Scientific Highlights from the Society for Investigative Dermatology 2010 Annual Meeting

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Approximately 1,500 researchers, representing more than 30 countries, attended the 70th Annual Meeting of the Society for Investigative Dermatology* to exchange information and ideas in the fields of dermatology and cutaneous biology. The nearly 900 oral and poster presentations of both basic and clinical research on such diverse topics as microbial diversity, cell signaling, epidermal development, disease pathogenesis, translational medicine, immunology, viruses, and vaccines highlighted the diversity and advancement of the field of dermatological research that is supported by the Society for Investigative Dermatology. The following discussion of selected research presentations from the meeting illustrates not only the excellence in research in this field but also the breadth of information shared at this conference. We regret that, owing to space limitations, many excellent presentations are not mentioned here; however, meeting abstracts are available in print and online (*J Invest Dermatol* 130 (Supplement 1), April 2010).

Microbial diversity of human skin

Because humans are host to a variety of microorganisms that actually outnumber human cells by a factor of 10, the bacterial flora of healthy human skin has been of interest to the dermatology community for quite some time, with descriptions published in the *Journal of Investigative Dermatology* as early as the 1950s. Although early reports were based on cultivatable species, current descriptions involve bacterial genomic data based on sequences from the universal bacterial 16S rRNA gene. In fact, researchers are engaged in a project to characterize the entire human microbiome (http://nihroadmap.nih.gov/hmp) at multiple physiologic sites. Heidi Kong (National Institutes of Health, Bethesda, MD) discussed the microbiome with respect to community structure in both healthy and diseased skin. Interestingly, direct sequencing revealed much greater diversity and changes in the community structure compared with culture techniques. Together with her collaborators, Kong's group analyzed skin swab, scrape, and punch samples from sebaceous, moist, and dry skin sites and found that species richness was dependent on the skin site. Future studies using the high-throughput 4-5-4 platform sequencing method are aimed at understanding how this community diversity changes with diseases, such as acne, atopic dermatitis (AD), and psoriasis.

Employing similar techniques to investigate wound microbiology and pathogenesis, Anne Han (Johns Hopkins, Baltimore, MD) compared the microbial diversity of normal healthy skin and wounded skin. Because bacteria influence wound development, the composition of the communities present at these sites is of great interest for understanding the process. Again, metagenomic analysis of the 16S rRNA gene revealed higher diversity than did culture methods. Different community structures in healthy versus wounded skin were also found. Indeed, increased numbers of anaerobic species were found in biofilms in chronic wounds. Biofilms, which are aggregates of bacteria that are embedded in a self-secreted matrix, actually impede treatment and wound healing. Furthermore, these bacteria were found to communicate via quorum-sensing molecules, which have been implicated in biofilm formation and regulation of virulence factors.

Epidermal cell signaling

In an effort to understand the mechanisms of organogenesis, Anthony Oro (Stanford University, Palo Alto, CA) presented evidence regarding sonic hedgehog (Shh) signaling–dependent hair morphogenesis in the hair follicle epithelium and the mechanisms of concurrent prevention of tumorigenesis, which occurs in response to increased Shh signaling. The primary cilium, which functions as a sensory organelle to transduce environmental signals to the nucleus, functions in hair follicle morphogenesis and regulates the Shh response. Shh components accumulate at the centrosome, which regulates cilia formation, and the end of the cilium actually binds Shh to promote signaling through this pathway. Missing in metastasis (MIM) is required for epithelial and mesenchymal Shh signaling and is also required for primary cilia formation. Loss of this factor resulted in a phenocopy of Shh signaling loss. Endogenous MIM localized to the centrosome throughout the cell cycle, and the hMIM actin regulatory

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domain rescued ciliogenesis in knockout systems, implicating actin in this process. Examination of the additional players cortactin (CTTN) and Src, which are required for cilia disassembly, revealed that MIM expression is negatively correlated with the expression of these factors and that knockdown of expression of either CTTN or Src restored cilia formation and Shh signaling in MIM knockdown cells. Overall, these studies demonstrated that modulation of the actin cytoskeleton via MIM, Src, and CTTN provides a cell cycle–dependent switch for primary cilia assembly and disassembly.

