Initial Description

 Ben is a 6-year-old male who attends the first grade in Huntington, West Virginia. Ben had a normal developmental history and met all milestones at appropriate times. When he was younger, Ben had leukemia and received chemotherapy as a result. Ben enjoys eating breakfast and drinking hot chocolate with his mother and sister, playing outside with his friends, and participating in reading and writing while at school. Ben is involved in his schoolwork and often asks and answers questions during class.

 Following an initial examination, results indicate that Ben suffered from a left ischemic MCA affecting the posterior superior and inferior portion of the frontal lobe, anterior superior and inferior portion of the parietal lobe, and the superior and posterior portion of the temporal lobe.

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| **The process of normal speech planning and production:**  |
| **Speech activities** | **Normal motor functioning** | **Normal sensory functioning** | **Damaged Motor and Sensory** | **Damaged Speech** |
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| **Post-stroke speech characteristics:** |

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| **Language based activities**  | **Normal language function** | **Areas damaged** |
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| **Post-stroke language characteristics:** |

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| **Process of normal swallowing:**1. The process of swallowing begins as food and/or liquid enters the mouth. The first phase of the swallow is the **oral preparatory phase**. During this phase, inhalation and exhalation occurs through the nose. Once food enter the mouth, the lips form a labial seal in order to keep food and/or liquid in the oral cavity. Then, food is chewed (mastication) and combined with saliva in order to form a bolus. The bolus is then held on the tongue in preparation for transport.
2. The second phase of the swallow is the **oral transit phase.** In this stage, the tongue moves anteriorly to posteriorly to move the prepared bolus towards the pharynx. This phase lasts approximately 1-1.5 seconds. As the tongue pushes the bolus back, sensory receptors in the oropharynx trigger a pharyngeal swallow.
3. The third phase of the swallow is the **pharyngeal phase**. During this phase, breathing is suspended. In this phase, many physiological responses occur almost simultaneously. First, the velum is elevated in order to prevent leakage into the nasal cavity. Next, the laryngeal muscles elevate the larynx, therefore contributing t the protection of the airway in order to prevent aspiration. The vocal folds adduct and the epiglottis moves to cover the airway. The tongue base moves to the posterior pharyngeal wall to aid in delivering the bolus. The pharyngeal muscles then begin to constrict from top to bottom. This phase ends as the bolus reaches the upper esophageal sphincter and breathing resumes.
4. The final phase of the swallow is the **esophageal phase**. The bolus enters the esophagus through the open upper esophageal sphincter. The esophageal muscles begin to contract and peristalsis moves the bolus towards the stomach. At the inferior portion of the esophagus, the lower esophageal relaxes and allows the bolus to enter the stomach. This phase can last anywhere from 8-20 seconds. Once the bolus has enter the stomach, digestion begins.
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| **Daily swallowing activities** | **Normal swallo**

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| CN V: Trigeminal * Innervates mastication muscles to chew and break down food. Muscles include the masseter, temporalis, and medial and lateral pterygoid muscles. The masseter is responsible for closing the mandible and this cutting the food with the incisors. The temporalis and pterygoid muscles are responsible for for grinding food with the molars.
* Also innervates mandibular elevators and depressors such as the mylohyoid and the digastric muscle.
* Responsible for touch, pain, temperature and vibration for the face, mouth, and anterior ⅔ of the tongue.

CN VII: Facial Nerve * Innervates muscles of the face, including labial muscles orbicularis oris and buccinator. These muscles are responsible for creating a labial seal in order to keep the bolus within the oral cavity.
* Responsible for the production of saliva in order to keep the mouth moist and assist in the breakdown of food during mastication.
* Responsible for taste in the anterior ⅔ of the tongue.
* Innervates the posterior belly of the digastric muscle, which aids in mandibular movement.

CN IX Glossopharyngeal * Innervates the pharyngeal muscles (superior, middle, inferior) used to move the bolus down towards the esophagus in the pharyngeal phase
* Responsible for taste in the posterior ⅓ of the tongue.
* Innervates the parotid gland, which is responsible for the production of saliva.

CN X: Vagus * Innervates the levator veli palatini and palatoglossus muscles, which raise the velum and seal off the nasal cavity.
* Innervates the superior, middle, and inferior pharyngeal constrictors, which help squeeze the bolus down towards the esophagus.
* Innervates the cricopharyngeus, which powers the upper esophageal sphincter. When relaxed, the bolus is able to pass through to the esophagus.
* Innervates the cervical portion of the muscles of the esophagus used in peristalsis.
* Responsible for taste in the epiglottis and pharynx.

CN XI: Spinal Accessory * Assists the vagus nerve in innervating the muscles that elevate the velum to close off the nasal cavity.
* Assists the vagus nerve in innervating the superior, middle, and inferior pharyngeal constrictors.

CN XII: Hypoglossal* Innervates the intrinsic and extrinsic tongue muscles (e.g., hyoglossus, genioglossus, palatoglossus) which gather the bolus and move it towards the pharynx

Medulla * Nucleus tractus solitarius (NTS): One of the specialized nuclei in the medulla. The NTS is responsible for receiving afferent information related to swallowing from CN V, VII, IX, and X. The NTS also receives sensory information from the respiratory and cardiovascular brainstem nuclei.
* Nucleus Ambiguus (NA): Specialized nuclei in the medulla. The NA is the motor swallowing center, in that it innervates the muscles used in swallowing by way of CN IX, X, and XII.

Subcortical Structures * The thalamus is responsible for hunger and thirst; alongside the basal ganglia, incorporates sensory information from food and liquid as the bolus passes from structures into the movement of swallowing.
* The thalamus relays NTS fibers to the primary sensory cortex for processing.
* Motor fibers begin in the inferior primary motor cortex and travel to the substantia nigra, then to the reticular formation of the pons.
* Additional fibers from the hypothalamus and cerebellum may influence swallowing.

Primary Motor Cortex * Activates muscles through the pyramidal system
* Activates the oral, pharyngeal, and cervical esophageal muscles.

Primary Sensory Cortex * Interprets sensory information from the oral cavity during the oral prep and oral transit phases of the swallow.

Insula * Mediates afferent and efferent information in the oral cavity, pharyngeal cavity, and the esophagus.

Anterior Cingulate Cortex * Aids in attention needed to swallow.

Premotor Cortex * Responsible for motor planning, therefore it is involved for the planning of motor movements needed for swallowing.
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 | **Motor damage** | **Sensory damage** |
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| **Post-stroke swallowing characteristics:** |

Resources