problem. Bulletin of the World Health Organization. 83(11):853-6.