In additional studies of the Shh signaling pathway, Marina Grachtchouk (University of Michigan, Ann Arbor) described differences in the responsiveness of follicle stem cell compartments to oncogenic Shh signaling. Because uncontrolled Shh signaling activation contributes to tumorigenesis, this group activated the Shh pathway oncogene *GLI2** using a conditional mouse model to test the tumorigenic potential of these activators targeted to hair follicle stem cells. Depilation, which triggers anagen hair growth in control animals, triggered widespread tumor development in the *GLI2** mice. The tumors, which derived from the hair follicles, expressed the Shh target genes *Gli1* and *Ptch1*. Although the transgene and target genes were expressed in both the bulge and the secondary hair germ (SHG), tumorigenesis was initiated only in the SHG of telogen hair follicles, suggesting that stem cells in different niches respond to signals differently.

Another critical factor for epithelial development and differentiation is the p53 family member p63. Maranke Koster (University of Colorado, Denver) gave an in-depth account of her work on the role of p63 in skin development and disease. In the absence of p63 expression, mice fail to develop epidermis or epithelial appendages, whereas ectopic p63 expression in lung epithelia induces epidermal differentiation. Thus, this protein is clearly important in the initiation of epithelial development. Studies with the development-inducible ΔNp63 knockdown mouse revealed an essential role for p63 in basement membrane formation, terminal differentiation, and barrier formation. Although aberrant expression of p63 occurs in skin cancers such as squamous cell carcinoma (SCC), this transcription factor is not mutated in these cells. In fact, expression of p63, typically the ΔNp63α isoform, in human SCCs indicates a good prognosis with low invasion/metastasis potential. These cancer cells also maintain differentiation, and tumor progression is inhibited. On the other hand, a poor prognosis with metastasis and a loss of differentiation is observed in the absence of p63 expression. Indeed, downregulation of ΔNp63α leads to spontaneous and more aggressive SCC tumors.

Because inherited p63 mutations have been identified in subsets of patients with ectodermal dysplasias (AEC, ankyloblepharon ectodermal dysplasia and clefting; EEC, ectrodactyly ectodermal dysplasia and clefting), which are characterized by differentially presenting developmental abnormalities in the skin and skin appendages, Dr. Koster has focused on understanding the role of this protein in these disease phenotypes. Apparently, different p63 target genes are affected by these mutations, giving rise to the various phenotypes. For example, in EEC patients, Dlx5/Dlx6 induction is compromised; however, these proteins are not affected in AEC mutants. In addition, Antonio Costanzo (University of Rome Tor Vergata, Italy) described the involvement of the p63 downstream target, interferon regulatory factor 6 (IRF6), in ectodermal dysplasias. Mutation of IRF6 results in a phenotype similar to that of p63 mutation with developmental defects and epidermal hyperproliferation in mice. The ΔNp63 isoform induces transcription of IRF6 at the onset of terminal keratinocyte differentiation. AEC patients exhibit reduced IRF6 expression and increased p63 expression in the epidermis. Once induced by ΔNp63, IRF6 actually controls ΔNp63 expression during keratinocyte differentiation via induction of ΔNp63 proteasome-mediated degradation. Thus, a regulatory feedback loop involving p63 and IRF6 links the pathogenesis of two genetically distinct ectodermal dysplasias.

Another player in the p63 signaling cascade is the special AT-rich binding protein Satb1. Although the molecular signatures of the epidermal layers are currently being elucidated, little is known about the three-dimensional chromatin organization and the dynamics of tissue-specific gene expression. Vladimir Botchkarev (University of Bradford, UK; Boston University, MA) described the control of this chromatin organization by the genome organizer Satb1 during epidermal development. The central motif of Satb1 binds to the matrix attachment regions of DNA enriched with AT base pairs. This protein is expressed in basal epidermal keratinocytes during skin development, and knockout of Satb1 results in a significant decrease in epidermal thickness and proliferation and alteration in the three-dimensional structure of the central epidermal differentiation complex (EDC) domain. Because Satb1 is decreased in the epidermis of $p63^{-/-}$ mice and is downregulated following p63 siRNA treatment, this protein is a key player in the p63-dependent program of tissue-specific chromatin remodeling during epidermal development.

Epidermal development

Although the complex regulation of the EDC affects epidermal differentiation, Christina de Guzman Strong (National Institutes of Health, Bethesda, MD) described the link of this locus to AD and psoriasis based on the discovery of mutations in filaggrin associated with AD and copy number variations within the LCE genes associated with psoriasis. Because the expression of genes in the EDC is coordinated by regulatory conserved noncoding elements (CNE), this group employed a comparative genomics approach to identify such elements. Using mammalian genomes ranging from humans to opossums, 48 CNEs were identified as potential *cis*-regulatory elements. These elements were confirmed in reporter assays in keratinocytes and in *in vivo* enhancer assays. Overall, these studies demonstrated conserved coordinated regulation of the EDC and epidermal-specific enhancer activity *in vivo* in two CNEs, including one that mapped within the psoriasis-associated locus.

