**Explicit memory** is the conscious recall of an event**. Implicit emotional** memory is an emotion without conscious recall of the event that created the emotion (LeDoux 2007). This fact has special importance with children less than three to four years of age. Prior to this age, the regions of the brain responsible for explicit memory are not fully developed, but **regions responsible for implicit emotional memory** exist from birth (Jacobs and Nadel 1985, Rudy and Morledge 1994). Other investigators state that **explicit memory** formation does occur **late in the first year of age** (Rovee-Collier and Cuevas 2009). Recognition of awareness in children may be problematic (Davidson 2007). Post-traumatic stress disorder (PTSD) is an anxiety disorder that occurs after a horrifying event. Awareness cases that are associated with pain and or panic can lead to PTSD. PTSD may also arise postoperatively in the absence of memory of intraoperative events, as well as in the setting of dreams, that were corroborated by the operating room staff or would meet the criteria of highly probable intraoperative memory (Blacher 1975, Messina 1996, Wang 1999)

When reviewing studies of the psychological sequelae of cases of anaesthetic awareness with full, explicit recall, **nightmare**s are the most common traumatic complaint (Wang 1999). Other sequelae are insomnia, intrusive images and thoughts about the operation, fear of returning to hospital, and anxiety. These nightmares are generally recurrent and have specific content relating to the experience of awareness and paralysis, such as being buried alive. Patients **without any explicit intra-operative recall** may report them. An attempt to correlate these nightmares with circumstantial evidence of light anaesthesia in the anaesthetic record may be unsuccessful. They may be associated with panic attacks with unusual content. The content of the panic attack and the recurrent dreams, along with the timing of onset, make intra-operative consciousness with distress but explicit amnesia the most likely aetiology, despite the absence of substantive intra-operative evidence of being conscious.

Light anaesthesia has been defined for past and current techniques (Browne, R et al. 1973, Russell 1986, Schwender, Faber-Zullig et al. 1994, Flaishon, Windsor et al. 1997, Ghoneim, Block et al. 2000, Ekman, Brudin et al. 2004, Zhang, Xu et al. 2011). The use of neuromuscular blocking drugs (NMBs) as chemical restraints in light anesthetic techniques has decreased due to the introduction of more effective anesthetics (Maurtua, Deogaonkar et al. 2008) and greater hemodynamic control with the introduction of echocardocardiography that has enabled more precise targeting of vasoactive drugs and anesthetics (Manecke and Vezina 2009) (Cardiovascular Function & Pathologies). We believe that the evidence supports that at least a **portion of intra-operative dreaming** is an indication of **light intra-operative** anaesthesia or wakefulness. Intra-operative dreaming should be considered an after-the-fact “clinical sign” similar in importance to intra-operative movement. **Intra-operative dreaming** is **not** the same as **postoperative nightmares** or other psychological disturbances which are a traumatic reaction to intra-operative awareness or wakefulness. These may be present without full-blown post-traumatic stress disorder (PTSD) (Andrade 2011), Appendix 1).

The ASA Task Force stated that “dreaming is not considered intraoperative awareness” (ASA 2006). However, other authors have concluded that **portions of dreams** represent both **corroborated** (Aceto 2003; Hutchinson 1960) and highly probable intraoperative **memory** (Bergstromme 1968; Brice 1970; Harris 1971; Leslie 2005; Lyons 1991; Russell 1985). Corroborated memory is memory of an event that is confirmed by eye witnesses of that event - usually the operating room staff. PTSD may also arise postoperatively in the absence of memory of intra-operative events, as well as in the setting of dreams that were corroborated by the operating room staff or would meet the criteria of highly probable intra-operative memory (Blacher 1975; Wang 1999). Awareness during surgery with distress, even without pain, is associated with PTSD (Lennmarken 2002; Samuelsson 2007). Wang and colleagues have proposed a refinement of the binary classification of awareness as being either present or absent (Wang 2012). This classification includes a **6 level hierarchy from unconsciousness to consciousness** that includes **wakefulness and awareness** (Table 2).

PTSD as well as sub-diagnostic PTSD symptoms (PTS) is an anxiety disorder that occurs after a horrifying event (Appendix 1). Memory of any traumatic event can be delayed or recovered many years after the event. The **principle of delayed memory** is demonstrated by the increase in the reports of anaesthesia awareness with each successive postoperative interview at one to three days and then four to seven days. By the final interview the event rate of awareness may have tripled compared to the first interview (Lennmarken 2002; Sandin 2000). Another source of evidence is the phenomenon of “**anniversary” PTSD**. The individual may have no symptoms for a year or more after the trauma, but on the anniversary of the incident develops full-blown PTSD. A patient’s memory of their awareness experience can be delayed like all types of traumatic events (Brewin 1996). The chronic nature of PTSD is demonstrated by a study where **PTSD symptoms secondary to awareness** under anaesthesia persisted on average **18 years after follow up** (Osterman 2001). In another study of PTSD, a patient was amnesic for 36 years after the event until he had late recall which was corroborated in court (Freyd 1994).

There is **no consensus as to the definition of consciousness** ((Laureys, Perrin et al. 2007)). Two forms of the incomplete abolition of consciousness during anesthesia have been reported: wakefulness and awareness (recall of events following surgery). Anaesthesiologists titrate the delivery of anaesthetic drugs under the assumption that non-purposeful or spinal cord reflex movement will progress to purposeful movement and then to consciousness or wakefulness unless more anaesthesia is administered to a patient (Jones 1994, Jones 1994) (Bailey and Jones 1997)). Wakefulness is a form of purposeful movement which is elicited by direct communication with the patient using the response to complex commands in the non paralyzed state (Artusio 1955) or in a paralyzed state using the isolated forearm technique (IFT) (Tunstall 1977); (Russell 1985). Controversy exists as to whether this response to complex commands (wakefulness) reflects consciousness (Sanders, Tononi et al. 2012); Alkire 2008; (Pandit 2013); (Russell and Wang 2015). Patients can be conscious and immobile. That is, they do not respond to complex command and they do not move during surgery even though they are awake or conscious (Alkire, Hudetz et al. 2008). This conscious state can occur with or without the use of neuromuscular blocking drugs, but is more likely with MR use. Detection of these episodes of consciousness is by postoperative interviews with an adjudication process.

Why it is important to do this review

Initial reports of patient awareness were done without any formal classification system. A classification system of definite and possible awareness was introduced to improve the identification of awareness complications by Sebel et al (Sebel 2004). Eger and Sonner proposed that objective criteria be required (operating room staff corroborating patients’ memories) (Eger 2005). The authors responded that such a standard would underestimate the true frequency of awareness events (Eger and Sonner 2005). For this reason, the expert classification system that adjudicated patient reports into categories of “no awareness “and” possible and definite awareness “was introduced (Sebel 2004). Wang and colleagues have proposed a refinement of this binary classification of awareness as being either present or absent (Wang 2012). This classification includes a 6 level hierarchy from unconsciousness to consciousness that includes wakefulness, awareness, explicit and implicit memory, post-traumatic stress disorder (PTSD), perioperative dreams and nightmares (Table 2) Appendix 1. We believe that it is important to assess the relationship between intra-operative wakefulness, post-operative awareness and PTSD and interventions that can decrease these complications. Awareness and possibly wakefulness can lead to PTSD which is a serious condition that can greatly impair quality of life. It may influence patients to delay follow up medical care. In some patients it may be sufficiently severe as to lead to suicide.

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