Single-layer to multilayer epidermal stratification occurs over the course of a few days during embryogenesis. To understand the mechanisms of asymmetric cell division, which promote stratification and differentiation, Terry Lechler (Duke University, Durham, NC) examined how cells orient their spindles to determine whether to divide asymmetrically to generate suprabasal cells or symmetrically to increase surface area, a choice nearly all epidermal progenitor cells make. Inscuteable (Insc), a key regulator of spindle orientation in *Drosophila*, is specifically expressed in these cells. In transgenic mice with controlled expression of mInsc in the basal layer of the epidermis in mitotic cells, an increase in asymmetric divisions was observed, indicating that regulation of expression of this factor is critical for this decision. In addition to this regulatory control point, Dr. Lechler also described the colocalization of the nuclear mitotic apparatus protein, which tethers mitotic spindles to the poles, with mInsc in asymmetrical but not symmetrical cell divisions, illuminating mechanisms of the decision process in mammalian epidermal stratification.

In an effort to isolate quiescent melanocyte progenitors in a viable state to more clearly understand melanocyte differentiation, Thomas Hornyak (National Institutes of Health, Bethesda, MD) discussed a complementary tetracycline-regulated transgenic mouse system. Melanocyte label-retaining cells were localized to the bulge region in tet-off animals and the SHG in tet-on animals. Interestingly, a hair follicle pigmentary reconstitution assay to test melanocyte stem cell function *in vivo* revealed that both bulge and SHG quiescent melanocytes were capable of regenerating the follicular pigmentary unit.

In a talk about the role of cadherins in normal and diseased skin, Carein Niessen (University of Cologne, Germany) described the classic cadherin–catenin complexes in adherens junctions that function in epithelial cell adhesion. Cadherins are required for coordinated movement and migration, sorting/positioning of cells, and the establishment and maintenance of polarity. Therefore, loss of cadherin function results in loss of tissue integrity. Specifically, E-cadherin, which is expressed in the upper layers of the skin, functions in adhesion and barrier formation. Although loss of epidermal E-cadherin results in water loss via alterations in tight junctions, E-cadherin and protein kinase C together regulate a late step in tight junction barrier formation. Normal desmosome formation, however, occurs in epidermis that lacks E-cadherin, although knockout of both E-cadherin and P-cadherin disrupts this structure. In addition, inhibition of epidermal growth factor receptor signaling restores the desmosomes in these knockout mice, suggesting a role of cadherins in the regulation of epidermal growth factor receptor signaling. Together, these studies indicated that differential cadherin levels determine skin barrier function and integrity: low levels allow desmosome formation, and higher levels result in functional tight junction formation. Importantly, cadherins have been implicated in skin diseases that are characterized by barrier dysfunction, inflammation, and autoimmunity, as well as in skin cancer.

Pemphigus pathogenesis

In the Albert Kligman/Phillip Frost Leadership Lecture, which is awarded in acknowledgment of significant contributions to the understanding of the structure and function of the skin, John Stanley (University of Pennsylvania, Philadelphia) described the personal and scientific lessons he's learned during his studies of pemphigus. Both informative and entertaining, Dr. Stanley recounted the experiences gained in his research career, advising young researchers to become obsessed with research, enjoy the process of science, collaborate, and embrace new technology.

Furthering the discussion on this blistering disease, Masayuki Amagai (Keio University, Tokyo, Japan) discussed pemphigus vulgaris (PV) as a paradigm of autoimmune disease. PV is mediated by IgG autoantibodies directed against desmoglein 3 (Dsg3). Autoimmunity occurs when tolerance, which is the failure to respond to an antigen (especially a self-antigen), is faulty. Although T cells are thought to be the commander-in-chief behind PV because of their key role in autoantibody production, passive transfer of IgG autoantibodies, but not T cells, results in blistering in neonatal mice. Development of a Dsg3 T-cell receptor (TCR) transgenic mouse model provided a tool for the analysis of central and peripheral tolerance. Autoimmunity regulator, which promotes self-tolerance by inducing transcription of tissue-specific antigens, is essential for expression of Dsg3 in medullary thymic epithelial cells. Adoptive transfer of the Dsg3-specific transgenic T cells, as well as retroviral transduction of Dsg3-specfic TCR on peripheral $CD4^+$ T cells, induced interface dermatitis. Furthermore, the transgenic T cells that developed in the absence of Dsg3 induced not only anti-Dsg3 IgG production but also T-cell infiltration *in vivo*. Thus, this mouse model provides a mechanism to study the pathophysiological mechanisms underlying pemphigus.

Analysis of the molecular events involved in PV pathogenesis by Xuming Mao (University of Pennsylvania, Philadelphia) revealed that p38α mitogen-activated protein kinase (MAPK) is not required for the loss of intercellular adhesion that characterizes this disease. Because p38 MAPK activation, which occurs in response to proinflammatory cytokines and cellular stress, has been detected in PV patient skin samples, this group investigated the role of this kinase in the pathogenesis of PV. Pathogenic antibodies against Dsg3 induced endocytosis of Dsg3 and loss from the desmosome. Some but not all of the pathogenic PV antibodies activated p38 MAPK, and this activation was secondary to blister formation. In mice with an epidermal deletion of p38α MAPK, Dsg3 internalization by the pathogenic antibodies was inhibited, although the antibodies still caused loss of intercellular adhesion. Using a complementary approach, these investigators demonstrated that inhibition of p38 MAPK expression via RNA interference prevented the internalization and loss of desmosomal Dsg3. These results illustrate that genetics can modify as well as cause disease.

Translational medicine

Effective wound healing occurs through a highly regulated multistage process that involves multiple cell types. Liora Braiman-Wiksman (HealOr Ltd., Ness Ziona, Israel) presented her findings on adipocytes and adiponectin secretion in skin physiology and wound healing in diabetic skin. Subcutaneous adipocytes participate in the wound healing process; however, adipocyte morphology is impaired in diabetic skin, rendering the wound healing process defective. Adiponectin, which exhibits inflammatory properties, is secreted from adipocytes, albeit at reduced levels in type 2 diabetic patients. This factor is induced during normal wound healing and is recruited to the wound following secretion from blood vessels. Treatment of wounds in mice with adiponectin promoted dermal closure. Indeed, 60% of the wounds treated with this protein exhibited epidermal closure, whereas only 30% of the untreated wounds did. In addition, significant inflammation was detected in the wounds even after 7 days; however, treatment with adiponectin significantly reduced the percentage of inflamed wounds. Thus, adiponectin is a promising therapeutic candidate for the treatment of diabetic wounds.

Melanoma, actinic keratosis along with squamous cell carcinoma and basal cell carcinoma, and photoaging have all been linked to solar UV radiation exposure. Evaluation of sunscreen particles is particularly important in infants and young children, because exposure to UV at a young age is of particular concern. M. Catherine Mack (Johnson & Johnson Consumer Products Worldwide, Skillman, NJ) presented studies on the penetration of micronized sunscreen particles. Although accumulating evidence indicates that sunscreen particles do not penetrate through the intact stratum corneum in animals and adults, the epidermal barrier is still developing in infants; thus, results from studies in adults cannot be directly applied to infants. Using Raman confocal microspectroscopy and/or confocal laser scanning microscopy, these investigators found that neither titanium dioxide nor zinc oxide particles penetrated deeper than the first few layers of the stratum corneum. These particles were not detected in the deeper layers in adults or infants, indicating that these micronized sunscreen particles remain safely on the skin surface to deflect UV radiation.

In another plenary session presentation, Eleni Linos (Stanford University, Palo Alto, CA) described studies of lifetime UV exposure and risk for lentigo maligna melanoma (LMM). Although meta-analyses show no impact of chronic sun exposure on melanoma, intermittent exposure early in life predicts melanoma. Because LMM occurs on chronically sun-exposed sites, the effects of lifetime UV exposure on incident LMM were examined in 121,000 female nurses and 51,000 male health professionals. Although no effects on non-LMM were observed, significant effects were observed for LMM. A 37% increase in LMM was found for those born in high-UV index regions, with a 56% greater lifetime risk of LMM if the individual remained in the high-UV exposure area. The magnitude of these effects was similar to that observed for other photosensitive cancers, supporting the effects of UV exposure in LMM risk.

In the Eugene M. Farber Lecture, which is presented to an investigator whose work is relevant to expanding our insights into the pathophysiology and treatment of psoriasis, James Krueger (The Rockefeller University, New York, NY) discussed the path of translational medicine for this chronic inflammatory disease. Indeed, translational medicine is a scientific process that begins with the elucidation of the underlying pathogenesis of a disease and then seeks to bring novel effective treatments to patients in need. In this informative "bench-to-bedside" talk, Dr. Krueger described the history of psoriasis treatments from the early IL-2 fusion protein in 1995 to alefacept in 2001 and efalizumab and etanercept in 2004. Understanding how inflammation is involved in the epithelial cell proliferative response has been the focus of considerable research. Because disease reversal has recently been observed following treatment with the IL-17 receptor agonist, targeting psoriasis with selective immunosuppressive drugs may offer an effective treatment strategy. In addition, Dr. Krueger's group has identified a significant molecular gene expression remnant in resolved lesions following treatment with etanercept or ustekinumab, underscoring the complexity of the etiology of this disease and the challenges for treatment. As with all stories about incurable diseases, the quest for the perfect treatment is still underway; however, Dr. Krueger and others have made remarkable advances in understanding not only the cellular players and pathways involved in this disease process but also the genetic signature of the disease.

In the William Montagna Lecture, which is an award presented to a young active investigator who is making a contribution in the field of skin biology, W.H. Irwin McLean (University of Dundee, Scotland, UK) chronicled his work on inherited skin diseases. Mutation of keratins, which are intermediate filament proteins, results in cell fragility and over- or undergrowth. The first clinical trials for siRNA in human skin were conducted with molecules to knock out the dominant negative mutant keratin 6a allele of pachyonychia congenita. This treatment eliminated the phenotype in cells and effectively decreased callus formation, essentially opening up this avenue for treatment of other skin diseases. Furthermore, McLean's group has identified small molecules to target these mutations as well. As a result, ongoing studies with combination therapy with statins and low-dose retinoids offer promising results. Recently, filaggrin null mutations that result in defective keratin aggregation and defective epidermal barrier function have been implicated in ichthyosis vulgaris, AD, and asthma, and these defects allow pathogens to gain access and trigger an immune response, inflammation, and eczema. Development of new therapies from genetics and the recent genome-wide association studies has been disappointing; however, high-throughput screening for siRNA and small molecule drugs has been rewarding. In addition, gene–environment interactions appear to modify this disease, as evidenced by work in filaggrin-deficient

mice. Importantly, the recent identification and subsequent investigation of filaggrin in AD has drawn considerable attention to the importance of keratinocytes and the epidermal barrier.

Immunology

Because many of the diseases affecting the skin involve inflammatory mediators, understanding the immunological response is critical for elucidating disease mechanisms. Akiharu Kubo (Keio University, Tokyo, Japan) presented data demonstrating that Langerhans cell dendrites penetrate through the epidermal tight junction barrier during foreign antigen uptake. Although tight junctions limit paracellular leakage in epithelial cellular sheets, activated Langerhans cells, which typically remain under the tight junction barrier, elongate their dendrites through this barrier to uptake antigens in a type of surface surveillance system in both mice and humans.

Furthermore, Kurt Lu (Case Western Reserve University, Cleveland, OH) presented his research on skin inflammation and wound healing. In IL-6 knockout mice, wound healing is mildly delayed, and treatment of these mice with a peroxisome proliferator–activated receptor-γ (PPARγ) agonist has no effect. Tissue destruction and severe delayed wound healing, however, was observed following UVB and PPARγ treatment. The wound tissue was also infiltrated by macrophages. Inducible nitric oxide synthase (iNOS), a proinflammatory player, was upregulated in the experimental wounds in IL-6 knockout mice. In fact, blocking iNOS blocked wound tissue destruction in these mice. Thus, generation of hyperinducible nitric oxide synthase-expressing macrophages leads to a severe delay in wound healing. Because therapeutic anti-IL-6 biologics have been approved for treatment of rheumatoid arthritis and autoantibody-mediated IL-6 deficiency is often observed in type 2 diabetes, these results have clinical relevance beyond this wound healing model.

In a description of yet another subset of immune cells in the skin, Thomas Kupper (Brigham and Women's Hospital, Boston, MA) discussed his work on effector memory T (T_{EM}) cells in the skin. Surprisingly, the skin harbors more than twice as many T cells as the blood, and almost all of these are T_{EM}. Vaccination of mice via skin scarification with live Vaccinia virus (VACV) that was genetically engineered to express the OT-1 TCR allowed scientists to study the temporal behavior of the T_{EM}. Specific T cells were detected very early after infection prior to migration to the draining lymph nodes and other lymphoid tissues before reaching the skin. The viral antigen-specific $CD8^+$ T_{EM} produced proinflammatory cytokines upon activation and protected against reinfection through peripheral tissues. Overall, these T_{EM} were found to persist long term in the skin to provide immunity, and their recirculation into the blood was limited.

Viruses and vaccines

In addition to presentations of research directly relating to the skin or skin diseases, the Herman Beerman Lecture, which features a renowned medical scholar from a field outside of dermatology, was presented by Raymond Schinazi (VA Medical Center/Emory University, Atlanta, GA), who discussed the changing landscape of HIV and hepatitis C virus (HCV) therapies. With 25 reagents available for treatment (some pioneered at Emory University), HIV has a 94% survival rate as of 2008. Unfortunately, up to one-third of HIV-infected individuals are co-infected with HCV, a situation that is more complicated and more difficult to treat. Based on the success of the 1 of 10,000 new drugs that makes it to market, researchers have found that targeting host factors in combination with viral factors is useful, that toxicity must be minimized as side effects prove problematic, that resistance is a prominent theme with these drug treatment protocols, and that combination regimes must be studied early to maximize potential treatment. On a final note, Dr. Schinazi emphasized that although great strides have been made in the development of therapeutics for HIV and HCV, success should be measured in number of lives saved as opposed to dollars generated.

Furthering the discussion of treating chronic viral infections, Rafi Ahmed (Emory University, Atlanta, GA) presented the Julius Stone Lecture, which is given to promote the advancement of knowledge in immunology as it relates to the skin and skin disease. Gene profiling of memory T cells that often are functionally exhausted during chronic HCV infection revealed overexpression of several inhibitory receptors, including the coinhibitory programmed death-1 (PD-1). Binding of PD-1 ligand (PD-L1) to the highly expressed PD-1 on T cells during chronic infection causes a lack of function of these cells. Although therapeutic vaccination based on this pathway was unsuccessful, therapeutic vaccination combined with PD-L1 blockade increased the T-cell response with greater numbers of $CD8^+$ T cells. This strategy has been applied with good results in the laboratory for simian immunodeficiency virus in monkeys, and increased levels of PD1 and PD-L1 expression have been noted in liver T cells in HCV patients. This therapy appears to be promising not only for chronic viral infections but also in the treatment of tumors.

In the Naomi M. Kanof Lecture, which was established to honor an individual making significant contributions to the improvement of health through clinical research, Douglas Lowy (National Institutes of Health, Bethesda, MD) described current and future preventive human papillomavirus (HPV) vaccines. HPV has served as the poster child for a cancer-causing virus. In fact, this HPV-induced cervical cancer is the second most common cause of death from cancer in women worldwide. The currently approved commercial HPV vaccines (Cervarix from GlaxoSmithKline and Gardasil from Merck) are L1 virus-like particles that exhibit high protection against genital warts and dysplasia in three animal models as well as in fully vaccinated women. The immune response involves the generation of high-titer antibodies that prevent viral basement membrane binding. Although the vaccine is highly effective, 30% of HPV infections and cancers are not protected, and the vaccine is not effective against established lesions. One potential improvement to this strategy involves the addition of multiple HPV

types to the vaccine. L2 polypeptides are candidates for incorporation into a vaccine because this minor capsid protein contains cross-neutralization epitopes, which are cryptic and thus only exposed during infection. This approach offers the chance for a pan-HPV vaccine, although no successful vaccine with cryptic epitopes has been developed. Fortuitously, L2 cross-neutralization epitopes are exposed while the virus is bound to the basement membrane but before the virus transfers to the keratinocytes. This life cycle feature allows induced neutralizing antibodies a chance to prevent infection. To date, L2 vaccine confers broad-spectrum protection from HPV challenge even against strains not included in the vaccine. In addition, *in vivo* neutralizing L2 antibodies cause HPV16 capsid displacement from the basement membrane, supporting the use of this strategy in the development of a new generation of HPV vaccines.

Conclusion

Overall, the annual meeting of the Society for Investigative Dermatology achieved its goals of reaching all members of the dermatology and cutaneous biology research communities. With the research presentations and associated meetings and symposia, basic scientists, clinicians, students, residents, and postdocs were offered a glimpse into the current state of top-notch dermatological research. In addition, the mixing of multiple disciplines and researchers from various locations and career paths will foster information exchange and collaboration, which can only improve the science, both basic and clinical.

**The 70th Annual Meeting of the Society for Investigative Dermatology was held at the Hilton Atlanta Hotel, Atlanta, Georgia, on 5–8 May 2010.*